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ABOUT THE SOCIETY

MOBILIZATION Society was established in 2003 as a non-profit professional society aimed at sensitizing and mobilizing development partners and community for sustainable development. The Society, during these ensuing years has successfully mobilized researchers, academicians, planners, grass root mobilizers and student and created conducive intellectual atmosphere for introspective deliberations and conducted National seminars/ workshop to address the emerging problems experienced by the agrarian mass. Presently the Society has more than 1500 Life Members. The recognition of the Society in the efforts for strengthening the forum for scientific communication is growing among the related professionals and concerned agricultural stakeholders rapidly. The Society works on following objectives-

1. To document the on-farm and adaptive research experiences in multi- disciplinary agri-bio sciences and extension education.
2. To offer a platform for sharing the empirical experiences of development professionals, community mobilizers, academicians, multi-sectoral researchers, students etc. for the benefit of ultimate users.
3. To facilitate close and reciprocal linkage among the institutions for sustainable rural development.
4. Promoting potential and practicing entrepreneurs.
5. To disseminate the documented knowledge to the global partners through approach abstracting and indexing.

ABOUT THE JOURNAL

Journal of Community Mobilization and Sustainable Development (print ISSN 2230 – 9047; online ISSN 2231 – 6736) is published by Society for Community Mobilization for Sustainable Development twice a year. The Journal of Community Mobilization and Sustainable Development has NAAS rating 5.67 and Journal ID J158. The Journal of Community Mobilization and Sustainable Development, is also available on our website www.mobilization.co.in and it has been registered with www.indianjournal.com for national and global abstracting and indexing. MOBILIZATION envisages reorienting the young professionals and researches for imbibing the values of community participation in research, training and extension efforts.

The aim and scope of the journal are:

1. Sharing the relevant experiences and issues related to agriculture and allied fields at the grass root level and global forum to create the necessary academic and development climate.
2. Sensitizing the different stakeholders about the knowledge and innovation management system in pluralistic agri-rural environment.
3. Developing network among the related partners for convergence of their efforts for sustainable academic development of extension education discipline.

Editorial

Digitalization, innovative technological integration, and an efficient production system are promising areas that the fourth agricultural revolution, or "Agriculture 4.0," has brought about. Agriculture was digitalized until recently with the idea of "*how might it aid the farmers to boost their output efficiency*." As a result, the primary extension efforts were restricted to offering farmers advice and extension services via e-advisory or precision agricultural technologies. Instead of the anticipated improvements in the outcome and sustainability of the production system, those digital agricultural interventions are more likely to lead to practice change and knowledge acquisition among the farmers. While reframing the research questions to "*how it might solve the sustainability issues of agricultural value chains*," we must go forward to anticipate the potential obstacles so that we may design effective interventions. A cutting-edge approach called "Digital Twins" (DT) is proposed to help and manage complex agricultural physical settings at different stages of value chains and connect people to it through an all-encompassing simulation process. To accomplish this, a physical agricultural commodity or system is digitally mirrored to monitor it, collect historical data about the plant behaviour, and forecast its future status using AI, satellite data, IoT, etc. These simulated scenarios will equip the value chain's participants to handle unforeseen deviations, for instance, by anticipating issues, planning predictive maintenance at the appropriate time, and offering quick fixes for problems that keep piling.

I am delighted to extend a warm welcome to all of our cherished readers to the MOBILIZATION journal's April–June 2022 issue. The research subjects and content presented in this issue strengthen society's multidisciplinary nature. Factors affecting girl education, impact analysis of KVK activities, the attitude of farmers towards mass media, adoption research, information need analysis, construction of knowledge test, health risk assessment, marginal farmers' information literacy about modern agricultural enterprises, factors influencing migration, non-linear optimization model for water allocation under deficit irrigation system impact assessment of cluster front line demonstration, resource conservation technologies, resource use level and yield gap, the economics of crop cultivation, workplace facilities, assessment of genotype x environment interaction and stability analysis etc. are a few among these. Given that this issue is a gathering of strategic and practical research findings, I am confident it will provide you with a genuinely engaging intellectual experience.

I owe the editorial team members Drs. Souvik Ghosh, S. K. Dubey, R. Roy Burman, Nishi Sharma, S.R.K. Singh, Reshma Gills, Sudipta Paul, Sujit Sarkar and Amit Goswami for the dedication they displayed all across the entire drafting process and the prompt release of the journal. I would like to express my profound appreciation to Dr. Subhashree Sahu and Dr. Hema Baliwada for their unwavering support in assisting in shaping this issue of the journal as online editors. Finally, I really would like to express my admiration for our excellent writers and followers. Your contributions are what allow the journal to thrive and work seamlessly. I urge everyone to keep sending us your insightful research findings, ideas, and criticism so that we can improve the quality of our journal.

J.P. Sharma
Chief Editor

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A Critical Review of Factors Affecting Girl Education in India

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ABSTRACT

According to census 2021, the literacy percentage of India is 77.70 per cent whereas; in the case of women it is 71.50 per cent. There has been a genuine attempt to improve the education attainment of women by both government and other voluntary Organization. The amendments in the policies and infrastructural supports on primary, secondary and higher education reveal the initiatives of the Government of India towards girl education. Rapidly changing and advancements in technologies and globalization proposes that efficient education and training have become essential for the sustainable development of the society improvement in the livelihood status of the families and economic development of the country. Need of education for the girls is required to be placed at the centre of the development agenda in order to make significant contribution in eradicating poverty and to ensure sustainable growth and to build human capacity for the development of the society. Education is the method that liberates the mind of the girls. Girl's literacy education is fundamental for financial reasonability and freedom. Attainment of knowledge is one of the requisites of human development. Today all development agencies agreed on the meaning of educating women with regard to improve and maintain family education, general well-being, nutrition and health. The main focus of the education ought to be to prepare girls so that they apply their gained information to the quest for day by day life.

Keywords: Girl child, Education, Participation, Empowerment, Development

INTRODUCTION

According to National Family Health Survey (NFHS-5) 2019-21 male literacy at India level in 2021 stands at 84.40 per cent and female literacy stands at 71.50 per cent. Male Female gap at the all-India level is 12.9 percentage points with male literacy at 84.7 per cent and female literacy at 70.3 per cent. The main aim of presenting the literacy level of women in our country is to emphasize the widespread disparities in the literacy rate between male and female and it also indicates variations in the different regions and points out the areas that require special attention.

Enhancement in the literacy skills and education of the girls are principally based upon factors such as, educational levels of the parents, socio-economic, socio-cultural and distance from school. These factors influence the participation of girls in schools and in the development of their capacities, educational skills and abilities. There are several number of familial, cultural social, economic, and educational issues that play the role of de-motivators within the course of acquisition of education by the girls and force them to drop out. The National Education Policy (2020) aims to address shortcomings concerning quality education, research and innovation. One of the major goals of the Sarva Siksha Abhiyan has been to achieve equity of elementary education that indicates both discontinued children during the primary school-going age and the children who were compelled to drop out before completing of primary school due to social and economic obligations. Accordingly, the Twelfth Five Year Plan (2012-17) emphasized development of equal educational opportunities, and the cultivation of high-

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quality education for all sections of society. India has an added advantage with its young population, with an average age of 29 years; the demographic dividend can be harnessed with an improvement in education, health and skill development (Pandey, 2018).

In order to empowering girls and give them full rights right from their birth government of India has launched Beti Bachao Beti Padhao scheme. Empowering and educating girls brings all around development and progress especially in the family and community. Beti Bachao Beti Padhao scheme is the approach to accomplish positive changes in the people negative mindset for girls. This scheme may make a call to people to end the discrimination between male child and female child and work as a key to end female foeticide and female infanticide. At the time of launching of the scheme, honorable Prime Minister of our country reminded to the entire medical fraternity that the intention of medical profession is to save lives and not end lives. Prime Minister of India has also given stress on the need of educating and protecting the girl child.

Objectives of the review paper

1. To explore and review the factors affecting girls education in India
2. To explore and review the attitude of parents towards girl education
3. To explore and review the impact of COVID-19 on girls education

FACTORS AFFECTING GIRL EDUCATION

There is a need to understand the problem of girls' education and the fundamental challenges of educating girls, especially those from marginalized communities. The section below highlights the factors and some of the key challenges.

Poverty: Poverty and gender-based biases are two of the most significant challenges to girls' education. To contribute to the household's income, girls are forced to stay at home or work for a daily salary. According to a UN report, more than 1.5 million Indian girls are married before they reach the age of 18. After marriage, they are not allowed to attend school. These young females eventually become mothers at a young age, which has adverse effect on the health of both mother and child.

Distance from home: Girls' safety and security at home, school, and in the community is a major concern. Violence against girls is caused by entrenched patriarchy and unequal gender norms and power relations, which emerge as bullying and physical abuse, physical punishment, sexual and verbal harassment, and other types of sexual assault. Girls are often subjected to different types of safety concerns at school, including harassment on the way to school, violence and bullying, including online bullying in school, gender-based violence (GBV), and other forms of discrimination. The problem is attributed to the absence of secondary school options. Due to shortage of secondary schools, girls need to travel long distances to attend school, increasing the risk of sexual abuse and kidnapping, often discouraging the parents from sending their girls to schools. Even though 80 percent of schools in India are located in rural areas and majority of them are inaccessible. There is a lack of proper teaching-learning facilities, teachers and infrastructure. Majority of the children in rural areas often have to walk a long distance to reach schools and due to fear of harassment and violence against girls, most of the parents in rural areas prefer to not send their girls to school.

Early marriage: Marriage is commonly considered as a higher importance than schooling in rural areas. Because of the low value placed on girls' education and they have few educational opportunities. Boys can be affected, but girls are the most common victims of child marriage. Every year, it is estimated that 15 million females marry before they turn 18. They stop school after their wedding and, as a result of their lack of educational skills, they and their families are more likely to live in poverty.

Lack of toilets in schools: In developing countries like India, lack of separate toilet facilities for girls and boys is one of the most serious obstacles to education. Adolescent girls commonly miss school due to hygiene-related problems and eventually drop out.

Entrenched patriarchy: The education of girls is affected by entrenched patriarchy and deep-seated gender biases in society. Regressive gender norms create an unpaid care burden on girls caring for siblings, and household duties are generally considered as their responsibility. Patriarchal social norms such as child marriage, dowry, and restrictions on girls' mobility act as barriers to their education. Female infanticide is highest in India, and prejudice remains in the form of poor nutrition, gender-based violence (GBV), and early marriage. For enabling girl education, is so important that life skills should be introduced timely in school in an empowerment framework. 'Life skills: Refers to a large group of interpersonal and psychosocial skills that can help women, communicate effectively, make informed decisions and develop self-management and coping skills that may help them to lead a healthy and productive life' (Table 1 & Figure 1).

ADVANTAGES OF GIRL EDUCATION

Goof for economic growth: Girl's education perhaps the most obvious of the advantages for potential economic growth. According to the World Bank, women with only one year of secondary education enjoy a 25 per cent rise in wages later in life. Female education even affects gross domestic product, with a rise of 0.3 percentage points per percentage point increase in female education participation. The economy as a whole expands and thrives when women are educated.

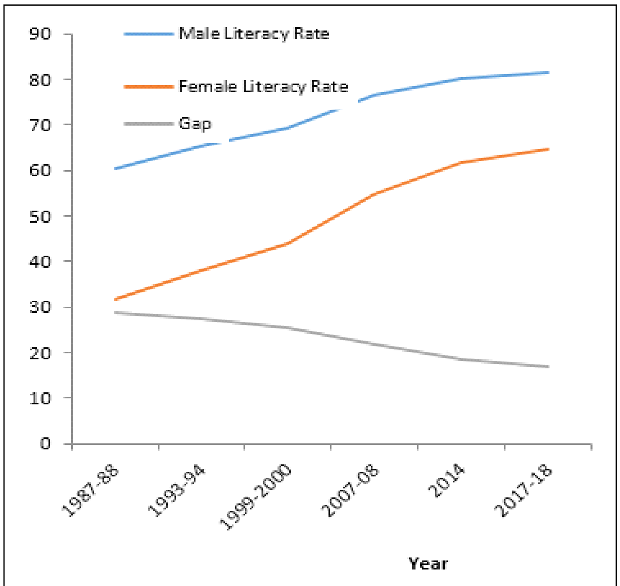

Figure 1: Trends in male and female literacy
Source: National Sample Survey, Observer Research Foundation's India Data Labs

Decreased chances of abuse by delaying marriage and child bearing: Educated women are less likely to suffer domestic violence than illiterate women. In more traditional developing households, women are considered as personal resources. Investing in girls' education delays early marriage and parenthood; it is estimated that if every girl in Asia completed secondary education, child marriage would reduce by 64 percent.

Decreased mother and child mortality rates: Educated women are more likely to marry later in life, pushing back the age that they have their first child. When women have children later in life, specifically after the age of 18, both the mother and the child are more likely to survive the potentially perilous first birth. In addition, educated women are generally more knowledgeable about children's nutrition, hygiene, and medical care. The Center for Global Development estimated that 1.8 million children's lives could have been saved if their mothers had completed secondary school.

Intergenerational success: Mothers who are educated had fewer mortality and illnesses in their children. The loss of a mother can be devastating to her children's likelihood of survival and future well-being. Similarly, children with educated mothers are more likely to attend school and pursue higher education than their counterparts with illiterate mothers. Women's education has a greater impact on children's education than men's education, according to a cross-country study in India. Women who have received an education are a better starting point for the next generation.

Table 1: Gender gap in literacy rates (2017-18)

	1987-88	1993-94	1999-00	2007-08	2014	2017-18
Male Literacy Rate	60.5	65.5	69.2	76.6	80.3	81.5
Female Literacy Rate	31.7	37.9	43.8	54.9	61.8	64.6
Gap	28.8	27.6	25.4	21.7	18.5	16.9

Source: National Sample Survey, Observer Research Foundation's India Data Labs

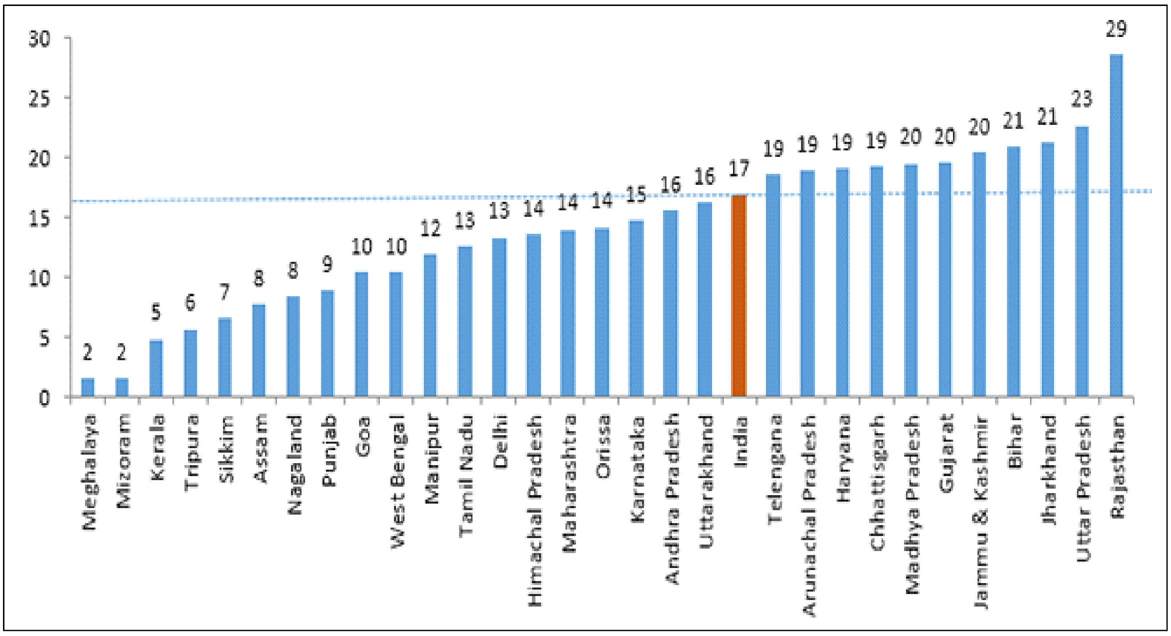

Figure 2: Gender gap in literacy rates (2017-18)
Source: Periodic Labour Force Survey (2017-18), NSSO, Observer Research Foundation's India Data Labs

Promoting social inclusion: When girls in developing countries are kept out of school, they are commonly expected to stay at home performing domestic chores. Unpaid household chores take 33 to 85 percent more time per day for girls than for boys of the same age. As girls reach adolescence, they are discouraged from engaging in activities outside the home, increasing their segregation from the public sphere. Girls' social isolation leads to higher levels of depression and other mental health problems in women.

Promoting good health: Children born to literate mothers are 50 per cent more likely to survive past age five than children born to illiterate mothers. Children whose mothers have completed secondary education are twice as likely to obtain vaccines against common diseases, resulting in better community health. More immunizations mean a disease has a lower likelihood of spreading through a population. The fight against the spread of HIV/AIDS is another advantage of female education.

Encouraging human rights: When women in a society are educated, they place a greater emphasis on gender equality. As women achieve equality, human rights become a strong value of communities, as women in leadership tend to fight for marginalized people. Female government leadership is becoming more widespread, and when women lead, they fight for more balanced governance systems.

GOVERNMENT SCHEMES FOR THE IMPROVEMENT IN GIRLS EDUCATION

Government Schemes for improvement in Girls Education The expansion of education among girls has been an integral component of educational policies and programmes. Ministry of Human Resource Development has taken a number of initiatives for expansion of girls' school and higher education.

School Education

Kasturba Gandhi Balika Vidyalaya- The scheme was launched in July 2004, and merged with Sarva Shiksha Abhiyan in the XIth Plan with effect from 1st April, 2007 to provide education to girls at primary level. It is primarily for the underprivileged and rural areas where literacy level for girls is very low. The scheme gives for a minimum reservation of 75 per cent of the seats for girls belonging to OBC, ST, SC or minority communities and precedence for the remaining 25 per cent, is accorded for the girls from families below poverty line. As on 31st January, 2009, 2423 KGBVs are reported to functional in the States and 1,90,404 girls enrolled in them. The objectives of KGBV are to make sure admission and quality education to the girls of underprivileged groups of society by setting up residential schools with boarding facilities at block level.

The main objective of this scheme is to mainstream the backward girls in school, to increase the quality education for the girls, to create awareness among the community members for girls education and to create girls friendly environment in schools. Along with education, vocational training is provided to the residents girls of KGBV so that after completion of education in the school they can be self dependent. For a smooth functioning of KGBV there is a requirement to build the capacity of the students and staff. The scheme has succeeded in increasing the girls enrolment in many blocks. Girls are sensitized on social issues and the challenges that they might face later in life. At KGBVs, girls are busy in a variety of crafts and art activities from ceramic work, embroidery, basket making, pottery, weaving, crochet, etc. Interested girls are given coaching and trainings in archery, tennis, etc.

***UDAAN* -** Giving wings to Girl Students - The Scheme is committed to the development of girl child education, so as to encourage the admission of girl students. The main aim of this scheme is to address the teaching gap between school education and engineering entrance examinations. It tends to increase the enrolment of girl students in prestigious technical and education institutions through monetary incentives & academic support.

***Mahila Samakhya*-** Mahila Samakhya (MS) is an ongoing government scheme for women's empowerment that was initiated in 1989 to translate the goals of the National Policy on Education into a concrete programme for the education and empowerment of women in rural areas, particularly those from economically and socially marginalized groups.

***Saakshar Bharat* -** In 2009, the National Literacy Mission was rebuilt as Saakshar Bharat, a new form. It attempts to accelerate adult education, particularly for women (aged 15 years and above) who do not have access to formal education, and it emphasizes on female literacy as a critical tool for women's empowerment.

***Mid-Day Meal Scheme* -** As the Mid-Day Meal Scheme attempts to eliminate the barriers that prevent girls from attending school, the gender gap in school participation tends to diminish. Mid-Day Meal Scheme also provides a helpful source of employment for women and helps liberate working women from the burden of cooking at home during the day. In these and other ways, women and girl children have a special stake in Mid-Day Meal Scheme.

***The National Program for Girls' Elementary Education (NPEGEL)* -** In July of 2003, this initiative was established. It served as a motivator to reach out to girls who the SSA had not been able to reach through other programmes. This scheme has been implemented in 24 Indian states. "Model schools" have been established under the NPEGEL to provide better opportunities for girls (Table 2).

REVIEW OF PARENTS ATTITUDE TOWARDS GIRL EDUCATION

Khasgiwal Aantonette (2006) revealed that the most of the school dropout girls worked as domestic maid servants. Girls had stopped going to school and started working with their mothers. In spite of being hard working, intelligent girls and extremely good in studies They were deprived of the opportunities of development and growth.

Sethi (2006) reported that families anticipate that girls should assist at home. Likewise parents felt that "ladki praya dhan hai… Isko padha kr kya fayda" which is really pervasive in rural area. There was also distance factor numerous children need to walk upto3-4Kms to arrive at the school, which again turns into a de-motivator.

Deka (2007) conducted a study on the educational problems of the drop out girls in secondary stage of education in Assam with the reference to Lakhimpur district. She found that social customs and beliefs, lack of awareness of the parents about education system, frequent flood, are some of the major problems with respect to the education of the drop out girls.

Table 2: Gross Enrolment Ratio of Girls in Higher Education Level

Years	2012-2013	2013-2014	2014-2015
Higher Education	20.1%	22%	22.7%

Source: AISHE, 2012-2015

Bandyopadhyay and Subrahmanian (2008) concluded that there has been extensive improvement in participation of girls during the post-Independence period time frame, yet it keeps on being underneath 50% both at primary and upper primary levels of school education. Although the increment in enrolment has been significant at the upper primary level as compared to primary level, progress has been seen.

Sharma *et al.* (2008) studied a year wise and class wise extent of dropout and it was discovered that in spite of the fact that there is a diminishing in rate of dropout of girls from 1998 to 2002, the degree of dropouts shows that the rate is higher in the fifth, seventh, 8th,10th and 12th classes of schooling. The participation of girls in vocational was found higher and technical education was observed very low.

Mukhtar *et al.* (2011) diagnosed that religious misinterpretation, illiteracy, social practice, early marriage, inadequate school infrastructure, poverty as some of the major factors contributed against girl-child education. For most of the parents, girl-child education was considered less important because no matter what level of education the girls will attain, their hope was to see the girl getting married. According to the opinion of some parents, western type of education system was named to be a way of negative transformation and initiation of girls into materialism, and inculcation of western social belief systems.

Beaman *et al.* (2011) observed that, in places where no woman had ever been the local leader, 86 percent of parents needed their girls to be either a housewife or whatever their in-laws would choose for her, compared with less than 1 per cent for their sons. Additionally, twice as numerous parents responded that they needed their adolescent sons to graduate from secondary school or college as those who wished the equivalent for their girls.

John and Shinde (2012) concluded that the literacy rate among Muslim women in 2001 was far below the national average. Education contributes to economic empowerment of the women. Among all the factors of women empowerment education is the most important social factor that initiates the process of economic, cultural, political and social development of the nation. he Constitution of India in Article 15(1) on right to equity, gives the fundamental approach system that reveres the vision of girls' education and the spirit wherein their education is to be given.

Ganapathi and Arju (2014) concluded that the pre-Independence period literacy rate of women was exceptionally low in 1901 as compared to literacy rate of men in India. This is proof from the way that women literacy rate had raised from 0.7 per cent to 7.3 per cent where as the literacy rate of men had risen from 9.8 per cent to 24.9 per cent, overall literacy rate had risen from 5.3 per cent to 16.1 per cent during these five census periods.

Prjapati (2014) conducted a study to recognize whether women empowerment correlates with education of girls and women. Household and labor force Survey method was used to gather data from Shahdol district of Madhya Pradesh. The women empowerment search for acquiring higher literacy level and education for girls, improved health care facilities for women and children, equal ownership of prolific assets as men, augmented participation in commercial and economic segments, awareness of their privileges and advantages, higher standard of living and to achieve independence, self-assurance, self confidence and self-respect among women.

Jagtap (2016) recognized the difficulties and challenges faced by rural girls in pursuing education. Significant obstacles faced by the girl in rural areas were low education level of parents, poverty, lack of female teachers, absence of separate toilet facilities, cultural practices and participation of girls in household to help during peak agricultural season.

Sahoo (2016) suggested that all the higher authorities, community members, NGOs and all citizens of India should take responsibility to eliminate diverse obstacles which are associated to girl's education from our country.

Dalal (2017) analyzed the various factors effecting girl education and noticed that the world is still male dominated, but numerous women were getting educated and the gap between the men and women education was reducing. If it will continues with unchanged speed then after only few years the gap will be filled.

Srivastava *et al.* (2017) carried out a study in Milkipur and Masodha block of Faizabad district of

Uttar Pradesh with the total sample size of 160 girl students with the help of personal interview. It was found that most of the girls (36%) were motivated by father followed by newspapers (22%), then by mother (10%), by herself (8%) and by friends (5%) for pursuing their educational goals.

Sunita Chugh (2020) conducted a study on "Dropout in Secondary Education: A Study of Children living in slums of Delhi", and concluded that both family and social factors are highly correlated with each other and contribute to dropouts. Some of the major reasons identified are lack of time for studies at home, to look after younger siblings, no need of education for employment, no need of education for girls, lack of interests in studies, disputes within the family, no effective teaching in school and medium of instruction, poor comprehension, or poor academic performance.

COVID-19 Rolls Back Progress on Female Education in India

Gender-based digital divide: According to a policy brief released by the Right to Education Forum in January 2021, approximately 10 million girls in India could drop out of secondary school due to Covid-19. The sudden shift from classroom learning to virtual learning was like a lock for students who come from marginalized communities due to the existing digital divide among students. However, some recent studies showed that there existed a 'gender-based digital divide' that made the situations more complicated for female students.

Girls are less likely to have access to technology for remote learning. In Bihar, a state that has one of the highest poverty rates in India, only 28 per cent of girls reported having access to a phone compared to 36 per cent of boys. According to a study carried out by the Malala Fund, which took sample populations from the five states of India, Assam, Bihar, Uttar Pradesh, Telangana, and Delhi and it was found that in 71 per cent of cases, phones are owned by male member of the family. This can hamper girls' access to phones as they may be hesitant to ask their male family members. Male family members often hold the authority at home and thus have the power to limit the access to phone by the girls. Only 26 per cent of girls responded that they could access the phone present in the house whenever they needed to, compared to 37 per cent of boys. According to a report released by the United Nations Children's Fund (UNICEF) in September 2020, based on a survey conducted across six states in India, the utilization of most commonly used platforms for online studies such as WhatsApp, google meet, Zoom and Youtube among girls was 8 per cent lesser than that of boys.

A Delhi-based NGO also conducted a survey on the occasion of International Day of the Girl Child. The survey was carried out among 766 girls between 21the ages of 7- from 64 slum clusters across the Delhi, to see the impact that schools and colleges have had since shifting their classes online. It was found that the majority of the girls perceived that their families think that it is more important for the boys to study and get an education. A 13-year-old girl from class 8 at a government senior secondary school in Delhi said that she had hardly studied anything online in the last 9 months because there was only one smartphone at home and she has to share it with her younger brother. Whenever she wants to study from a smartphone, the daily limit of mobile data gets exhausted. Several other students share similar experiences. Another girl from class 9 at a government school of UP also said that there was only smartphone in their house which stays with her father during the day while he is at work. When he returns house, he gives it to his brother. She barely gets an opportunity to use it and that's why she hardly studied anything in the last one and a half years.

CONCLUSION

Thus it can be concluded that to promote the education of girls, therefore, it involves changing the perception of the people across the society as well as increasing the number of school places accessible for girls. Education enhances a girl's sense of her own health needs and perspectives and her power to make decision related to her career. Subsequently, helps to reduce infant and maternal morbidity and mortality. Thus increased literacy rate among girls can contribute to empowerment of women, to a delay of the age of marriage and to a reduction in the size of the families by family planning. In order to encourage girls for better education, it is most important to make understanding among their parents that girls are not only intended to perform the household work, but they should be educated and permitted to access the empowerment opportunities.

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Study on Employment Opportunity for Migrant Labour in Bihar (India) After Outbreak of First and Second Wave of COVID-19 (Corona Virus)

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ABSTRACT

Present study is on employment opportunity for migrant labour force in Bihar (India) after outbreak of 1st and 2nd wave COVID-19 (Corona Virus). This research is based on 300 samples of migrant labours of Vaishali, Muzaffarpur and Darbhanga district of Bihar (India). Primary data were collected in 2020 and 2021 by the method of purposive sampling. We have planned to identify the category of labour on the basis of their skilling capacity and socioeconomic condition by well develop questionnaire for employment generation of the migrants labour. Due to outbreak of COVID-19 through first and second wave as a crisis and almost all sections of society have been badly affected. However, the poor sections of society, including migrant laborers require support from government due to pandemic. The sudden declaration of lockdown after outbreak of COVID-19, created a vacuum in the life of the socio-economically weaker sections of society. They expected employment support from the government in the absence of any other viable sources of income. The Study emphasis on how to create employment for migrant labour at their state. Study says that employment opportunity may be created among the migrant labour through different technology given by Agricultural University. Policy maker should provide training in the field of agricultural and its allied sectors as guide line given by National policy for skill development and Entrepreneurship-2015, Ministry of skill development and Entrepreneurship, Govt. of India.

Keywords: Employment opportunity, COVID-19, Socio-economic condition, Migration of labour, National Policy for Skill Development and Entrepreneurship

INTRODUCTION

Labour is the aggregate of all human physical and mental effort used in creation of goods and the services. After outbreak of Covid-19 huge numbers of labourer return their home, due to lack of employment in city of other state and also in own state. Majority of labour approx more than 15 lakh migrant labourer reached in only 32 district (except Arwal, Jehanabad, Munghyer, Sheikhpura, Sheohar & Lakhisarai district) of Bihar (*Source:* Dainik Bhaskar dated 20th June 2020). About 67 lakhs migrant labourer reached from 27 district of various states only in six states (i.e. Bihar, Jharkhand, Uttar Pradesh, Madhya Pradesh, Odhisa and Rajsthan) in 116 district of these states (*Source:* Indian Express, dated 11.06.2020). It is very difficult to maintain smooth economic status, social status and law in order, due to unemployment among the migrant labour. How many labour back to their work with or without family & how many stay here permanently were exercise with their impact. The effect of the COVID-19 pandemic and its associated nationwide lockdown on internal migrants. As of 12th September 2020, India had recorded 958,316 active cases, with 77,472 deaths (Ministry of Health and Family Welfare 2020a). The rapid spread of this highly contagious disease prompted the Government of India to implement a nationwide lockdown on the 24 March, with strict restrictions on mobility and transportation links summarily cut off overnight (Rajan *et al.,* 2020).

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Review at a Glance for COVID-19: COVID-19 emerged as a epidemic, migrant workers in large cities are forced either to stay in perilous conditions in the urban areas, or go back to their places of origin i.e. villages or smaller towns. Many of these migrant workers come from the most depressed and backward regions of the country, where there is currently little potential for employment and education (Kumar *et al.,* 2009). In this way, any health or economic crises at the destination also increase return migration to origin communities (Castles, 2011). India is one among the countries where child under nutrition is severe. Around 38.4 per cent, 21 per cent and 35.7 per cent of children below 5 years suffer from stunting, wasting and underweight, respectively. Malnourishment results in compromised immunity, which puts an individual with a greater risk and susceptible to the spread of the virus. Under nutrition is a major underlying cause of child mortality in India, as it is the primary reason behind 69 per cent of deaths of children below the age of 5 in India (UNICEF, 2019). Jha (2020). The Union government is planning to give unemployment benefits to a section of organised workers who may lose their jobs due to the COVID-19 pandemic. The labour and employment ministry is looking to extend the scheme and allow workers to avail unemployment insurance if they are impacted by corona virus. Bansal (2020) reported that a large proportion of informal urban workers have not benefited from social welfare schemes due to the lack of accurate. Khanna (2020) study about Impact of Migration of labour force due to Global COVID-19 Pandemic with reference to India. According to the Retailer Association of India (Nahata, 2020), about 40 million people in the informal sector and 6 million people in the formal sector are employed by the retail sector alone. Nearly 900,000 workers lost their jobs in Spain since it went into lockdown in mid-March 2020 (Keeley, 2020). In March 2020, more than 10 million Americans lost their jobs and applied for government aid (Weissmann, 2020). The Federal Reserve Bank of St. Louis estimated that the corona virus outbreak could cost 47 million jobs in the USA and unemployment rate may hit 32 per cent (Davidson, 2020). According to the early estimates, tens of millions of migrant workers were left unemployed in India by the end of March 2020 due to the lockdown (Al-Jazeera, 2020). A significant number of migrant workers are temporary or seasonal migrants, with 21 out of every 1000 migrants classified as a temporary or seasonal migrants in 2007–08 (Keshri and Bhagat, 2013). The Economic Survey 2016–17 estimated an interstate migrant population of 60 million and an inter-district migrant population of 80 million (Government of India, 2017a). Media has extensively reported an enormous number of men and women walking hundreds of kilometres back to their native land carrying children (Venkatraman *et al.,* 2020; Pandey *et al.,* 2020). Some women died on the way, and a few women gave birth to children on the road and continued walking with the newborn (Singh *et al.,* 2020; Press Trust of India, 2020). Many of them tested positive with COVID-19. The unfortunate incident of train running over and killing 16 migrant labourers who were sleeping in the railway tracks, tired of walking (BBC, 2020), gives an account of their fateful travails. In addition, 80 passengers, including many women, died in Shramik trains (Awasthi *et al.,* 2020). The most affected are the children who will possibly lose education and be at threat of child labour.

COVID-19 during first and second wave: During first wave, Bihar accounted for 1.5 million i.e. 14.3 per cent of the 10.5 million migrant workers who returned to their home states, the central government told in the Lok Sabha on September 14, 2020. Over 10.6 million migrant workers returned to their home state during the period March to June 2020, the government said on September 22, 2020. Prime Minister Narendra Modi launched the Garib Kalyan Rojgar Abhiyan on June 20, 2020 during a video call with villagers in Bihar's Khagaria district, one of the 116 districts listed under the scheme. Under the 125 day scheme, Rs. 50,000 crore to be spent for building rural infrastructure in 116 districts "with a large concentration of returnee migrant workers" in six states i.e. Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Jharkhand and Odisha (*Source:* Indian Express, dated 11.06.2020).

After outbreak of 2nd wave of COVID-19, as in Bihar on Tuesday, 20 April 2021 reported 10,455 cases and 98 deaths. The active cases in the state have gone up to 57,000 and the recovery rate has decreased to 82.99 per cent (*Source:* Hindustan Times, New Delhi dated 21st April 2021). Minister Vijay Kumar Chaudhary said the state government is now better equipped and prepared for the challenge of providing jobs to the migrant workers returning home. All the DMs (District Magistrates) have been directed to provide jobs to migrants as per their skills under various government schemes.

Effect on livelihood and feeling of some migrant labour after outbreak of 1st and 2nd wave of COVID-19 (Corona Virus): "One of the respondent of (40 years old) Muzaffarpur, Bihar was working at Erode (Tamil Nadu) in thread mill, and his income was Rs. 15000/-per month. Upon this amount they nourish their 4 members of family. He were return back to their native place (Bihar) due to lockdown in the first wave of COVID-19. After reaching here (Bihar) they were passing through a very bad time due to jobless in Bihar. They were waiting for support from Bihar Govt. for few months. After staying few months in Bihar, they not got support from Govt. Ultimately they again back to Erode (Tamil Nadu) before outbreak of second wave of COVID-19. After interviewed with telephone, after outbreak of second wave of COVID-19, again they are unemployed at Erode and put to starvation".

Another "Respondent of (38 years old) from, Vaishali, Bihar was working at Delhi in structuring welding of pipe industries, and his income was Rs. 21000/-per month. Upon this amount they nourish their 6 members of family. He were return back to their native place due to lockdown in the first wave of COVID-19 from Delhi. After reaching Bihar they got training on Vegetable seed production at Hariharpur, through Krishi Vigyan Kendra, Hariharpur, Vaishali, RPCAU, Pusa, Bihar. After some time they try for loan from Bank for start vegetable production. But due to several process they can't able to succeed for loan. They were passing through a very bad time due to jobless in Bihar. They were waiting for support from Bihar Govt. for few months. After staying some months in Bihar, they not got support from Govt. Ultimately they again back to Chennai (T.N.), before outbreak of second wave of COVID-19. After interviewed with telephone, after outbreak of second wave of COVID-19, again they come back Bihar in the month of 28th April 2021 and still he is unemployed at Bihar and put to starvation".

Another "Respondent of (38 years old) from Jale, Darbhanga, Bihar was working at Vishakhapatnam (AP) in Cement factory, and got Rs. 20000/-per month. Upon this amount they nourish their 4 members of family. He were return back to their native place due to lockdown in the first wave of COVID-19 from Vishakhapatnam on March 2020. After reaching Bihar they got training on fish production at Jale, through Krishi Vigyan Kendra, Jale, RPCAU, Pusa, Bihar. After some time they tried for loan from Bank for start honey processing plant. But due to several process they can't able to succeed for loan. They were passing through a very bad time due to jobless in Bihar. They were waiting for support from Bihar Govt. for few months. After staying fews months in Bihar, they not got support from Govt. Ultimately they again back to Vishakhapatnam on Nov.,2020, before outbreak of second wave of COVID-19. After interviewed with telephone, after outbreak of second wave of COVID-19, Again come back, Bihar, still he is unemployed at Bihar put to starvation".

MATERIALS AND METHODS

Area of employment opportunity: In the view of opportunity of employment generation we have, planned to identify the category of labour on the basis of their skilling capacity in Bihar / India. Skilling capacity may be divided in to four categories, as flows:

- Unskilled labour, who have experience about construction work as well as physically work capacity.
- Semiskilled labour, who have little knowledge about education.
- Skilled labour and who have capacity to supervise work.
- Another category is those women, who worked inside the house and having selling cooked material besides the road of town/market. (Source: National policy for skill development and Entrepreneurship-2015, Ministry of skill development and Entrepreneurship, Govt. of India).

After exploring the opportunity for the category of labour, ground water recharge system can be adopted, because it takes very less space and required minimum maintenance whole the year. By the use of waste materials produce from home and flowers and leaf from temples of different places, we can produce vermin-compost for organic farming. By adoption of artificial insemination for cow, buffalo, goat etc. employment can be generated among the landless people of category for first, second and third type of labour. Mushroom production is one of the most beneficial for landless labour. In the field of mushroom production employment can be generated on different stages i.e. Spon production, compost production from waste materials of mushroom production and marketing of different products of mushroom.

Honey production by honeybee rearing, birds rearing, prawn rearing in (chour and munn area) and fish seed production are the best opportunity for employment for the second category of labour.

Third category labour have the opportunity to use in the minimum space huge amount of fish can be produce, by the methods of rearing culturing aquaculture system. In organized sector business for mushroom can be adopted. Selling of Bamboo based and wooden based ornamental goods are also one of the good source of employment generation. Mechanization of farm increases the agricultural produce and side by side it also creates the opportunity for employment among the labour, who have skill to run the machines.

The last and fourth category for those women who have working inside the home, she can generate employment by making herbal Gulal (for Holi), pickles, papad, mushroom based products (samaso, laddu, pickles) and also energy food etc., by the help of SHG (Self Help Group) as well as individual. Production and selling of ornamental fish in the market is also a good source of employment generation. Processing of honey after huge amount of honey production, it can be sell in market after branding. For honey rearing no need to so much land, it can be put in orchard and other shady places under the tree in limited area.

National policy for skill development and entrepreneurship: On the basis of above classification, National policy for skill development and Entrepreneurship -2015 recommended by Ministry of skill development and Entrepreneurship, Govt. of India should be implemented in different employment sector in Bihar/ India. Emphasis should be given on skill development' and 'Skilled India as stated by Our Hon'ble Prime Minister of India, Shri Narendra Modi. Today, India is one of the youngest nations in the world with more than 62 per cent of its population in the working age group (15-59 years), and more than 54 per cent of its total population below 25 years of age. Its population pyramid is expected to "bulge" across the 15 to 59 age group over the next decade. It is further estimated that the average age of the population in India by 2020 will1 be 29 years as against 40 years in USA, 46 years in Europe and 47 years in Japan (*Source:* National Higher Education Mission, Ministry of Human Resource Development, 2013) In fact, during the next 20 years the labour force in the industrialized world is expected to decline by 4 per cent, while in India it will increase by 32 per cent. This poses a formidable challenge and a huge opportunity. To reap this demographic dividend which is expected to last for next 25 years, India needs to equip its workforce with employable skills and knowledge so that they can contribute substantively to the economic growth of the country.

For employment and economic growth Skill is one of the major integral part. It is estimated that during the five year period from 2004-05 to 2009-10, only 2.7 million net additional jobs were created in the country (*Source:* Global Employment Trends, ILO, 2013). The Indian capacity for harnessing entrepreneurship has not been fully realized the MSME (micro, small and medium enterprises) sector contributes to only 17 per cent of GDP as compared to 85 per cent in Taiwan, 60 per cent in China and 50 per cent in Singapore (*Source:* FICCI & Nathan Associates, Nurturing Entrepreneurship in India, August 2014).

In India, the first National Labour Policy comes in 1966. In 2009 the first National Policy on Skill Development was notified. To promote private sector participation via innovative funding models, National Skill Development Corporation (NSDC) was established in 2009 and tied up with more than 211 training providers. Many of whom have started scaling up their operations, to offer short term training programmes. NSDC supported 37 Sector Skills Councils (SSCs) which are intended to facilitate needs based training programmes. In June 2013 National Skills

Development Agency (NSDA) was created and has been working with State governments to rejuvenate and synergise skilling efforts in the States. National Skills Qualification Framework (NSQF) skilling and education outcomes with the competency based NSQF levels. These efforts build on the legacy vocational training infrastructure approximately 12,000 Industrial Training Institutes and 3,200 polytechnics (*Source:* National policy for skill development and Entrepreneurship-2015, Ministry of skill development and Entrepreneurship, Govt. of India).

Study area: The proposed study is for 3 districts for migrants namely, Viashali, Muzaffarpur and Darbhanga of North Bihar, India for 300 respondents.

Sampling design: Primary Data were collected through Purposive sampling design in above mentioned different blocks of three district i.e. Viashali, Muzaffarpur and Darbhanga of North Bihar, India

Independent variables: Skillset of migrant labourers, Age structure, category of caste, occupation, education, family type, family size, family income, marital status, size of land holding, size of operational land holding, farming experience related to weather forecasting advisory services, source of information utilization, social participation, extension contact, farm mechanization, gender, land type, total cultivated land, size of family, occupation of respondents, work experience, migrant from which states etc.

Dependent variables: i) Employment opportunity; ii)Training requirement for job achievement

RESULTS AND DISCUSSION

The following results is based on 300 respondents of migrant labours of Viashali, Muzaffarpur and Darbhanga districts. On the basis of skillset of migrant labours of Viashali, Muzaffarpur and Darbhanga districts, we have observed that maximum labour were unskilled i.e. 36.66 per cent and only 17.66 per cent women labourers were involved in domestic cook and food preparation work for commercial purpose. Rest are Semi-skilled and skilled labour (Table 1).

Table 1: Skillset of migrant labourers (N=300)

Category	F	%
Unskilled	110	36.66
Semi-skilled	64	21.33
Skilled	73	24.33
Women labourers involved in domestic cook and food preparation work for commercial purpose	53	17.66

As per Age structure maximum labours belong to below 35 years i.e. 66.66, 28.33 per cent belongs to age group of (35-50) years and 5 per cent belongs to above 50 years age groups. Among Caste category, majority were OBC, i.e. 63.66 per cent, than SC/ST 29.33 per cent and lowest one is unreserved category i.e. 7 per cent. On the basis of literacy maximum labourers were up to Intermediate i.e. 28.66 per cent and minimum were graduation and above i.e. 5.66 per cent. Maximum family were nuclear type i.e. 51.66 per cent and minimum family were joint i.e. 48.33 per cent. Maximum family size were (5-8) members i.e. 51.66 per cent and minimum size were above 8 members, i.e. 20 per cent. On the basis of Family income, maximum were low income farmers (1.01 lakh to 5.00 lakhs), i.e. 97 per cent and high income groups farmers (10 lakh or above) were 0 %. Maximum migrants labourers were married i.e. 68.33 per cent where as 31.66 per cent were unmarried. Maximum labours were small land holders i.e. (0-2.5) ha, is 89 per cent and no one were having large land holders (above 5.0 ha). As size of operational land holding (acres) maximum were in the category leased outland i.e. 34.66 per cent, leased inland and no inland /no out land both were equal i.e.33.33 per cent. On the basis of farming experience related to weather forecasting advisory services maximum having experience (more than 3 years) i.e. 41.66 per cent. Having knowledge about weather forecasting and farm advisory through nearest KVK. As per information utilization Maximum person having no idea about KCC. There are no television in the house of 205 labours out of 300 labours i.e. 68.33 per cent (no T.V.). 50 per cent have knowledge about KVK i.e. (most often). 50 per cent labourers were benefitted through RPCAU, Pusa, Samastipur, Bihar, India (most often). 100 per cent labours were participate in social works. 83.33 per cent labours were in well contact regarding extension works. On the basis of farm mechanization, were found only 20 per cent. 80 per cent were male and 20 per cent were female migrant, no were transgender. Land type were maximum were irrigated (from other boring) i.e. 60 per cent. Total cultivated land were maximum 60 per cent. On the basis of occupations of migrant labour maximum were in others category (Kulee, Hawkers, Construction work (other than Rajmistri), Kadhai labour, textile/Garments factory labour etc.) are 58.66 per cent. Minimum labour were Plumber i.e. 1.66 per cent. Occupation wise distribution of labourers, i.e. Rajmistri, Cooks in hotel, Delivery boy, Barber, Automobile factory, Plumber, Newspaper distributer, Carpenter are presented Table 2.

Table 2: Occupation at outside of native place (N=300)

Category	F	%
Rajmistri	40	13.33
Cook in hotel	15	5.00
Delivery Boy	20	6.67
Barber	15	5.00
Automobile factory(worked)	15	5.00
Plumber	05	01.66
Newspaper distributer	08	2.66
Carpenter	06	2.00
Others (Kulee, Hawkers, Construction work (other than Rajmistri), Kadhai labour, textile/ Garments factory etc.)	176	58.66

Labour of Muzaffarpur district were stay maximum period i.e. more than 10 years at different part of country followed by Darbhanga district labour i.e. 7 years and minimum period of staying at other places of country were Vaishali district labour i.e. 5 years. Maximum labours migrated from Delhi i.e. 33.66 per cent and minimum from Karnataka, Jharkhan, Goa, Kerala and Haryana i.e. 1.66 per cent. Labourers were also migrated from different part of country of different states (Table 3).

After collecting feedback from migrant labours towards employment, there are several labours show willingness for emloyment in different agricultural and its allied sectors. They all are interested for training in agricultural and its allied sectors. Maximum migrant workers want to training on mushroom (approx 39%) and honey processing plant (Approx 39%) and minimum (0.00%) were interested for training on soil test laboratory. Others are interested for training on mechanization management, Poultry, Goat rearing, Dairy, Bee Keeping, Fisheries, Nutrition park, Integrated farming and Vermicompost (Table 4).

Table 3: Place from Migrated (N=300)

Place	No. of people	Percentage
Haryana	5	1.66
Gujrat	27	9.00
Kerala	5	1.66
Andhra Pradesh	18	6.00
Rajasthan	10	3.33
Punjab	27	9.00
Maharashtra	22	7.33
Delhi	101	33.66
West Bengal	50	16.66
Assam	10	3.33
Telangana	10	3.33
Karnataka	5	1.66
Jharkhand	5	1.66
Goa	5	1.66

Table 4: Sector of Employment option for training (N=300)

Employment sector	No. of respondents	Percentage
Dairy	54	18.00
Mushroom	117	39.00
Bee Keeping	40	13.33
Vermi compost	23	7.66
Vegetable production	10	3.33
Poultry	55	18.33
Fishries	32	10.66
Goat Rearing	50	16.66
Integrated farming	10	3.33
Nutritional park	68	22.66
Honey processing plant	117	39.00
Mechanization management	68	22.66

Requirement of manpower by 2022: In comparison to others country India has only 4.69 per cent of the total workforce in undergone formal skill training as compared to 68 per cent in UK, 75 per cent in Germany, 52 per cent in USA, 80 per cent in Japan and 96 per cent in South Korea. Projected Employment created by 2022 will be 581.89 million and incremental human resource requirement will be 120.79 million (Source: National policy for skill development and Entrepreneurship-2015, Ministry of skill development and Entrepreneurship, Govt. of India). Analysis is based on results of 66th and 68th round of NSSO. It is observed that today the total workforce in the country is estimated at 487 million, of which approximately 57 per cent is in the non-farm sector. Approximately 241.86 million would either be unskilled or skilled through non formal channels. Out of these, it is estimated that approximately 170 million would be in the age group 15-45 years. This workforce will need to be mapped through recognition of existing skills and then provided with necessary skilling, reskilling and upskilling to increase productivity and provide a livelihood pathway. Similarly, in farm sector, this figure works out to be 128.25 million.

Impact assessment: Impact assessment should be undertaken in Bihar / India to ensure that the targets are met well within the time frame. For the purpose of impact assessment, the following monitoring indicators, amongst others, are prescribed: as "National Policy for Skill Development and Entrepreneurship 2015 published by Ministry of Skill development and Entrepreneurship". On the basis of this study following measure should be undertaken i.e. increases the Number/registrations of youth interested in skilling, registered in training programmes, assessed and certified by regulatory authorities, Placement rate of skilled trainees, accredited/affiliated training providers/ centres, certified trainers, sector-wise, skilled persons engaged in overseas employment. Reduction in sectoral demand and supply gap. Increases Amount of private funds mobilised for encouraging skill development and entrepreneurship, running skills and entrepreneurship courses.

RECOMMENDATION

Skilling programme should be organized to promote entrepreneurship and ensure sustainable livelihoods for all citizens in the Bihar/India. On the basis of skilling capacity of labour force for employment the following measure should be implemented by the Govt./policy maker:

- All youth and employers needs quality vocational training to create job opportunity.
- Training should be organized to develop skill in formal and informal education both by vertical/ horizontal direction to unskilled/semiskilled/skilled and women (involved in making domestic product) workforce.
- Provide quality skilling that on one hand results in increased employability and better livelihoods for individuals.
- Establishment of IT based information system for aggregating demand and supply of skilled workforce which can help in matching and connecting supply with demand.
- An environment should be created by Employers to develop skilling space through active involvement in setting occupational standards, helping develop curriculum, providing apprenticeship opportunities, participating in assessments, and providing gainful employment to skilled workforce with adequate compensation.
- All type of skillset development efforts should be promote through on-the-job training and making apprenticeships by University/organization.
- A policy should be passed on skilling training for the socially economically weaker section, SCs, STs, OBCs, minorities and differently abled persons.
- Women participation in the workforce through appropriate skilling and training should be increases.

CONCLUSION

Above research concludes that Govt. have to make some policy to generate employment opportunity among the people by the adopting above mentioned enterprises with the help of Universities/organization/ Govt. For achievement of this target, training are needed in the field of Agricultural and its allied sectors. Govt./Policy maker should attention on above mentioned recommendation to generate employment opportunity among the migraint labour / labourers, who were return from different states after Ist wave and 2nd wave of COVID-19 in own state (Bihar). Appropriate agricultural and its allied based employment should be created through small industries in every district, so that labours can't move again after end of 2nd Wave of COVID-19 and able to got works in own state, Bihar.

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Impact Analysis of KVK Activities in Different Adopted Villages of Punjab

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ABSTRACT

Krishi Vigyan Kendras under the aegis of PAU, Ludhiana are working in eighteen districts and conducting various agricultural activities in collaboration with state agriculture and allied departments. These have adopted ninety six villages in different districts of the state. The main purpose to adopt the villages is to enhance income of the rural families through enhancing farm profitability, engaging rural youth and farm women in subsidiary occupations, imparting skill in rural youth in agriculture and selected areas to improve their employability and entrepreneurship and to facilitate improvement in public services infrastructure. One best adopted village by each KVK was taken as sample of the study. Data was collected on different aspects and relative scoring was done for comparing the impact of activities in adopted villages. It was observed that Chatha Nanhera adopted village of KVK Sangrur was the topper in performing extension activities and also jointly shared top position with KVK Patiala in adoption of different technologies/practices. KVK Patiala was most successful in developing seventeen enterprises of Home Science (Preservation, stitching &embroidery, detergent making) in adopted village. Karmuwala village of KVK Ferozepur was leader in entrepreneurship development in vegetable production. The adopted village of KVK Sangrur and KVK Patiala also got almost same score in overall activities performance.

Keywords: Adopted village, Extension activities, Entrepreneurship, Technologies

INTRODUCTION

The idea of Krishi Vigyan Kendras gets rooted in the sixties when Education Commission (1964-66) recommended to establish specialized institutions to provide vocational education in agriculture and allied fields at the pre and post matriculate levels to cater the training needs of a large number of boys and girls coming from rural areas. After discussing the recommendation of the Commission, Indian Council of Agricultural Research (ICAR) propounded the establishing of Krishi Vigyan Kendras (Agricultural Science Centres) as innovative institutions for imparting vocational training to the practicing farmers, school dropouts and field level extension functionaries. After its merger with National Demonstrations, Operational Research Projects, and the Lab-to-Land, mandate of KVK was revised to technology assessment and demonstration for its wider application and to enhance capacity development during 1992 (Venkata subramanian *et al.,* 2009). To implement the mandate effectively through creation of awareness about the improved agricultural technologies, the following activities are defined for each KVK: (i) On-farm testing to assess the location specificity of agricultural technologies under various farming systems, (ii) Out-scaling of farm innovations through frontline demonstration to showcase the specific benefits/worth of technologies on farmers' fields, (iii) Capacity development of farmers and extension personnel to update their knowledge and skills in modern agricultural technologies and enterprises, (iv) Work as Knowledge and Resource Centre for improving the overall agricultural economy in the operational area, (v) Conduct frontline extension programmes and provide farm advisories, (vi) Using ICT and other media on varied subjects of interest to farmers and (vii) Data documentation, characterization and strategic planning of farming practices. KVK are also required to produce quality technology related inputs/products (seeds,

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planting materials, bio-agents, livestock, fingerlings etc.) and make them available to farmers, besides identifying and documenting selected farmer-led innovations and converging with the ongoing schemes and programmes within the mandate of KVK (Prasad *et al.,* 2017). At present number of KVKs has reached to 721 and still it is increasing (Anonymous, 2020). In Punjab, all the KVKs are adopting villages to make them a model village after carrying out all these mentioned activities. So the present study was planned to compare the impact of activities carried out by different KVKs under the aegis of Punjab Agricultural University Ludhiana.

MATERIALS AND METHODS

Every KVK in India is supposed to adopt villages for the holistic development. There were eighteen KVKs under the aegis of Punjab Agricultural University, Ludhiana during the study period i.e. 2017-18. KVK Pathankot was emerged new during the period of study. Hence, Seventeen KVKs were selected for the purpose of the study. These KVKs were from districts Amritsar (Asr), Bathinda (Btd), Faridkot (Fdk), Fatehgarh Sahib (FGS), Ferozepur (Fzr), Gurdaspur (Gsp), Hoshiarpur (Hsp), Jalandhar (Jal), Kapurthala (Kpt), Ludhiana (Ldh), Mansa (Man), Moga, Patiala (Pat), Ropar, Sangrur (Sgr), Shaheed Bhagat Singh Nagar (SBSN). One best adopted village by each KVK was taken as sample of the study. In this way, Nag Khurd (Amritsar), Killi Nihal Singh (Bathinda), Pindi Blochan (Faridkot), Badoushi Kalan (FatehgarhSahib), Karmuwala (Ferozepur), Chhina Railwala (Gurdaspur), Todarpur (HSP), Dalla (Jalandar), Meripur (Kapurthala), Powat (Ludhiana), Makha (Mansa), Jhandewala (Moga), Goneana (Muktsar), Binaheri (Patiala), Fatehgarh Viran (Ropar), Chatha Nanhera (Sangrur), Balon (Shaheed Bhagat Singh Nagar) villages respective of KVK were constituted the sample of the study. Data was collected on different aspects in the broader area of extension activities, adoption of practices and enterprises. A relative scoring was done on different aspects of KVK interventions in the adopted villages while consulting various experts, extension scientists etc. The detailed scoring of different aspects is given in the Table 1.

RESULTS AND DISCUSSION

Different extension activities of KVKs in best adopted village: Table 2 gives the account of different extension activities been carried out by different KVKs in their one best adopted village. It is clear from the data given in Table 2 that as far the organisation of training was concerned, KVK, Sangrur has organized maximum number (54) of trainings in the adopted village Chatha Nanhera. Field Days a very important extension activity was extensively carried out by KVK, Ropar (12 in number) in its adopted village Fatehgarh Viran and also maximum number of solar gadgets (15) were sold. KVK Sangrur has also taken lead as

Table 1: Scoring of different activities carried out in the adopted villages

Extension Activities	Max. Score	Adoption of practices and Enterprises	Max. Score
Trainings	4.0	Soil test based fertilizer applications	7.0
Field days	5.0	Recommended varieties	7.0
Health/Animal/other Camps	2.0	Crop diversification	7.0
Campaigns	2.0	Laser leveling	7.0
Field Demonstrations	6.0	Straw management	7.0
Method Demonstrations	4.0	IPM Practices	7.0
SHG developed	2.0	**Enterprises**	
Biofertilizer sold	2.0	Dairy/Poultry/Piggery/Fishery	3.0
Soil Samples tested	2.0	Mushroom production	3.0
Solar Gadgets sold	2.0	Veg. Production	3.0
Planting material		Bee Keeping	3.0
Vegetable Kits	2.0	Food Processing	3.0
Saplings of Fruit Plants	2.0	Home Science (Preservation, stitching & embroidery,	3.0
Seed Sold **(q)**	3.0	detergent making	
Total	40.0	Total	60.0

Table 2: Relative Scoring of Different Extension Activities of KVKs in Best Adopted Village During Jan 2016 to Dec.2017

Extension Activities	Asr	Btd	Fdt	FGS	Fzr	Gsp	Hsp	Jld	Kpt	Ldh	Mansa	Moga	Mkt	Patiala	Ropar	Sgr	SBSN
Trainings	32 (2.4)	14 (1.0)	43 (3.2)	23 (1.7)	26 (1.9)	13 (1.0)	44 (3.3)	30 (2.2)	30 (2.2)	11 (0.8)	8 (0.6)	8 (0.6)	6 (0.4)	52 (3.8)	42 (3.1)	54 (4.0)	22 (1.6)
Field days	7 (2.9)	3 (1.3)	7 (2.9)	3 (1.3)	3 (1.3)	7 (2.9)	9 (3.8)	2 (0.8)	7 (2.9)	5 (2.1)	4 (1.7)	6 (2.5)	2 (0.8)	11 (4.6)	12 (5.0)	11 (4.6)	6 (2.5)
Animal Health /other Camps	4 (2.0)	4 (2.0)	4 (2.0)	0 (0.0)	4 (2.0)	2 (1.0)	1 (0.5)	3 (1.5)	1 (0.5)	0 (0.0)	3 (1.5)	4 (2.0)	0 (0.0)	2 (1.0)	3 (1.5)	3 (1.5)	3 (1.5)
Campaigns	87 (2.0)	6 (0.1)	26 (0.6)	6 (0.1)	8 (0.2)	14 (0.3)	25 (0.6)	20 (0.5)	24 (0.6)	4 (0.1)	23 (0.5)	11 (0.3)	2 (0.0)	40 (0.9)	15 (0.3)	42 (1.0)	28 (0.6)
Field Demonstrations	196 (3.7)	65 (1.2)	293 (5.5)	188 (3.5)	161 (3.0)	43 (0.8)	42 (0.8)	35 (0.7)	71 (1.3)	29 (0.5)	27 (0.5)	51 (1.0)	65 (1.2)	318 (6.0)	51 (1.0)	319 (6.0)	61 (1.1)
Method Demonstrations	65 (4.0)	8 (0.5)	37 (2.3)	4 (0.2)	25 (1.5)	10 (0.6)	26 (1.6)	50 (3.0)	5 (0.3)	5 (0.3)	23 (1.4)	9 (0.5)	10 (0.6)	60 (3.7)	45 (2.7)	60 (3.7)	44 (2.7)
SHG developed	1 (2.0)	0 (0.0)	0 (0.0)	1 (2.0)	0 (0.0)	1 (2.0)	1 (2.0)	0 (0.0)	1 (2.0)	1 (2.0)	1 (2.0)	0 (0.0)	1 (2.0)	1 (2.0)	0 (0.0)	1 (2.0)	1 (2.0)
Planting material																	
Vegetable Kits	558 (1.8)	100 (0.3)	600 (2.0)	100 (0.3)	63 (0.2)	125 (0.4)	120 (0.4)	45 (0.1)	125 (0.4)	175 (0.6)	20 (0.1)	68 (0.2)	96 (0.3)	380 (1.2)	400 (1.3)	382 (1.3)	114 (0.4)
Saplings of Fruit Plants	190 (0.9)	150 (0.7)	100 (0.5)	0 (0.0)	15 (0.1)	150 (0.7)	80 (0.4)	56 (0.3)	72 (0.4)	290 (1.5)	25 (0.1)	20 (0.1)	25 (0.1)	403 (2.0)	400 (2.0)	405 (2.0)	20 (0.1)
Seed Sold **(Qtl)**	172 (0.5)	9 (0.0)	55 (0.1)	85 (0.2)	219.5 (0.6)	36 (0.1)	105 (0.3)	36 (0.1)	250 (0.7)	95 (0.6)	91.5 (0.2)	153 (0.4)	25 (0.1)	728 (3.0)	190 (0.5)	730 (3.0)	144 (0.4)
Biofertilizer sold	174 (0.9)	75 (0.4)	250 (1.3)	50 (0.3)	75 (0.4)	30 (0.2)	150 (0.8)	45 (0.2)	8 (0.0)	85 (0.5)	85 (0.4)	272 (1.4)	20 (0.1)	400 (2.0)	130 (0.7)	400 (2.0)	40 (0.2)
Soil samples tested	177 (1.2)	120 (0.8)	119 (0.8)	160 (1.0)	43 (0.3)	77 (0.5)	180 (1.2)	62 (0.4)	40 (0.3)	250 (1.1)	74 (0.5)	55 (0.4)	45 (0.3)	183 (1.2)	300 (1.3)	460 (2.0)	76 (0.5)
Solar Gadgets sold	2 (0.3)	2 (0.3)	2 (0.3)	2 (0.3)	0 (0.0)	2 (0.3)	0 (0.0)	1 (0.1)	0 (0.0)	10 (1.3)	1 (0.1)	1 (0.1)	0 (0.0)	13 (1.7)	15 (2.0)	14 (1.9)	5 (0.7)
Farm Literature sold (copies)	148 (1.0)	100 (0.7)	301 (2.0)	0 (0.0)	80 (0.5)	0 (0.0)	45 (0.3)	52 (0.3)	15 (0.1)	40 (0.3)	25 (0.2)	155 (1.0)	112 (0.7)	100 (0.7)	50 (0.3)	250 (1.7)	300 (2.0)
Total Score	25.4	9.3	23.4	11.0	12.0	10.8	15.7	10.2	11.7	10.3	9.8	10.5	6.8	33.8	21.7	36.4	16.3

Figures in parenthesis shows relative scoring compared to other KVKs in carrying out extension activities in village Chatha Nanhera viz. Field Demonstrations (319), Saplings of Fruit Plants (405), Seed Sold (730 q), Biofertilizer packets sold (400) and soil samples tested (460). However in case of Animal Health /other Camps, five KVKs i.e. Amritsar, Bathinda, Faridkot, Ferozepur and Moga jointly lead while organizing four camps each. KVK Amritsar has organised maximum number of Campaigns (87) and Method Demonstrations (65) in the adopted village Nag Khurd. Vegetable kits (600) and number of copies of literature sold (301) were highest by KVK, Faridkot in the adopted village Pindi Blochan. If we see the aggregate of scores for different extension activities, KVK Sangrur was the clear topper with overall score of 36.4 whereas KVK Muktsar with total score of 6.8 was at the bottom.

Comparative adoption level of different technologies/practices in adopted villages: One of the major aims of KVKs is to achieve maximum adoption of recommended technologies/practices which are beneficial for farming community. Some of the major practices in which maximum adoption was sought by KVKs were soil test based fertilizer application, recommended varieties, crop diversification, laser leveling, straw management and IPM practices. Based on scoring it is evident from Table 3 that in case of adoption of soil test base fertilizer application maximum adoption was observed in village Binaheri adopted by KVK, Patiala that has shown 68 per cent increase in adoption. Same village led in adoption of recommended varieties of different crops with 77 per cent increase over the baseline data and also with an increase of 29 per cent achieved maximum crop diversification. Maximum adoption of laser land leveling was came forward from village Killi Nihal Singh adopted by KVK, Bathinda which has shown 79 per cent increase in the adoption. As far the adoption of different straw management technologies was concerned village Pindi Blochan adopted by KVK Faridkot has topped the table with 77 per cent increase. However KVK, Sangrur was most successful in achieving adoption of IPM practices (40%) in its adopted village Chatha Nanhera.

When overall scoring based on the adoption of different recommended practices was worked out KVK Patiala and KVK Sangrur jointly shared the top position with a score of 36.5. However lowest score was obtained by KVK, Mansa.

Entrepreneur development: Third aspect considered for comparing the impact in adopted villages was Entrepreneur Development. No doubt this is a very important dimension to generate employment in the villages. All the KVKs are engaged in developing enterprises based on the requirements and potential of the operational areas. It is clear from the table that KVK Sangrur has taken lead in the entrepreneurship development in the field of Dairy/Poultry/Piggery/ Fishery where it has produced twenty entrepreneurs in village Chatha Nanhera. This has also developed thirteen mushroom growers, six food processing units and topped the tally. However, Karmuwala village of KVK Ferozepur was leader in entrepreneurship development in vegetable production (55). In this way, KVK Patiala was most successful in developing seventeen enterprises of Home Science (Preservation, stitching and embroidery, detergent making) in adopted village Binaheri. On the basis of overall relative scoring, KVK Sangrur has shown maximum impact (11.6 score), followed by KVK Patiala (11.6 score), KVK Amritsar (5.8 score) and KVK, Hoshiarpur has shown lowest impact (0.8 score) as far the entrepreneurship development was concerned.

Overall impact of activities: Till now different activities in respective one best adopted village of different KVKs in Punjab was discussed. It was clear that there was lot of variation according to activity wise as one KVK was leading in one dimension and other KVK in other activity. So to get overall picture, relative scoring of all activities was aggregated and data is presented in Table 5. It is clear from Table 5 that Chatha Nanhera village adopted by KVK, Sangrur was leading in impact of KVK activities with a total score of 81.9. However, Binaheri village of KVK Patiala was not far behind and was at second place with overall score of 81.5 and Nag Khurd Village adopted by KVK, Amritsar was distant third with a score of 56.2. If we look at the bottom positions, Makha village of KVK Mansa was at lowest position with overall score of 17.6 followed by Balon village of KVK, Shaheed Bhagat Singh Nagar (23.1) and Goneana Village of KVK, Muktsar (24.8). One of the possible reasons behind this may be that KVK Mansa and KVK Muktsar were relatively newer KVKs. There may be other

Table 3: Relative Scoring Based on Adoption Level of Practices in Adopted Village

Adoption of practices		Asr	Btd	Fdk	FTGS	Fzr	Gsp	Hsp	Jal	Kpt	Ldh	Mansa	Moga	Mkt	Ptl	Ropar	Sgr	SBSN
Soil test based fertilizer	Before	6.0	30	21	25	0	4.3	40	28	10	16	3	25	16	2	25	27	55.2
applications	After	66.0	72	84	60	40	26.8	65	70	50	82	12	42	23	70	75	85	89.4
	%age change	60.0 (6.2)	42 (4.3)	63 (6.5)	35 (3.6)	40 (4.1)	22.5 (2.3)	25 (2.6)	42 (4.3)	40 (4.1)	66 (6.8)	9 (0.9)	17 (1.8)	6.5 (0.7)	68 (7.0)	50 (5.2)	58 (6.0)	34.2 (3.5)
Recommended varieties	Before	39	20	53	40	60	0	60	36	45	21	59	42	67	3	30	35	85
	After	72	90	96	60	90	0	95	81	75	90	70.5	75	97	80	80	95	98
	%age change	33 (3.0)	70 (6.4)	43 (3.9)	20 (1.8)	30 (2.7)	0 (0.0)	35 (3.2)	45 (4.1)	30 (2.7)	69 (6.3)	11.5 (1.0)	33 (3.0)	30 (2.7)	77 (7.0)	50 (4.6)	60 (5.5)	13 (1.2)
Crop diversification	Before	8	2	5	15	0	0	20	5	20	12	0.5	30	26	9	3	60	0
	After	26	18	17	25	12	0	30	25	38	25	2.5	52	40	38	15	85	0
	%age change	18 (4.3)	16 (3.9)	12 (2.9)	10 (2.4)	12 (2.9)	0 (0.0)	10 (2.4)	20 (4.8)	18 (4.3)	13 (3.1)	2 (0.5)	22 (5.3)	15 (3.5)	29 (7.0)	12 (2.9)	25 (6.0)	0 (0.0)
Laser leveling	Before	40	16	64	10	60	27.9	70	35	32	49	55	55	81	5	15	25	67
	After	95	95	100	60	90	53.7	98	64	80	82	62	85	100	75	90	95	79
	%age change	55 (4.9)	79 (7.0)	36 (3.2)	50 (4.5)	30 (2.7)	25.8 (2.3)	28 (2.5)	29 (2.6)	48 (4.3)	33 (2.9)	7 (0.6)	30 (2.7)	19 (1.7)	70 (6.2)	75 (6.7)	70 (6.2)	12 (1.1)
Straw management	Before	5	3	8	2	40	7.5	25	30	10	31	0.5	20	4.8	3	0	22	0
	After	35	38	85	15	60	34.4	60	65	80	74	4.5	70	8	38	30	86	0
	%age change	30 (2.7)	35 (3.2)	77 (7.0)	13 (1.2)	20 (1.8)	26.9 (2.4)	35 (3.2)	35 (3.2)	70 (6.4)	43 (3.9)	4 (0.4)	50 (4.6)	3.2 (0.3)	35 (3.2)	30 (2.7)	64 (5.8)	0 (0.0)
IPM Practices	Before	18	2	7	5	0	3.2	30	2	10	8	0	30	80	0	5	45	0
	After	40	22	42	25	0	41.9	45	35	20	23	10	60	105	35	30	85	0
	%age change	22 (3.9)	20 (3.5)	35 (6.1)	20 (3.5)	0 (0.0)	38.7 (6.8)	15 (2.6)	33 (5.8)	10 (1.8)	15 (2.6)	10 (1.8)	30 (5.3)	25 (4.4)	35 (6.1)	25 (4.4)	40 (7.0)	0 (0.0)
Total Relative Scoring		25.0	28.3	29.6	17.0	14.2	13.8	16.5	24.8	23.6	25.7	5.2	22.5	13.3	36.5	26.4	36.5	5.8

Figures in parenthesis shows relative scoring

Table 4: Relative Scoring Based on Entrepreneur Development

Enterprises	Asr	Btd	Fdk	FTGS	Fzr	Gsp	Hsp	Jal	Kpt	Ldh	Mansa	Moga	Mkt	Ptl	Ropar	Sgr	SBS Ngr
Dairy/Poultry/Piggery/Fishery	16 (0.3)	11 (1.7)	2 (0.3)	0 (0.0)	5 (0.8)	0 (0.0)	5 (0.8)	4 (0.6)	1 (0.2)	6 (0.9)	5 (0.8)	4 (0.6)	5 (0.8)	12 (1.8)	0 (0.0)	20 (3.0)	5 (0.8)
Mushroom production	2 (0.5)	0 (0.0)	0 (0.0)	4 (0.9)	1 (0.2)	0 (0.0)	0 (0.0)	2 (0.5)	7 (1.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.9)	0 (0.0)	13 (3.0)	5 (1.2)
Veg. Production	3 (0.2)	0 (0.0)	2 (0.1)	0 (0.0)	55 (3.0)	0 (0.0)	0 (0.0)	15 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)
Bee Keeping	10 (3.0)	0 (0.0)	0 (0.0)	1 (0.3)	2 (0.6)	0 (0.0)	0 (0.0)	3 (0.9)	4 (1.2)	4 (1.2)	6 (1.8)	0 (0.0)	6 (1.8)	5 (1.5)	6 (1.8)	0 (0.0)	0 (0.0)
Food Processing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.0)	0 (0.0)	6 (3.0)	0 (0.0)
Home Science (Preservation, stitching and embroidery, detergent making	10 (1.8)	13 (2.3)	7 (1.2)	1 (0.2)	4 (0.7)	5 (0.9)	0 (0.0)	8 (1.4)	2 (0.4)	0 (0.0)	0 (0.0)	7 (1.2)	12 (2.1)	17 (3.0)	8 (1.4)	15 (2.6)	0 (0.0)
Total Relative Scoring	5.8	4.0	1.6	1.4	5.8	1.4	0.8	4.2	3.4	3.6	2.6	1.8	4.7	8.6	3.2	11.6	1.0

Figures in parenthesis shows relative scoring

Table 5: Relative Scoring of All Activities Performed By KVKs

Activities	Sangrur	Patiala	Asr	Fdk	Ropar	Btd	Ldh	Jal	Kpt	Moga	Hsp	Fzr	FTGS	Gsp	Mkt	SBSN	Mansa
Extension Activities	33.8	36.4	25.4	23.4	21.7	9.3	10.3	10.2	11.7	10.5	15.7	12.0	11.0	10.8	6.8	16.3	9.8
Adoption of Practices	36.5	36.5	25.0	29.6	26.4	28.3	25.7	24.8	23.6	22.5	16.5	14.2	17.0	13.8	13.3	5.8	5.2
Enterprises	11.6	8.6	5.8	1.6	3.2	4.0	3.6	4.2	3.4	1.8	0.8	5.8	1.4	1.4	4.7	1.0	2.6
Total	81.9	81.5	56.2	54.6	51.3	41.6	39.6	39.2	38.7	34.8	33.0	32.0	31.3	26.0	24.8	23.1	17.6

factors also like number of SMSs positions filled, specialization of different SMSs, location specific technologies, characteristics of adopters etc. which produced such a varied impact. Any ways Village Chatha Nanhera was clearly leader in showing impact of KVK activities.

CONCLUSION

Village adoption by KVKs is a very important activity where KVKs can develop it into a model village by carrying out different extension activities as a package approach. It does not matter that one KVK is showing impact in one particular field and other in second field. But it is the sum of diverse activities and consistent efforts which make a village well developed than other as far the recommended practices are concerned. Although every activity is important but in today's concern entrepreneurship development is one of the most important aspect which can generate additional income and employment. It was entrepreneurship development only in which KVK, Sangrur has done remarkable job and as a result become overall leader in showing impact in the adopted village Chatha Nanhera. However there are a number of other factors affecting the impact which can't be ignored while comparing the different KVKS. Despite that comparison of impact is a good practice to inculcate the sense of competition among KVKs to achieve new heights.

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Spatial Knowledge and Attitude of Farmers towards Soil Testing Practices in Bathinda Districts of Punjab

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ABSTRACT

Through soil testing farmers will able to know nutrients already available in soil and how much will have additionally provided for a particular crop under different site-specific conditions. Majority of the farmers of the region had knowledge about soil testing practices, and were using the knowledge gained from scientists working in different government organisations. Most of the respondents were agree with the statements and possessed favourable attitudes towards soil testing practices. Majority of the farmers were agreed with the statements "Soil testing is essential for better crop production and maintain soil health and insect/pest/desesse infestitation deceased with soil test based fertilizer (urea) application. The efferts made by personal contect by different organisations to encourage the farmers in adoption of soil testing practices were more effective. Similarly, during the present digital era different agricultual extension liturautres are also more effective for encourage the farmers in adoption of soil testing practices in the district.

Keywords: Attitude, Crop cultivation, Knowledge, Soil testing practices

INTRODUCTION

Soil is the major source which provides essential nutrients to the plant. Healthy soil contains all the elements for growth and development of plants. The soil deficient from one or more nutrient reduces the production and quality of crops. Therefore, proportion and quantity of macro and micro nutrients all together refer to appropriate crop yield the soil health.

In general most of the farmers are using continuously larger quantities of chemical fertilizers to increase crop production without knowing the soil fertility status of their fields. Therefore, judicious application of chemical fertilizers by the farmers in crops is very much essential to achieve maximum production and earn maximum profit. Soil testing involves estimation and evaluation of the available nutrient status, acidic reaction and salinity of soil. It is the base for management decisions about fertilizer requirements of the crops. Soil testing of a particular field gives reliable information about the nutrients availability in the soil as well as hazards such as soil acidity, alkalinity and salinity etc. After the soil testing, farmers will be able to know the quantity of nutrients already available in the soil and how much will have to be applied additionally for a particular crop. Therefore, soil testing will definitely be advantageous to the farmers in achieving maximum production and in earning maximum profit. Hence it is essential to create maximum awareness among farmers for judicious use of chemical fertilizers. Keeping in view the importance of soil testing towards optimum crop production and maximum net profit, this study was carried out in Bathinda district of Punjab to find out the knowledge and attitude of farmers towards soil testing practices.

MATERIALS AND METHODS

The present study was undertaken in Bathinda district in Punjab during 2020-21. One hundred forty farmers were randomly selected from the districts, who visited Punjab Agricultural University, Regional Research Station, Bathinda for soil and water testing, purchase of crop seeds and fruit nursery plants as well as getting advisory regarding insect-pests and diseases

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management of different crops. The questionnaire was prepared in Punjabi language with a view to study and collect data through personal interview of the selected respondents. The data were tabulated and analyzed with the objectives to assess the knowledge and attitude of farmers toward soil testing practices.

RESULTS AND DISCUSSION

The data presented in Table 1 showed that knowledge of the respondents about soil testing practices in Bathinda districts. Majority of the farmers had knowledge about ideal time for soil sampling (87%), proper sampling technique for fertilizer application in crops (75%), implements used for taking soil samples (85%) and locations of soil testing laboratories in the district (90%). Similarly, it is observed that 48, 42 and 36 per cent of the farmers had medium level of knowledge about selection of soil sampling points in field, proper sampling technique for fruit plants and proper sampling technique for reclamation the degraded soils, respectively.

Whereas, low level of knowledge regarding quantity of soil sample required for testing (30%), frequency of soil testing for same field (28%), information on soil sample bag (20%) and preparation of soil samples for testing (15%) were recorded among the farmers in Bathinda districts of Punjab. The results are in conformity with the result of Yadav *et al.* (2005); Pagaria (2011); Pandey *et al.* (2012); Kapur *et al.* (2013); Archana and Balasubramanian (2019); Patel *et al.* (2019) and Solanki *et al.* (2020). Results of the study revealed that there is a scope to improve extent of adoption of soil testing among farmers of the district by awareness bringing through training, demonstration and other extension activities.

There are several sources (Table 2) which plays a significant role to aware the farmers for soil testing practices. The data regarding the sources of information for farmers were divided in two categories (personal contact and other different extension activates) are provided in Table 2.

Table 2: Distribution of respondents according to the source of knowledge in Bathinda district (N=140)

Source of Knowledge	Frequ-ency	Percen-tage
Personal contact		
KVK/ FAS/ RRS Scientist	106	76
Person of State Agriculture Department	31	22
Fellow Farmers	03	02
Different extension activities		
Agriculture Extension Liturатures-News Papers, Magazines, Changi Kheti (Punjabi), Progressive Farming (English)	49	35
Radio	31	22
T V	04	03
Kishan Gosthi	11	08
Kishan Mela	39	28
No Knowledge	06	04

KVK= Krishi Vigyan Kendra; FAS= Farmers Advisory Service; RRS=Regional Research Station

Table 1: Knowledge of farmers about soil testing practices in Bathinda district (N=140)

Particulers	Response (%)	
	Possitive	Negative
Ideal time for collection of soil samples	122 (87)	18 (13)
Proper sampling technique for fertilizer application	105 (75)	35 (25)
Proper sampling technique for orchard plantation	59 (42)	81 (58)
Proper sampling technique for soil reclamation	50 (36)	90 (74)
Selection of points in field for soil sampling	67 (48)	73 (52)
Implements used for soil sampling	119 (85)	21 (15)
Quantity of soil sample required for testing	42 (30)	98 (70)
Preparation of soil samples for testing	21 (15)	119 (85)
Information required to fill on soil sample bag	28 (20)	112 (80)
Frequency of soil testing done for same field	39 (28)	101 (72)
Location of soil testing laboratory	126 (90)	14 (10)

Table 3: Distribution of respondents according to their attitude towards soil testing practices in Bathinda district (N=140)

Statements	Response (%)		
	Agree with statements	Disagree with statements	Undecided
Behavioures of soil testing staff is good	97 (69)	33 (24)	10 (7)
Results are given in time stated	94 (67)	25 (18)	21 (15)
Result of soil testing is reliable	66 (47)	63 (45)	11 (8)
Soil testing is essential for better crop production and maintain soil health	115 (82)	17 (12)	08 (6)
Soil testing is very long practices	112 (80)	21 (15)	07 (5)
Soil testing is wastage of time any money	17 (12)	117 (84)	06 (4)
Expenditure on fertilizer decreased for crop production after soil testing	78 (56)	52 (37)	10 (7)
Crop yield increased after soil testing	58 (41)	46 (33)	36 (26)
Insect/pest/desesse infestitation deceased with soil test based fertilizer (urea) application	90 (64)	21(15)	29 (21)

Majority of the respondents 76 and 22 per cent were gaining the knowledge from scientists working under different government organisations under personal contact category. However, under different extension activities lituratures contributes (35%) maximum dissemination of knowledge followed by kishan mela (28%), radio (22%) and kishan gosthi (8%). Furthermore, it was observed that 4 per cent farmers had no knowledge of soil testing.

In the study of present knowledge about soil testing analysis, the study was conducted with the help of some variables which are presented in Table 3. The results indicated that majority of respondents were in agreed with the statements and mostly adaptors possessed favourable attitude towards soil testing practices. It was also observed that majority (82%) of farmers agreed with the statement "testing is essential for better crop production and maintain soil health". However, when the respondents were asked that "result of soil testing is reliable" only 47 per cent adopters agreed with the statement, whereas 45 per cent adopters disagreed with it. Fifty six percent adopters told that expenditure on fertilizer decreased for crop production after soil testing,whereas only 41 per cent adopters aggreed with the statement that "crop yield increased after soil testing. Eighty per cent adopters said that, "soil testing is very long process", however 90 per cent adopters were agreed with the statement that insect/pest and desesses infestitation in crops deceased by urea application based on soil testing. The adopters of the district were also satisfied with behavioures of soil testing staff (69%) and getting soil testing reports (67%) with given time. These findings are consistent with the findings of Pagaria (2011); Pandey *et al.* (2012); Kapur *et al.* (2013); Patel *et al.* (2019) and Solanki *et al.* (2020). Educational awareness and resource laboratory to test soil samples in nearby location found to be the most influential factor in adoption of the technology. Therefore, as per problem faced and suggested by the farmers more scientific and educational trainings and facilities are required to disseminate the technology at large scale. Extension worker can take their lead in this to overcome the barriers in adoption of the technology.

CONCLUSION

The present study indicated that the majority of respondents had good knowledge, however maximum knowledge gap was observed in some scientific facts about soil testing such as quantity of soil sample required, soil samples preparation, information on sample bags and frequency of soil testing for same field. The study also shows positive attitude because most of adaptors (84%) did not agree with the statement that "soil testing is wastage of time and money and it was also observed that majority of farmers agreed (82%) with the statement "soil testing is essential for better crop production and maintain soil health. It was also reported that 64 per cent adopters were agree with the statement that insect/pest and desesse infestitation deceased when urea was applied based on soil test. Educational awareness and resource laboratory to test soil samples in nearby location found to be the most influential factor in adoption of the technology. Therefore, as per problem faced and suggested by the farmers more scientific and educational trainings and facilities are required to disseminate the technology at large.

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Attitude of Farmers Towards Mass Media in Nimar Agro Climatic Region of Madhya Pradesh

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ABSTRACT

Mass media channels are catering to important needs and craving of information for a large section of population including farmers. Mass communication in agriculture is not only to notify and generate awareness among the farmers additionally to execute new ideas that change the method and patterns of farming. Communication media play a vital role in the transfer of agricultural technologies to the farmers by minimizing the gap between technology and its uses. There are several mass media like television, films, slides, radio, literature, documentaries, dramas, exhibitions and tours etc. being used by the farmers to cater their information needs for the farming. Keeping importance of these mass media channels in view, a research study was conducted in Nimar Agro Climatic Region of Madhya Pradesh on Attitude of the farmers towards mass media. The study was carried out on a sample of 240 mass media user farmers. Data were collected through personal interviews of respondents with the help of a structured interview schedule. *The study concludes farmers' strongly favourable attitude towards mass media.* It can be summarized that the variables namely socio-economic status, scientific orientation and contacts with extension agency was found positively significant at 0.01 level of probability, while, education and social participation were found positively significant and age were found negatively significant at 0.05 level of probability *with* attitude towards mass media, whereas, extension participation, cosmopoliteness, innovativeness and mass media exposure were found non-significant relationship *with* attitude towards mass media.

Keywords: Mass media, Personal, Socio-psychological, Communicational characteristics

INTRODUCTION

The process of transmitting meaningful information between individuals is designated as communication. It is only all the ways through the transmission of meaning from one person to another that information and ideas can be communicated. The information has become an important part of our daily life. At present, people want sufficient and genuine information as early as possible. The mass media channels are catering to this important need i.e. craving for information. Communication in agriculture is not only to notify and generate awareness among the farmers additionally to execute new ideas that change the method and patterns of farming. Communication media play a vital role in the transfer of agricultural technologies to the farmers by minimizing the gap between technology and its uses. There are several mass media like television, films, slides, radio, literature, documentaries, dramas, exhibitions and tours etc. being used by the farmers to cater their information needs for the farming. Mass media are essential ingredients needed for effective transfer of technologies that are designed to boost agricultural production (Okwu and Daudu, 2011). Agriculture information delivery is precisely a process of communication of improved skills, practices, innovations, technologies and knowledge to the farmers. Hence, the agricultural extension provides a great pillar to the rural people, particularly farm families through educational procedures in promoting their farming practices techniques, increasing their

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production efficiency and enhancing economy raising their living standard and uplifting the social and educational level of rural life. Keeping importance of these mass media channels in view, a research study was conducted in Nimar Agro Climatic Region of Madhya Pradesh on Attitude of the farmers towards mass media.

MATERIALS AND METHODS

Locale of the study: The study was conducted in district Barwani (Tribal dominated district) and Khargone of Nimar Agro Climatic Region of Madhya Pradesh.

Sampling procedure: The sample of the present study was selected by multistage sampling method. The Nimar Agro Climatic Region consist four districts viz., Barwani, Khargone, Khandwa and Bhurhanpur. Out of the four districts, two districts (Barwani and Khargone) were selected randomly by using simple random sampling method. Out of two selected districts, Three Blocks from each district; giving a total of six Blocks (Barwani, Pati Sendhwa, Khargone, Segaon and Jhirnaiya) was selected using simple random sampling method. From the selected six blocks, two villages from each block (All 12 villages) were selected using simple random sampling method. A total of 20 farmers from each village were randomly selected as respondents for the study. Thus, a total of 240 respondents served as sample for the study. Data were collected through personal interviews of respondents with the help of a structured interview schedule.

RESULTS AND DISCUSSION

Personal, socio-psychological and communicational characteristics of the farmers: The data regarding personal, socio-psychological and communicational characteristics of the farmers has been summarized in Table 1. It is evident from the data more than half of the respondents (51.25%) belong to middle age group, followed by old (30.42%) and only 18.33 per cent young age group. This may be due to the reason that middle to old aged farmers are generally more experienced in farming than young farmers so they try to seek innovative technologies to improve their farming practice which can save time and make their farming easy. They are eager to know new and additional information for exploring their skills

Table 1: Personal, socio-psychological and communicational characteristics of the farmers (n=240)

Category	Frequency	Percentage
Age		
Young (Up to 31 year)	44	18.33
Middle (32 to 50 year)	123	51.25
Old (Above 50 year)	73	30.42
Education		
No schooling (illiterate)	17	07.08
Functionally literate	39	16.26
Primary school	37	15.42
Middle school	46	19.16
High School	54	22.50
College	47	19.58
Socio-economic status		
Lower SES (3-11 Score)	32	13.34
Lower middle SES (12-18 Score)	39	16.25
Middle SES (19-25 Score)	80	33.33
Upper middle SES (26-32 Score)	58	24.16
Upper SES (33-40 Score)	31	12.92
Extension participation		
Low (8-13 Score)	39	16.25
Medium (14-19 Score)	129	53.75
High (20-24 Score)	72	30.00
Social participation		
Low (7-12 Score)	51	21.25
Medium (13-16 Score)	117	48.75
High (17-21 Score)	72	30.00
Cosmopoliteness		
Village-level	46	19.16
Block-level	101	42.08
District-level	57	23.76
State-level	36	15.00
Scientific orientation		
Low (6-14 Score)	54	22.50
Medium (15-22 Score)	116	48.34
High (23-30 Score)	70	29.16
Innovativeness		
Low (7-12 Score)	52	21.66
Medium (13-16 Score)	121	50.42
High (17-21 Score)	67	27.92
Mass media exposure		
Low (6-10 Score)	52	21.66
Medium (11-14 Score)	117	48.76
High (15-18 Score)	71	29.58
Contact with extension agency		
Low (5-8 Score)	53	22.08
Medium (9-12 Score)	117	48.76
High (13-15 Score)	70	29.16

which they already acquired through their vast farming experience. The major findings are in line with Chahal (1992); Kukrety and Singh (1994); Bhagwat *et al.* (2010); Jhajharia (2012) and Chaitra *et al.* (2019).

Maximum (22.50%) of the farmers were educated up to high school level whereas, 19.58 per cent got education up to college level while 19.16 per cent attended school up to middle level. Nearly one out of six respondents was functionally literate and educated up to primary school level while it is notable to know that about 7.08 per cent were respondents were completely illiterate. The findings of the study are similar to the Venkataramaiah and Sethurao (1983); Chahal (1992); Kukrety and Singh (1994) and Bhagwat *et al.* (2010).

One third of the respondents own middle socio economic status whereas, 24.16 per cent falls in upper middle socio economic status category. About one sixth respondents (16.25%) were in lower middle socio economic status while 13.34 per cent were in lower socio economic status and only 12.92 per cent are categorized under upper socio-economic status. The findings of the study are similar to the Venkataramaiah and Sethurao (1983); Kukrety and Singh (1994) and Bhagwat *et al.* (2010).

Majority (53.75%) of the farmers were under medium extension participation, whereas 30 per cent were in high and only 16.25 per cent were in low extension participation category. The probable reason for above situation might be due to the fact a fairly higher number of farmers had high education level and medium contact with extension agency.

Maximum (48.75%) of the farmers had medium level of social participation; whereas, 30 per cent had high and 21.25 per cent had low level of social participation. The possible reason of maximum percentage of the farmers with medium and level of social participation might be that they recognized the importance of social organization as an important source of sharing useful information or inputs for farming. This finding finds support with the work of Chahal (1992); Sodhi and Sangha (1992); Singh (2002) and Bhagwat *et al.* (2010).

More than forty per cent (42.08%) of the farmers were under block level of cosmopolitans whereas, 23.76 per cent have reach up to district level while about one fifth of them have exposure of village level only. It is notable that about one out of seven respondents had exposure of state level in terms of cosmopoliteness. The reason may be due to as most of the farmers belongs to villages near to urban area they might be visiting nearby towns for various reasons like entertainment, religious satisfaction, gaining information and purchase of inputs etc., due to above reason farmers had block to district level cosmopoliteness. These findings are supported with the work of Chahal (1992); Bhagwat *et al.* (2010) and Chaitra *et al.* (2019).

Nearly half of the respondents (48.34%) had medium scientific orientation, while 29.16 per cent had high and 22.50 per cent halls in low scientific orientation category. The probable reason for above situation might be due to the fact that farmers with medium to high level of positivism towards the use of new and scientifically approved high production oriented technologies were more involved in the management and adoption of mass media utilization behaviour. The mass media utilization behaviour is such an exercise, where person needs to adopt modern methods of cultivation, it is natural that farmers with medium to highly favourable mentality towards scientific methods only will try to get involved more in it. This finding finds support with the work of Supe and Singh (1969).

A little more than half of the respondents (50.42%) had medium level of innovativeness, while 27.92 per cent had high and 21.66 per cent had low level of innovativeness. The reason for medium to high level of innovativeness of the farmers was that most of them had exposure on various media and had good contact in the society with various institutions. It is obvious that the individual who had more exposure in different dimensions in his life then his ideology, his innovativeness and skill components are comparatively better. Due to all these characters the farmers of study area have medium to high level of innovativeness. This finding finds support with the work of Chaitra *et al.* (2019).

It is shown in the table that maximum (48.76%) of the farmers had a medium extent of mass media exposure followed by high 29.58 per cent and low

21.66 per cent extent of mass media exposure. It might be because the penetration of internet, smart phone and DTH is relatively in initial stage in rural areas. They also used internet regularly because now-a-days internet became part of each and every common man's life. The awareness about the significance of agricultural mass media in increasing useful agricultural information among maximum percentage of the mass media users as well as positive impact demonstrated by media through eye catching ways of presentation of messages. These findings finds support with the work of Singh *et al.* (1998); Manwar (2005); Dhayarkar (2007) and Bhagwat *et al.* (2010).

A little less than half of the farmers (48.76%) expressed a medium level of contacts with extension agency followed by high 29.16 per cent and 22.08 per cent low level of contact with extension agency. The reason for medium contacts with extension agency might be that the farmers were dependent to obtain right information about availability of inputs and other relevant agriculture information so they need support from department personnel for aforesaid benefits. These findings find support with the work of Chahal (1992) and Chaitra *et al.* (2019).

Attitude towards mass media: The data given in Table 2 shows that about 51.25 per cent of the farmers had strongly favourable attitude towards mass media followed by 38.75 per cent farmers who had favourable attitude. It is notable that only 2.08 per cent farmers had unfavourable attitude and only 0.84 per cent of the farmers had strongly unfavourable overall attitude towards mass media while 7.08 per cent farmers who were having neutral attitude towards mass media.

Table 2: Distribution of the respondents as per overall attitude towards mass media (n=240)

Category	Freq-uency	Percen-ntage
Strongly unfavourable (40-72 Score)	02	00.84
Unfavourable (73-104 Score)	05	02.08
Neutral (105-136 Score)	17	07.08
Favourable (137-168 Score)	93	38.75
Strongly favourable (169-200 Score)	123	51.25

To epitomize the results, it can be stated that an overwhelming number of respondents (90%) had strongly favourable to favourable overall attitude towards mass media. The experience of tremendous benefits of mass media in farming in terms of quality production, productivity, saving of resources and ready reference for future use might have played a major role in building strongly favourable to favourable overall attitude towards mass media.

The values of correlation coefficient of personal, socio-psychological and communicational *characteristics of the farmers with their* attitude towards mass media are furnished in Table 3. It can be observed that correlation coefficients in respect of socio-economic status (0.229), scientific orientation (0.174) and contacts with extension agency (0.225) was found positively significant at 0.01 level of probability, while, education (0.164) and social participation (0.130) were found positively significant and age (-0.131) were found negatively significant at 0.05 level of probability with their attitude towards mass media, whereas, extension participation (0.121), cosmopoliteness (0.023), innovativeness (0.111) and mass media exposure (0.082) were found non-significant relationship.

Table 3: Relationship between personal, socio-psychological and communicational characteristics of the farmers and their attitude towards mass media (n=240)

Characteristics	Correlation coefficient
Personal variables	
Age (X_1)	-0.131*
Education (X_2)	0.164*
Socio-economic status (X_3)	0.229**
Extension participation (X_4)	0.121^{NS}
Socio–psychological variables	
Social participation (X_5)	0.130*
Cosmopoliteness (X_6)	0.023^{NS}
Scientific orientation (X_7)	0.174**
Innovativeness (X_8)	0.111^{NS}
Communicational variables	
Mass media exposure (X_9)	0.082^{NS}
Contact with extension agency (X_{10})	0.225**

^{NS} Non-significant, **Significant at 1% level of probability, *Significant at 5% level of probability

CONCLUSION

The study concludes farmers' strongly favourable to favourable attitude towards mass media is a positive sign for use of more Information Communication Technologies (ICTs) in the farming ventures. It can be summarized that the variables viz., age, education, socio-economic status, social participation, scientific orientation and contacts with extension agency were found significant with their attitude towards mass media. The result also depict that the characteristics viz., extension participation, cosmopoliteness, innovativeness and mass media exposure were found non-significant relationship with their attitude towards mass media.

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Micronutrient Status of Guava (*Psidium guajava* L.) Orchards in the Semi-arid Region of Haryana

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ABSTRACT

Twelve representative guava orchards were selected from five blocks of Rewari district namely Bawal, Rewari, Jatusana, Khol and Nahar and composite soil samples of orchard and nearby non-orchard lands were collected from 0-15, 15-30 and 30-60 cm depth. The water and composite leaf sample was also taken from each orchard. At 0-15 cm depth, average iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn) content in orchard soils was 11.49, 1.68, 0.92 and 9.98 mg kg^{-1}, while in non-orchard soils it was 11.47, 1.70, 0.94 and 10.01 mg kg^{-1}, respectively. At subsurface depth (15-30 cm) average Fe, Zn, Cu and Mn content were10.31, 1.56, 0.87 and 7.25 mg kg^{-1} in orchard soils, while at the same depth average Fe, Zn, Cu and Mn content in non-orchard soils was 10.51, 1.58, 0.88 and 7.27 mg kg^{-1}, respectively. Orchard soils had average Fe, Zn, Cu and Mn content 6.69, 1.03 0.39 and 4.79 mg kg^{-1}, while non-orchard soils had 6.66, 0.96, 0.41 and 4.82 mg kg^{-1}, respectively at lowermost depth (30-60 cm). Available iron, zinc, copper and manganese content showed a decreasing trend with the increasing depth. Most (75%) soil samples of orchard and non-orchard soils were sufficient in DTPA extractable iron content. In both orchard and non-orchard soils, the majority of the soils were sufficient in available copper and manganese, while low to medium in available zinc. Average leaf iron, zinc, copper and manganese content was 99.45, 10.63, 8.21 and 10.33 ppm. In leaf samples, iron content was medium to high while, copper and manganese were in sufficient range. Zinc content was low in all leaf samples.EC of water samples varied from normal to saline, pH was alkaline, SAR was low to high and RSC varied from safe limit to high. Hence, the application of micronutrients may play a key role in enhancing the production of guava orchards.

Keywords: Micronutrients, Guava, Soil samples, Leaf samples, Water samples

INTRODUCTION

Guava (*Psidium guajava* L.) is a popular fruit of the tropic and grown successfully throughout tropical and subtropical regions of India. In the world, India is the third-largest producer of fruits with an annual production of 18.8 million tonnes against the world's 46.5 million tonnes and which accounts for 40.4 per cent of the total global share (Anonymous, 2018). Haryana hasa 12,090 ha area and 1,37,020 MT production of guava (Anonymous, 2018a). In Haryana, it is grown in nearly all districts and the popular cultivars are Hisar Safeda, Hisar Surkha, Allahabad Safeda and Lucknow-49. It is one of the popular, cheapest and a good source of ascorbic acid (Osman and Abd El-Rahman, 2009). The excess or deficiency of an essential element may cause hindrance in plant metabolism ultimately leading to abnormal performance (Ganai *et al.,* 2020). In this contemporary era, soil health has received attention due to the non-availability of plant nutrients ultimately affecting various physical and chemical characteristics of the soil (Deshmukh *et al.,* 2020). Micronutrient deficiencies in fruticulture crops are common globally. Micronutrients content in the active root zone (0-60 cm) are as important as macronutrients for better plant growth and fruit quality

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(Bhatnagar and Sharma, 2018). Thus, analysis of soil and leaf samples for micronutrient composition is a better tool to assess the fertilizer requirements (Bould *et al.,* 1964). Various researchers developed soil and leaf nutrient concentrations standards to estimate the nutrient status of orchards as reported by Chavan and Patil (1980). In Haryana, there is a prevalent practise of leasing the guava orchards, who don't have ample knowledge of orchards management. The orchardist or their contributors do not supply adequate quantities of required fertilizers/nutrients, as a result, constant mining of soil takes place ultimately leading to soil exhaustion and ultimately their deficiency in plants. Micronutrients are needed in trace amounts, hence their requirement is partly met from the soil, through chemical fertilizer or organic sources. In soil, the total micronutrient quantity may be adequate but usually, micronutrient translocation, as well as uptake, doesn't match with the growth and development characteristics of the crop due to the unavailability and deficiency which is affected by the combination of various factors (Shah *et al.*, 2012). Analysis of various plant parts has been also reported as a direct method and reliable diagnostic tool for assessing the micronutrient status of fruit crops (Ibrahim *et al.*, 2004). The information on the micronutrient status of guava orchards serve as a guide for economic guava production and reclaiming micronutrient deficiencies with fertilizers. Therefore, the present investigation was undertaken to evaluate the micronutrient status of soil and guava leaves from the orchards of Rewari district to correct their deficiencies.

MATERIALS AND METHODS

Twelve guava orchards were selected for survey work from five blocks of Rewari district which lies between 27.95^{o} N to 28.47^{o} N latitude and 76.28^{o} E to 76.85^{o} E longitude in south-west Haryana. The climate of the Rewari is semi-arid which is characterized by hot and dry summer, cold winter and humid-warm monsoon season. The mean minimum and maximum temperature vary from 6-41° C during winter (January) and summer (May-June), respectively. In the Rewari district, the rainy season is monsoon which extends from July to September contributing about 80-85 per cent of the annual rainfall. A little rain may be experienced during winter also. The average annual rainfall in the Rewari district is 569.6 mm.

In Haryana, guava cultivation is acclimatized in southern parts having light-textured sand to loamy sand with poor fertility, high pH, trace $CaCO_3$ and low organic carbon content. In order to analyze the chemical properties of experimental soil, 108 soil samples were collected from 12 guava orchards as well as 108 soil samples from non-orchard soils adjoining in the vicinity of selected orchards Guava orchards having at least 3-acre area were selected for the nutritional survey and soil sampling from each acre from 3 depths (0-15, 15-30, 30-60 cm) on these randomly selected sites was done in August 2019. The collected soil samples were air-dried in shade and then grind with a wooden pestle and mortar. The ground soil samples were passed through a 2 mm sieve to isolate the coarse fraction (>2 mm). A composite sample of leaves was collected from each orchard. Lindsay and Norvell (1978) proposed a method for the determination of available micronutrients (Fe, Cu, Mn and Zn) in soil using Diethylene Triamine Penta Acetic Acid (0.005 DTPA+0.1 M Triethanolamine and 0.01M $CaCl_2$ solution buffer) on atomic absorption spectrophotometer. In leaves, the micronutrient cations (Fe, Cu, Mn and Zn) were analyzed taking 0.5 g of dried plant sample digested with 10 ml of diacid mixture (1 perchloric + 4 nitric acid) on a hotplate till the residual solution became colourless. Digestate final volume was made 50 ml and the content of micronutrient was recorded on AAS.The water samples were also collected from running tube wells if the main source of irrigation was underground water. If another source of irrigation like a canal or pond was used then water samples were taken from them, respectively during August 2019 and their locations were recorded using handheld GPS.

The water samples were analyzed for pH, EC, soluble cations (Ca^{2+}, Mg^{2+} and Na^{+}) and anions (CO_3^{2-}, HCO_3^{-}) by their standard methods according to USDA handbook No.60.Conductivity meter having a predetermined cell constant was used for determination of EC. It was expressed in dS m^{-1}. The pH of water samples was measured by potentiometric method using glass electrode. Calcium was estimated in water samples by titrating known volume of solution with standard 0.01N EDTA at pH 12 by using 4N NaOH. Ammonium purpurate used as an indicator. The color changed from orange red to purple at the completion of the reaction. Magnesium was estimated in water samples by titrating a known volume of solution with standard 0.01N EDTA using Erichrome Black T (EBT) indicator. Ammonium chloride and ammonium hydroxide (NH_4Cl+NH_4OH) buffer were used. The color changed from wine red to blue at end point. Versanate method of (Richard, 1954) was followed for the determination of Calcium and Magnesium. Sodium in water samples were determined flame photometrically by using standard curves. Carbonates and bicarbonates were estimated by titrating known volumes of water with standard sulphuric acid (H_2SO_4) using two indicators (phenolphthalein and methyl red indicator). The color disappearance by phenolphthalein showed that the carbonates converted into bicarbonates. Yellow colour produced by addition of methyl red and the color changed from yellow to rose red at the end point (Richard, 1954).

RESULTS AND DISCUSSION

The data in Table 1 revealed that the iron content of surface (0-15 cm) orchard soils varied statistically from 8.14-14.84 mg kg^{-1}, zinc from 0.91–2.45 mg kg^{-1}, copper from 0.58–1.27 mg kg^{-1} and manganese from 6.05–13.92 mg kg^{-1} with a mean value of 11.49, 1.68, 0.92 and 9.98 mg kg^{-1} while in case of surface (0-15) non orchard soils iron varied statistically from 8.16-14.79 mg kg^{-1}, zinc from 0.92–2.47 mg kg^{-1}, copper from 0.58–1.29 mg kg^{-1} and manganese from 6.08–13.94 mg kg^{-1} with a mean value of 11.47, 1.70, 0.94 and 10.01 mg kg^{-1} respectively. The minimum and maximum value of Fe, Zn, Cu and Mn at 0-15 cm depth of both orchard and non-orchard soils were recorded in Suthana soils (S_2) and Ghaseda soils (S_8), Balwari soils (S_{12}) and Mumtajpur soils (S_{10}), Bhoatwas Ahir soils (S_{11}) and Jakhala soils (S_9), Suthana soils (S_2) and Jakhala soils (S_9), respectively. Guava orchards, 25 per cent soil surface (0-15) samples were found deficient in iron while remaining were adequate with 1.75 nutrient index value. Forty-one per cent of surface soil samples were deficient, eight per cent were adequate and fifty-one percent were in the high range for zinc with a 2.08 nutrient index value. Copper (83%) and manganese (92%) guava orchards surface (0-15) soil samples were adequate with nutrient index values 1.83 and 1.91, respectively (Table 5). At subsurface depth (15-30 cm) minimum iron content in orchard soils was 4.05 mg kg^{-1} while the maximum was 18.28 mg kg^{-1},

Table 1: DTPA extractable micronutrient status in Rewari soils as influenced by the depth of sampling

Depths (cm): 0-15

Sample No.	Fe (mg kg⁻¹) Orchard	Fe (mg kg⁻¹) Non orchard	Zn (mg kg⁻¹) Orchard	Zn (mg kg⁻¹) Non orchard	Cu (mg kg⁻¹) Orchard	Cu (mg kg⁻¹) Non orchard	Mn(mg kg⁻¹) Orchard	Mn(mg kg⁻¹) Non orchard
S1	11.91	11.95	0.59	0.57	1.63	1.72	18.06	18.09
S2	4.13	4.01	1.24	1.26	0.19	0.19	2.49	2.48
S3	12.64	12.72	0.55	0.56	1.35	1.31	16.13	16.16
S4	10.37	10.93	1.43	1.39	0.29	0.25	3.05	3.08
S5	11.92	12.05	0.57	0.57	0.77	0.79	4.18	4.21
S6	4.38	4.49	0.59	0.64	0.65	0.67	6.25	6.35
S7	17.19	17.30	3.09	3.12	1.13	1.17	15.2	15.23
S8	19.03	19.36	3.24	3.29	1.28	1.28	5.97	5.99
S9	16.91	15.18	2.31	2.34	1.79	1.80	19.11	19.13
S10	16.22	16.54	3.82	3.85	0.74	0.77	9.14	9.15
S11	4.43	4.47	2.25	2.26	0.19	0.19	5.73	5.76
S12	8.85	8.75	0.53	0.55	1.11	1.14	14.56	14.57
Mean	11.49	11.47	1.68	1.70	0.92	0.94	9.98	10.01
CI (95%)	8.14-14.84	8.16-14.79	0.91-2.45	0.92-2.47	0.58-1.27	0.58-1.29	6.05-13.92	6.08-13.94
CV (%)	45.87	45.44	72.20	71.99	59.04	59.30	62.00	61.80

Depths (cm): 15-30

Sample No.	Fe (mg kg⁻¹) Orchard	Fe (mg kg⁻¹) Non orchard	Zn (mg kg⁻¹) Orchard	Zn (mg kg⁻¹) Non orchard	Cu (mg kg⁻¹) Orchard	Cu (mg kg⁻¹) Non orchard	Mn(mg kg⁻¹) Orchard	Mn(mg kg⁻¹) Non orchard
S1	10.98	11.20	0.54	0.55	1.56	1.59	12.19	12.08
S2	4.05	3.95	1.13	1.13	0.18	0.17	2.44	2.45
S3	11.35	11.45	0.50	0.52	1.27	1.27	11.07	11.11
S4	9.47	9.72	1.18	1.21	0.27	0.23	2.98	2.99
S5	11.05	11.27	0.52	0.51	0.73	0.75	3.85	3.94
S6	4.14	4.38	0.53	0.57	0.60	0.61	6.20	6.26
S7	14.91	15.05	2.85	2.87	1.06	1.08	8.16	7.17
S8	18.28	18.71	3.10	3.14	1.21	1.23	5.86	5.88
S9	13.02	13.57	2.29	2.31	1.71	1.74	13.05	13.11
S10	15.15	15.33	3.47	3.47	0.64	0.65	9.08	9.11
S11	4.29	4.36	2.17	2.16	0.18	0.19	5.65	5.69
S12	7.06	7.19	0.51	0.52	1.08	1.10	6.52	7.55
Mean	10.31	10.51	1.56	1.58	0.87	0.88	7.25	7.27
CI (95%)	7.33-13.29	7.47-13.55	0.84-2.29	0.85-2.30	0.54-1.20	0.54-1.22	5.02-9.48	5.06-9.49
CV (%)	45.52	45.58	73.15	72.29	59.97	60.82	48.47	47.92

Depths (cm): 30-60

Sample No.	Fe (mg kg⁻¹) Orchard	Fe (mg kg⁻¹) Non orchard	Zn (mg kg⁻¹) Orchard	Zn (mg kg⁻¹) Non orchard	Cu (mg kg⁻¹) Orchard	Cu (mg kg⁻¹) Non orchard	Mn(mg kg⁻¹) Orchard	Mn(mg kg⁻¹) Non orchard
S1	6.39	6.01	0.41	0.43	0.74	0.77	7.95	8.87
S2	4.02	3.92	1.01	0.92	0.16	0.16	2.01	2.04
S3	6.89	6.93	0.48	0.48	0.55	0.54	7.86	7.03
S4	5.93	6.01	1.06	1.07	0.18	0.19	2.13	2.17
S5	4.86	4.18	0.36	0.37	0.27	0.21	2.08	2.06
S6	3.51	3.42	0.39	0.42	0.26	0.27	3.13	3.16
S7	9.64	10.25	1.74	1.75	0.42	0.44	6.07	6.05
S8	12.38	11.84	1.98	1.01	0.50	0.56	5.80	5.82
S9	7.33	7.89	1.16	1.18	0.88	0.92	8.94	9.04
S10	10.26	10.03	2.38	2.41	0.23	0.25	6.93	6.97
S11	3.97	3.94	1.14	1.13	0.15	0.16	2.22	2.26
S12	5.11	5.52	0.32	0.39	0.43	0.45	2.45	2.43
Mean	6.69	6.66	1.03	0.96	0.39	0.41	4.79	4.82
CI (95%)	4.92-8.46	4.88-8.44	0.59-1.47	0.56-1.36	0.24-0.54	0.25-0.56	3.07-6.52	3.07-6.57
CV (%)	41.65	42.07	67.44	65.09	60.56	61.09	56.60	57.20

minimum zinc content was 0.50 mg kg^{-1} while the maximum was 3.47 mg kg^{-1}, minimum copper content was 0.18 mg kg^{-1} while the maximum was 1.71 mg kg^{-1} and minimum manganese content was 2.44 mg kg^{-1} while the maximum was 13.05 mg kg^{-1}. In the case of non-orchard subsurface soils (15-30 cm), minimum iron content was 3.95 mg kg^{-1} while the maximum was 18.71 mg kg^{-1}, minimum zinc content was 0.51 mg kg^{-1} while the maximum was 3.47 mg kg^{-1}, minimum copper content was 0.17 mg kg^{-1} while the maximum was 1.74 mg kg^{-1}, minimum manganese content was 2.45 mg kg^{-1} while the maximum was 13.11 mg kg^{-1}. At lowermost depth (30-60 cm) Fe, Zn, Cu and Mn in orchard soils varied statistically from 4.92 to 8.46 mg kg^{-1}, 0.59 to 1.47 mg kg^{-1}, 0.24 to 0.54 mg kg^{-1} and 3.07 to 6.52 mg kg^{-1} while in non-orchard soils Fe, Zn, Cu and Mn varied statistically between 4.88-8.44 mg kg^{-1}, 0.56-1.36 mg kg^{-1}, 0.25-0.56 mg kg^{-1} and 3.07-6.57 mg kg^{-1}, respectively. At this depth average Fe, Zn, Cu and Mn content were 6.69, 1.03, 0.39 and 4.79 mg kg^{-1} in orchard soils while 6.66, 0.96, 0.41 and 4.82 mg kg^{-1} in non-orchard soils, respectively. The smallest and largest value of iron, zinc, copper and manganese at 30-60 cm depth of both orchard and non-orchard soils were recorded in Laduwas soils (S_6) and Ghaseda soils (S_{8}), Balwari soils (S_{12}) and Mumtajpur soils (S_{10}), Bhoatwas Ahir soils (S_{11}) and Jakhala soils (S_9), Suthana soils (S_2) and Jakhala soils (S_9), respectively.

Iron content was observed varying from sufficient to deficient in surface and sub-surface soil samples, which might be due to low organic carbon content and light-textured soils. Surface soil samples were found in deficient to medium range with respect to available zinc, due to the presence of more $CaCO_3$, on a result zinc precipitate in $ZnCO_3$ or $Zn(OH)_2$ (Singh and Singh, 1981), in light-textured soil having low organic carbon and high pH. The medium range of zinc in soils might be due to the presence of quartz, feldspar or the exchange complex might have sites saturated with calcium/magnesium under high soil pH. Similar findings were observed by Nayak *et al.* (2000); Kumawat (2005) and Shukla *et al.* (2015). The adequate availability of copper may be due to low organic matter in soils because high organic matter binds to copper and make it unavailable. Manganese was found adequate in surface soils. All micronutrients showed a decreasing trend with depth. Similar findings were observed by Gathala *et al.* (2004); Kumar (2007) and Shukla *et al.* (2015). DTPA extractable iron had a positive and significant correlation with zinc and copper whereas it had non-significant relation with manganese (Table 2). The result presented in Figure 1 exhibited that the iron content of guava leaves varied statistically from 83.52-115.39 ppm with a mean value of 99.45 ppm. Fe content of leaf samples was found in sufficient range. Similar results have been reported by Gathala *et al.* (2004); Kumar (2007); Sharma and Kumawat (2019). It was observed that 66 per cent of guava orchards were adequate and 34 per cent were high in leaf iron content, which may be due to its sufficient range in

Table 2: Correlation matrix between various soil micronutrients

	Fe	Zn	Cu	Mn
Fe	1	0.648*	0.583*	0.473NS
Zn		1	-0.012NS	0.078NS
Cu			1	0.885**
Mn				1

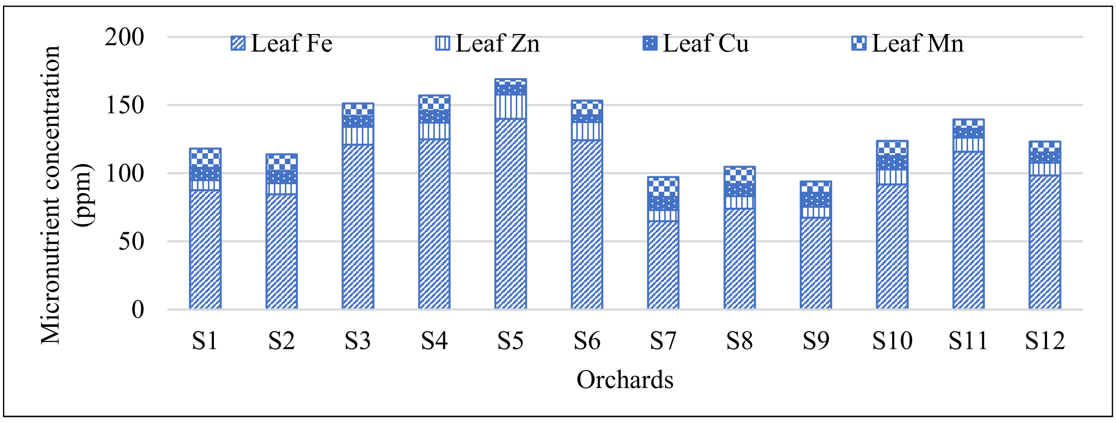

Figure 1: Leaf micronutrient content of guava orchards

soil. These findings are in accordance with the observations of Kumar (2007); Sharma and Kumawat (2019). The minimum zinc content in leaves was 7.20 ppm while the maximum was 17.71 ppm. The mean value of zinc was 10.63 mg kg^{-1}. Data showed that all the samples under study were found low in zinc content. The low zinc content in the guava leaf samples may be attributed to the zinc-phosphorus interaction in soils. The soils were moderate in phosphorus availability which ultimately renders the zinc availability. These findings have conformity with the results of Dahiya *et al.* (1987); Sharma (2002); Sharma and Kumawat (2019). The zinc content of guava leaves was found to have a negative and significant correlation with manganese and copper while it showed a significant and positive correlation with iron (Table 3). This is supported by the findings of Sharma (2002) and Kumar (2007). Foliar copper and manganese content varied statistically from 7.20 to 9.21 ppm and 8.45 to 12.22 ppm with a mean value of 8.21 and 10.33 ppm respectively. Most of the leaf samples (83%) were sufficient in copper content which may be adequate availability of copper in Rewari district soils and low organic matter. Manganese content of mostly leaf samples (92%) was in the adequate range. The possible reason may be the sufficient availability of manganese in Rewari soils and the low mobility of manganese due to which it accumulated in leaves with time.

Data (Table 4) indicates that the pH of water samples collected from selected orchards in the Rewari district varied statistically from 8.10-8.42 with an average of 8.26. The minimum (7.87) and maximum (8.61) values of pH were reported in water samples of Mumtajpur (S_{10}) and Balwari (S_{12}), respectively. The reason for alkaline pH may be the presence of bicarbonates in water samples as these ions are hydroxyl generating ions. Singh *et al.* (2011) and Deshmukh (2012) have also reported similar results. Electrical conductivity of guava orchards water samples varied

Table 3: Correlation matrix between different leaf micronutrients

	Fe	Zn	Cu	Mn
Fe	1	0.866^{**}	-0.786^{**}	-0.573^{NS}
Zn		1	-0.660^{*}	-0.609^{*}
Cu			1	0.483^{NS}
Mn				1

statistically from 2.13 to 4.00 dS m^{-1} with a mean value of 3.07 dS m^{-1}. The minimum value of SAR was 3.95 (mmol l^{-1})$^{1/2}$ in Suthana (S_2), whereas the maximum value of SAR was 13.66 (mmol l^{-1})$^{1/2}$ in Kharkhara (S_4). The mean value of SAR was 7.04 (mmol l^{-1})$^{1/2}$. The sodium ion was the dominant ion in water samples of the Rewari district. Carbonates and bicarbonates intensify sodium hazards, as they combine with sodium and remove exchangeable calcium and magnesium from the soil solution. The results of the investigation are in close proximity with the findings of Suresh and Kottureshwara (2009) and Singh *et al.* (2011). RSC of water samples collected from selected orchards in Rewari district varied from 0-3.92 meq l^{-1} with an average of 1.80 meq l^{-1}. The RSC of water samples increased with an increase in bicarbonates and carbonates concentration as compared to calcium and magnesium concentration. Singh *et al.* (2011) also reported the same results. The PI value of water samples varied from 54.88 to 88.7 per cent with an average value of 70.24 per cent. In the study samples, total hardness (TH) of irrigation water samples ranged from 14.04 to 96.21 ppm with a mean value of 44.96 ppm. This means 75 per cent samples belong to soft category. Kelley's ratio (KR) reveals a balance between Na^+, Ca^{2+} and Mg^{2+} ions in water samples. When KR ratio is more than 1, it indicates the surplus level of Na^+ presence in water samples. Kelley (1963) recommended that the irrigation water KR should not exceed 1. However, only about 8.33 per cent samples (S_{11}–Bhoatwas Ahir village) indicated excellent irrigation water quality and remaining were having excess level of sodium in water MAR (Ragunath, 1987) causes the detrimental effect to the soil when its value exceeds 50 (Gupta and Gupta, 1987). MAR ranged from 54.22 to 84.09 with an average value of 73.14, depicting 100 per cent harmful effect to the soil for irrigation.

The data in Figure 2 represents that the bicarbonate of irrigation water showed a positive and significant coefficient of determination with electrical conductivity (R^2=0.34) followed by pH (R^2=0.32). All the cations (sodium, calcium and magnesium) showed a positive coefficient of determination with EC of water. However, RSC (R^2=0.20) was found to have a more strong & positive coefficient of determination than SAR (R^2=0.002) with the electrical conductivity of irrigation water.

Table 4: Variation in water characteristics under different orchards

Sample	Water sample														Category	
No.	EC (dS m^{-1})	pH	CO_3^{2-}	HCO_3^-	Ca^{2+}	Mg^{2+}	Na^+	TH (ppm)	Na (%)	SAR (mmol l^{-1})$^{1/2}$	RSC (me l^{-1})	MAR	KR	PI	AICRP	Manc-handa
S_1	0.71	7.89	NIL	2.45	2.95	3.83	12.56	23.10	64.94	6.82	NIL	56.48	1.85	73.03	A	A
S_2	4.45	8.43	NIL	7.71	0.95	2.84	5.24	14.04	58.03	3.95	3.92	74.93	1.38	88.77	C1	0
S_3	4.19	7.97	NIL	1.78	1.93	5.47	9.05	27.30	55.02	4.94	NIL	73.91	1.22	63.12	B2	C1
S_4	4.01	8.35	NIL	4.25	6.27	19.6	49.06	96.21	65.47	13.66	NIL	75.76	1.89	68.22	B3	C3
S_5	2.11	8.15	NIL	3.18	4.35	11.49	19.76	58.08	55.51	7.03	NIL	72.53	1.24	60.51	B2	C1
S_6	4.89	8.31	NIL	6.51	0.85	3.43	6.14	16.21	58.93	4.20	2.23	80.14	1.43	83.41	B1	B
S_7	3.05	8.48	NIL	6.12	2.6	3.08	12.49	19.15	68.74	7.43	0.44	54.22	2.19	82.35	B1	B
S_8	2.14	8.23	NIL	4.75	5.86	14.95	21.37	76.07	50.66	6.63	NIL	71.84	1.02	55.83	B2	C1
S_9	2.26	8.54	NIL	6.54	1.08	4.85	13.84	22.63	70.01	8.04	0.61	81.78	2.33	82.94	B1	B
S_{10}	0.65	7.87	NIL	2.11	2.43	7.88	13.99	38.45	57.57	6.16	NIL	76.43	1.35	63.54	B1	B
S_{11}	4.32	8.37	NIL	6.75	4.07	12.64	14.57	62.11	46.58	5.04	NIL	75.64	0.87	54.88	B2	C1
S_{12}	4.07	8.61	NIL	8.2	3.56	18.82	35.62	86.23	61.41	10.66	NIL	84.09	1.59	66.35	B3	C3
Mean	3.07	8.26	NIL	5.02	3.07	9.07	17.82	44.96	59.40	7.04	1.8	73.14	1.53	70.24		

Table 5: Nutritional status of soils under guava cultivation in Rewari district of Haryana

	At 0-15 cm depth				At 15-30 cm depth				At 30-60 cm depth			
Micronutrient	Deficient (%)	Adequate (%)	High (%)	Index value	Deficient (%)	Adequate (%)	High (%)	Index value	Deficient (%)	Adequate (%)	High (%)	Index value
Fe	25	75	-	1.75	25	75	-	1.75	25	75	-	1.75
Zn	41	8	51	2.08	41	8	51	2.08	41	33	26	1.83
Cu	17	83	-	1.83	17	83	-	1.83	25	75	-	1.75
Mn	8	92	-	1.91	8	92	-	1.91	41	59	-	1.58

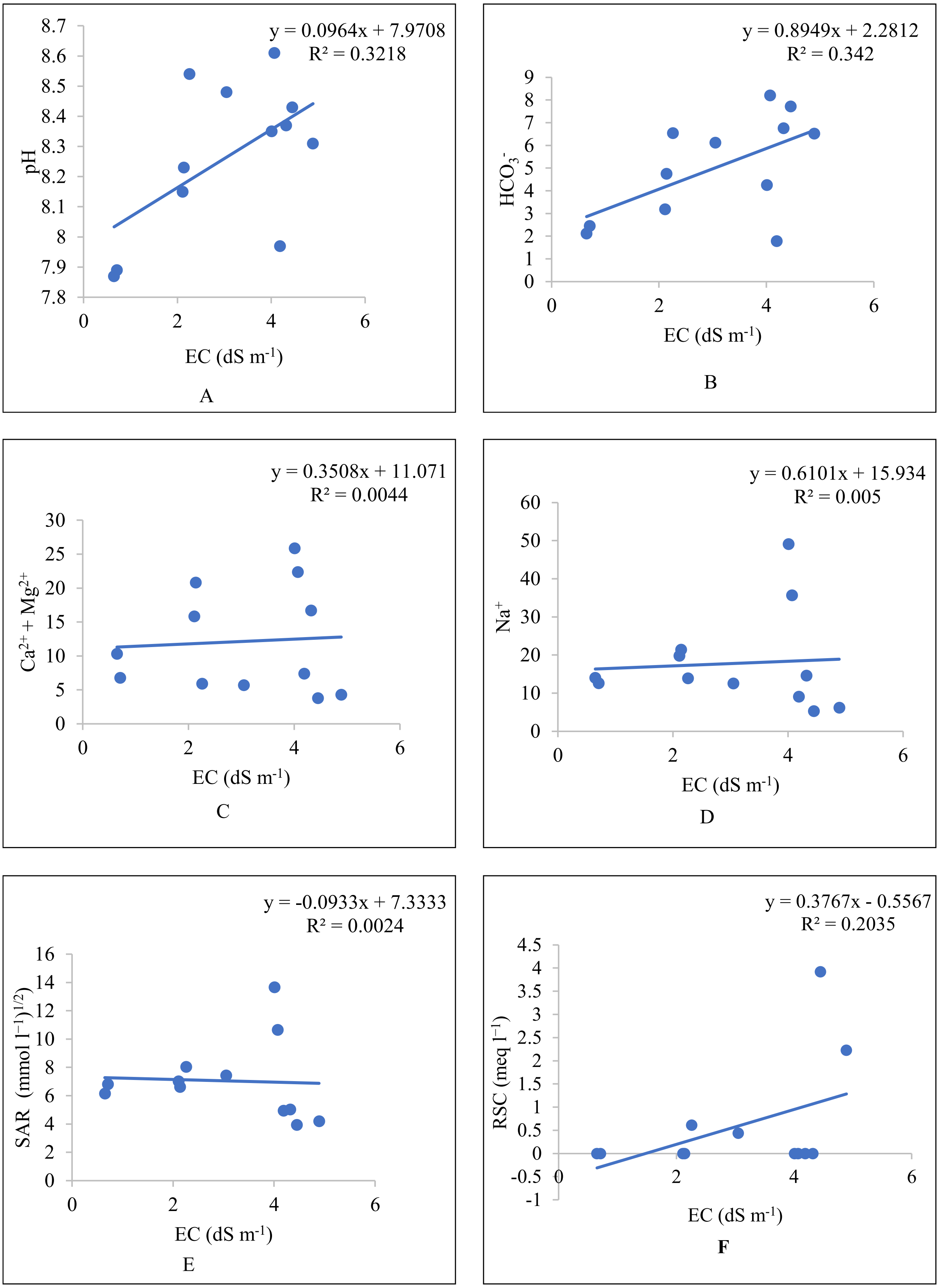

Figure 2: Relationship of irrigation water EC with pH (A), HCO_3^- (B), $Ca^{2+} + Mg^{2+}$ (C), Na^+ (D), SAR (E) and RSC (F)

CONCLUSION

The availability of micronutrients in guava orchards and non-orchard soils was revealed from their relationship study. All micronutrients were sufficient in the majority of soil samples except zinc and iron which were deficient to sufficient. Leaf samples of guava were deficient in zinc. The copper, manganese and iron content in leaves samples were in the optimum range. Guava orchards DTPA extractable iron was found positively and significantly correlated with zinc and copper whereas it had non-significant relation with manganese.The zinc content of guava orchards leaf samples was significantly and positively correlated with iron while negatively correlated with copper and zinc. Based on water quality criteria given by AICRP (1989) irrigation water samples of the studied area are grouped into five classes namely marginally saline (33%), saline (33%), high SAR saline (18%), marginally alkaline (8%) and good (8%), respectively. Hence it is concluded that micronutrients recommendation should be made for these orchards especially for zinc and good quality water should be used for irrigation purpose, if less availability of good quality water then the mixed application of good and poor quality water should be followed.

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Adoption of the Recommended Package of Practices by the Almond Growers of Pampore Area of Kashmir Valley

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ABSTRACT

The present study was conducted in the Pampore block of the Kashmir valley. The area is specifically known for production of world's most precious spice viz. Saffron. Owing to its Karewa lands, the area is known to produce top quality almonds both bitter and sweet ones. The study was undertaken in this area to get the first-hand information regarding the production technology adopted by the almond growers of the different villages falling in Pampore area in order to enable the policy makers to develop strategies for the transfer for technology wherever there exists any such scope for the same. The study was carried out in five randomly selected villages of horticulture block Pampore of district Pulwama of J&K state. A sample of 120 almond growers was taken for collecting the primary data with the help of a well-structured interview schedule. The study reveals that majority of the respondents were literate with middle age (16-30 years) having family size of 6-10 members, possessing a land holding of above 2 hectares. Majority of the respondents were dependent on agriculture for their livelihood with farming experience of 16-30 years, annual income upto Rs 2 lakhs, medium sources of information and scientific orientation and majority of the respondents had medium extension contacts. Majority of the respondents (46.67%) had medium level adoption regarding the recommended package of practices.

Keywords: Karewa lands, Almond growers, Interview schedule, Income, Scientific orientation, Adoption

INTRODUCTION

Almonds (*Prunus amygdalus*) are native to Mediterranean region and considered as one of the oldest tree nut in the world, it is closely related to peach and have probably evolved from the same ancestral species in South-Central Asia. From there it spread along the shores of the Mediterranean in Northern Africa and Southern Europe by Egyptians, Greeks and Romans. It was bought to California in the 17th century by Spanish where the industry progressed and production increased several folds due to cultivation of superior varieties accompanied by prudent scientific production and protection technologies making California, the world leader in almond production. In India it was first introduced to Kashmir during 16th century by Persian settlers but in spite of its great potential in the region, the crop could not be developed on commercial scale as that of apple. Almond (*Prunus amygdalus*) belongs to family Rosaceae a drupe, consisting of an outer hull and a hard shell with the seed, which is not a true nut. There are two main types of almonds. One variety (*Prunus amygdalus var. dulcis*) produces sweet almonds, which are edible, and may be eaten raw or roasted or pressed for the almond oil (Bender and Bender, 2005). The other variety (*Prunus amygdalus var. amara*) produces bitter almonds, which are used for almond oil.

The world almond production for the year 2017 stands at 2,239 thousand metric tonnes, with United States being the leading producer. In united states the production amounted to approximately 10 lakh tonnes with area 4 lakh hectares in that marketing year followed by Spain 2.5 lakh tonnes having area under almond 6.3 lakh hectares and Iran having production of 1.1 lakh

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tonnes and area 50 thousand hectares approximately (Anonymous, 2017a).

The India's almond production for the year 2016-17 stands at 7.94 thousand metric tonnes. Out of this, 7 thousand metric tonnes are being produced alone in Kashmir valley, which accounts for 88 per cent of the total almond production in India and rest 0.94 metric tonnes are being produced in Himachal Pradesh, accounting for 11 per cent of the total almond production in India. In Jammu and Kashmir, almond is cultivated over an area of 5.11 thousand hectares with production of 7 thousand metric tonnes. However, the world average production of a professionally maintained almond tree is 23-30 kg/ tree which are higher than the almond production in Jammu and Kashmir (Rao, 2017). Pulwama is the leading producer of almonds and is having maximum area 4688 hectares under almond in the state of Jammu and Kashmir with a production of 4180 metric tonnes followed by Budgam having area under almond 1467 hectares and production 1486 metric tonnes. In Baramulla area under almond is 258 hectares and production is 553 metric tonnes. In district Pulwama block Pampore has the maximum area under almond 1435 hectares with production 574 metric tonnes. The area and production of Himachal Pradesh for the year 2017 stands at 6.58 thousand hectares and 7 thousand metric tonnes respectively (Anonymous, 2017b).

MATERIALS AND METHODS

Agro-climatic conditions: District Pulwama lies Mid to High altitude Temperate Agro Climatic Zone. Pulwama is located at 33^{o} 54'N latitude, 70^{o}.53'E longitude and 5273 meter altitude with average annual rainfall of 658 mm. Majority of the area has clay soils and very limited area has sandy loam soils. Net sown area is 32.381 thousand ha with net irrigated area 21.319, gross irrigated area is 38.858, rainfed area 20.453 with a cropping intensity of 176 per cent.

Cropping pattern of District: Besides, Pampore being known for the world's famous cash crop i.e. saffron, the Cropping pattern of this karewa land is dominated by horticulture as it is economically preferable especially apple and almond fruit Crops.

Data collection: The researcher personally collected the data by interviewing the respondents using well-structured interview schedule. The questions were simple and brief, asked in local language i.e. Kashmiri. All the selected respondents were personally interviewed by the researcher and the data was recorded directly on the schedule, which enabled the author to get first-hand information and gave an opportunity to observe their reactions. The respondents were at ease and expressed their opinion freely, fairly and frankly as friendly atmosphere was maintained during the interview.

Compilation of data and working out of scores: Scores were given to responses collected from respondents and then accordingly tabulated. Suitable statistical tools were used and findings emerged out of the data analysis were interpreted based on the study objectives and accordingly discussed and necessary inferences, conclusions were drawn in Table 1.

RESULTS AND DISCUSSION

Age: The data presented in the Table 2 revealed that more than half of the respondents i.e. 50.83 per cent belonged to middle age category, whereas 36.67 per cent belonged to old age category and only 12.50 per cent belonged to young age category. Most of them were middle aged, with more experience, but younger farmers being more innovative counteract it. It might be because of the reason that farmers of middle age are enthusiastic having more responsibility and are more efficient than the younger and older ones. These results are in line with Ashok (2011).

Education: With regard to education, it is evident from the Table 2 that 26.67 per cent of the respondents studied upto middle level, while 25.00 per cent and 25.83 per cent of respondents have education upto high school and graduation & above level respectively followed by illiterate 20.83 per cent and primary level of education 1.67 per cent. The possible reasons for more educated sample from the total sample could be the importance of education in one's life, easy availability and access to education facilities in the area. The findings also get support from Moulasab (2004).

Occupation: The data presented in the Table 2 revealed that majority 45.00 per cent of the respondents had agriculture as their main occupation followed by 30.84 per cent who were involved in agriculture as well as Govt. services and rest of the sample size 24.16 per

Table 1: Measurement of variables

Variables	Empirical Measurement
Dependent variables	
Knowledge	Out of 21 questions framed, only 16 questions were retained for measuring the level of knowledge of recommended almond cultivation practices after pre-testing of the schedule.
Adoption	Level of adoption has been measured by framing questions based on package of practices regarding almond cultivation given by SKUAST-K.
Independent Variables	
Age	Chronological age of the respondent
Education	Number of years of formal schooling
Occupation	Measured with involvement of respondents in various occupations.
Annual Income	Total annual income from agriculture and allied activities.
Family size	Number of members in family
Experience in almond cultivation	Number of years completed by the respondent in almond farming at the time of interview.
Land holding	Total land possessed by the farmer in kanals
Source of information	Measured with the degree to which the respondents utilized various information sources.
Scientific orientation	Measured with scale developed by Raja (1998) with suitable modifications.
Extension contacts	It has been measured by the frequency of contact of farmers with various extension personals.

cent were having agriculture as well as business as their occupation. Hence, the agriculture was seen as an important occupation in the study area. The results are in line with the findings of Raghuprasad (2018).

Annual income: Table 2 revealed that majority 37.50 per cent of the respondents were having annual income upto 2 lakhs, 33.33 per cent had annual income of 2-4 lakhs and 29.17 per cent of the respondents were having annual income of above 4 lakhs per annum. The data in Table 2 show significant relation with the results from Table 1 which reveals why majority of the farmers had low annual income upto (2 lakhs) as majority of farmers had only agriculture as their main occupation. The findings are similar to the findings reported by Gupta *et al.* (2018).

Family size: A close look at Table 2 shows that majority 58.33 per cent of the respondents belonged to family group of 6-10 members followed by 25.84 per cent which belong to family group of above 10 members and only 15.83 per cent of the respondent were having upto 5 members of family. The reason for falling majority of respondents in medium category is due to the fact that in modern days people prefer to live with families having medium and nuclear family size to maintain their economic status and livelihood, also the emergence of government policies which emphasizes on having small families also might be one of the reasons. This is in conformity with the findings of earlier studies by Khalache and Khaire (2014).

Experience in almond cultivation: The data pertaining to experience in almond cultivation in the Table 2 showed that majority 45.00 per cent of the respondents had an experience of 16-30 years, 30.83 per cent had above 30 years and 24.17 per cent had experience upto 15 years. This might be due to the reason that farming experience mainly depends upon age of the farmer. Since majority of the respondents belonged to middle age category, having medium level of farming experience. The results are in line with the findings of Devi (2012).

Land holding: From the Table 2, it was revealed that 35.00 per cent of the respondents were having land holding of 2 hectares, 34.16 per cent had holdings of more than 2 hectares and 30.83 per cent had holding of 1 hectare of land. The study area greatly has the plain land and in such lands large land holdings are common. Similar findings were reported by Sidram (2008).

Sources of information: The data presented in the Table 2 revealed that majority of the respondents 45.84

Table 2: Socio-economic profile of almond growers (N=120)

Variable	Category	Respondents	
		Frequency	Percentage
Age	Young (23-44 years)	15	12.50
	Middle (45-66 years)	61	50.83
	Old (above 66 years)	44	36.67
Education	Illiterate	25	20.83
	Primary level	02	01.67
	Middle level	32	26.67
	High level	30	25.00
	Graduate and above	31	25.83
Occupation	Only Agriculture	54	45.00
	Agriculture + Business	29	24.16
	Agriculture + Services	37	30.84
Annual income	Annual income group I (up to 2 lakhs)	45	37.50
	Annual income group II (2-4 lakhs)	40	33.33
	Annual income group III (above 4 lakhs)	35	29.17
Family size	(up to 5 members)	19	15.83
	(6-10 members)	70	58.33
	(above10 members)	31	25.84
Experience in Almond cultivation	Up to 15 years	29	24.17
	16-30 years	54	45.00
	Above 30 years	37	30.83
Land holding	Small (up to 1 hectare)	37	30.83
	Medium (2 hectares)	41	34.17
	Large (more than 2 hectares)	42	35.00
Source of information	Low (below mean- S.D)	40	33.33
	Medium (btwn mean +S.D)	55	45.84
	High (above mean +S.D)	25	20.83
Scientific orientation	Low (below mean - S.D)	51	42.50
	Medium (btwn mean + S.D)	47	39.50
	High (above mean + S.D)	12	10.00
Extension contacts	Low (below mean- S.D)	33	27.50
	Medium (btwn mean +S.D)	64	53.33
	High (above mean +S.D)	23	19.17

per cent belonged to medium level of information sources category followed by 33.33 per cent who had low level of sources of information and 20.83 per cent of respondents had high level of sources of information. Thus, it may be concluded that majority of the farmers had medium information source utilization followed by low and high. The reason behind this fact may be that majority of respondents belonged to middle level of education, which affects the overall information seeking behaviour of almond growers. The results of this finding are in line with the previous study conducted by Motiwale (2017).

Scientific orientation: With regard to scientific orientation the data presented in the Table 2 showed that, 42.50 per cent of the respondents had low level of scientific orientation. Whereas, 39.50 per cent and

10.00 per cent had medium and high level of scientific orientation respectively. This might be due to, that majority of respondents were middle aged with medium level of education. The results are in accordance with the findings of Sriramana (2014).

Extension contacts: It is evident from data given in Table 2 that more than half of the respondents 53.33 per cent belonged to medium level extension contacts, whereas 27.50 per cent of the respondents had low level extension contact and 19.17 per cent had high level of extension contact. This might be due to reason that majority of respondents might have medium extension participation as the Agriculture/Horticulture departments, KVK'S were not far from the villages resulting in medium extension contacts. The above findings were in accordance with the findings of study conducted by Raja (2018).

Table 3 reveals that majority of the respondents (65.00%) had adopted the varieties other than those of the recommended ones. Only a small percentage of the respondents had adopted the recommended varieties in their almond orchards. In case of the rootstocks, Table 3 reveals that majority (more than 50.00%) of the respondents had adopted both sweet and bitter rootstocks for almonds. However, it was also found that only a marginal percentage (5.00%) of the respondents had adopted the bitter rootstocks alone whereas, more than 40 per cent of the respondents had adopted the sweet rootstocks alone. That advocates the fact that the sweet rootstocks were highly preferable than the bitter ones.

Table 3: Distribution of respondents on the basis of different varieties and rootstock adopted in almond crop (N=120)

Variety Adopted	Respondents	
	Frequency	Percentage
Makhdoom (recommended)	28	23.33
Chellestan (recommended)	19	15.83
Varieties other than recommended	78	65.00
Rootstock Adopted		
Sweet	49	40.83
Bitter	06	5.00
Both*	65	54.17

*Multiple responses recorded

Regarding fertilizer management, findings from Table 4 revealed that half of the respondents 50.00 per cent had applied recommended quantity of FYM per tree of almond while 50 per cent of the respondents had not adopted recommended quantity of FYM per tree of almond. Regarding quantity of urea, Table 4 shows that 24.17 per cent were applying recommended quantity of urea per tree, whereas, majority of the respondents 75.83 per cent were applying non-recommended quantity of urea per tree of almond. Table 4 also shows that 35.00 per cent of respondents had applied urea in recommended split doses, whereas, majority 65.00 per cent of respondents had not applied urea recommended splits. Majority 80.00 per cent of

Table 4: Distribution of respondents on the basis of nutrient management per tree of almond bearing age of 10 years & above (N=120)

Quantity of FYM applied	Respondents	
	Frequ-ency	Percen-tage
Recommended (40 kgs)/tree	60	50.00
Farmers practice (non-recommended)	60	50.00
Quantity of Urea applied		
Recommended dose (900 g)/tree	29	24.17
Farmers practice (non-recommended)	91	75.83
No. of Applications of urea		
Recommended (2 split doses)	42	35.00
Farmers practice (non-recommended)	78	65.00
Quantity of DAP applied		
Recommended dose (375g)/tree	24	20.00
Farmers practice (non-recommended)	96	80.00
Quantity of MOP applied		
Recommended dose (900 g)/tree	43	35.83
Farmers practice (non-recommended)	77	64.17
No. of Applications of MOP		
Recommended (2 split doses)	63	52.50
Farmers practice (non-recommended)	57	47.50
Application of Micro nutrient		
Recommended ($CaCl_2$)	42	35.00
Farmers practice (non-recommended)	18	15.00
Didn't applied any micro-nutrient	60	50.00
Time for application of urea for Ist split		
Recommended (21 DBF)*	29	24.17
Farmers practice (non-recommended)	91	75.83

*DBF = days before flowering

respondents had applied non-recommended quantity of DAP per tree, whereas, 20.00 per cent of the respondents had applied recommended quantity of DAP per tree of almond. It is clear that majority 35.83 per cent of respondents had applied recommended quantity of MOP per tree, whereas, majority 64.17 per cent of respondents had not applied recommended quantity of MOP per tree of almond. Majority 52.50 per cent of respondents had applied MOP in recommended split doses, whereas, 47.50 per cent of respondents had not applied MOP in recommended splits.

Table 4 also reveals that majority 50.00 per cent of respondents had not applied any micro-nutrient, whereas, 35 per cent and 15.00 per cent of respondents had applied recommended and non-recommended micro-nutrients respectively. Regarding time for application of urea for first split Table 4 revealed that 24.17 per cent were applying first split of urea at recommended time which is 21 days before flowering, whereas, 75.83 per cent were not applying first split of urea at recommended time.

From Table 5 regarding layout of the almond trees, it is clear that majority 70.00 per cent of respondents had adopted recommended square layout, 7.00 per cent triangular, 10.00 per cent hexagonal and 13.33 per cent had not adopted any recommended layout.

Table 5: Distribution of respondents on the basis of layout practices adopted in almond crop (N=120)

Layout	Respondents	
	Frequency	Percentage
Square (recommended)	84	70.00
Hexagonal	12	10.00
Triangular	08	7.00
Haphazard layout	16	13.33

It is clear from Table 6 that Shot-hole, Canker and dieback were the main problems in the almond orchards. 56.67 per cent of the respondents had faced dieback problem in their orchards. While, 33.33 per cent had faced shot-hole problem in their orchards, 22.50 per cent had faced Canker problem in their orchards. Whereas, 44.17 per cent had faced both Shot-hole and Canker problems in their almond orchards. Regarding disease management of almond trees, it is evident from Table 6 that 55.83 per cent of the respondents were using recommended management practices and 44.17 per cent were using non-recommended management practices to control the shot hole problem. In case of canker management

Table 6: Distribution of respondents on the basis of disease problems faced in almond crop and their management (N=120)

Name of Disease/Pest	Farmers who faced problem	
	Frequency	Percentage
Shot hole	40	33.33
Canker	27	22.50
Both (Shot hole and Canker problem)*	53	44.17
Dieback	68	56.67
Management of Shot-hole		
Recommended (copper oxychloride 2.5 g/L of H_2O)	67	55.83
Farmers practice (non-recommended)	53	44.17
Management of canker		
Recommended (Chaubatia paste/Bordeaux mixture)	54	45.00
Farmers practice (non-recommended)	66	55.00
Management of dieback		
Recommended (mancozeb 3g/L of H_2O)	63	52.50
Farmers practice (non-recommended)	57	47.50

* Multiple responses

45.00 per cent were using recommended fungicides and 55.00 were using non-recommended fungicides to control the canker. Whereas, 52.50 per cent of the respondents were using recommended fungicides and 47.50 were using non-recommended fungicides to control dieback problems. A close look at the Table 7 clearly reveals that 51.67 per cent of respondents had adopted recommended method of budding for propagation of almond. Whereas, 23.33 per cent of the respondents did not adopt recommended budding method and 25.00 per cent of the respondents did not adopt any method of propagation of almond. In case of grafting, 44.17 per cent of respondents had adopted recommended grafting methods. Whereas, 35.00 per cent of the respondents had not adopted any grafting method for propagation of almond. Whereas, 20.83 per cent of respondents had adopted methods other than recommended methods for grafting of almond. In case of training methods, more than half of the respondents 57.50 per cent had adopted recommended methods of training and pruning, 6.67 per cent had adopted open system, 8.33 per cent had adopted modified leader system and 27.50 per cent of the respondents does not have adopted any kind of training and pruning system.

Table 7: Distribution of respondents on the basis of propagation methods and training practices adopted in almond crop (N= 120)

Propagation methods	Respondents	
	Frequ-ency	Percen-tage
Budding		
Recommended (T budding)	62	51.67
Farmers practice (non-recommended)	28	23.33
No method of budding adopted	30	25.00
Grafting		
Cleft grafting (Recommended)	53	44.17
Farmers practice (non-recommended)	25	20.83
No grafting method adopted	42	35.00
Training		
Central modified leader system (Recommended)	69	57.50
Open system	08	06.67
Modified leader system	10	08.33
No training system adopted	33	27.50

A cursory look at the Table 8 reveals that only three variables could contribute significantly to the variance in farmer's extent of adoption of improved almond production practices. Out of these, experience, information sources and scientific orientation contributed significantly in predicting the extent of adoption of almond production technology by farmers. Thus, it can be concluded that these three variables have strongly impacted the extent of adoption.

Table 8: Regression analysis of extent of adoption of improved almond production practices by respondents (N= 120)

Predictor	Coefficient	Standard error coefficient	T-statistics	P- value
Constant	21.926	3.790	5.78	0.000
Age	-0.03821	0.04733	-0.81	0.421
Education	0.0638	0.2534	0.25	0.802
Occupation	0.2533	0.4861	0.52	0.603
Annual income	-0.00000139	0.00000234	-0.59	0.553
Family size	0.00432	0.08609	0.05	0.960
Experience in almond cultivation	0.07973*	0.03587	2.22	0.028
Land holding	-0.01161	0.01695	-0.68	0.495
Source of information	0.3824*	0.1505	2.54	0.012
Scientific orientation	0.2523*	0.1353	1.87	0.065
Extension contacts	0.2386	0.2617	0.91	0.364

* Significant at 0.05 level of probability; ** Significant at 0.05 level of probability

CONCLUSION

Almond being one of the important fruit crop of Jammu and Kashmir, which is being cultivated in wide area by farmers in the selected survey area. The current study brought out certain important findings which have got direct bearing on those involved in technology transfer and policy making. They are detailed below.

- Majority of the almond growers had adopted recommended layout in their orchards, quantity of FYM, number of split doses of MOP.
- Majority of the almond growers had adopted recommended management practices for leaf fall and shot-hole disease management. A major chunk of the almond growers had not adopted recommended budding, grafting methods and training and pruning system in their orchards.
- Majority of the almond growers were harvesting almond fruit at recommended maturity index. Most of the almond growers were not adopting the recommended fertilizer management practices, pesticide spray and recommended varieties.

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Information Need Analysis of Coastal Rice Growers about Climate Change Adaptation and Mitigation Practices

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ABSTRACT

Eastern coastal districts of India are more subjected to weather vagaries in comparison the western coastal districts. Rice as major crop of the country, the loss of productivity of the crop due to climate change can be managed by giving proper information to the farmers about mitigation practices. The study was conducted in two blocks of Balasore district of State of Odisha. The present study revealed that farmers 68.33 per cent of farmers have medium level of information need about climate change adaptation and mitigation strategies. Analysing through Principal Component method of exploratory factor analysis, reported that the extent of Information need had been determined by three factors explained 62.60 per cent variation in information need. For factor I impact three indicators showing 0.784 factor loading by water management practices, 0.729 by soil management practices and 0.410 by disease and pest control practices are contributing. For factor II by risk management practices 0.827 factor loading is contributed followed by 0.533 by cropping practices, for factor III 0.768 factor loading contributed by weather parameter.

Keywords: Climate change, Adaptation, Mitigation, Information need, Factor analysis, Principal component method

INTRODUCTION

Information is an essential tool used by individuals to realize every objective or target collection. It remains the life-blood of every individual or organization. It is a valuable resource needed in any society; therefore, information acquisition and use are essential and necessary activity. The concept of information is more complicated and difficult than typically meets the eyes, given the fact that information is as old as man and affects and is influenced by all forms of human activity, it is evident in the different meanings and attributes of the term. Miranda and Tarapanoff (2008) stated that information need process started when an individual perceives that there is a gap between the information available to solve a problem and the real solution the problem. Human beings need infor-mation so they can make choices on something important. Therefore, appropriate, productive and successful information needs to be pursued for any progress to take place. Which means that the agricultural sector needs up-to-date and timely information (Ronke, 2005).

Climate change has the most promising vulnerable effect upon agriculture in present scenario. Since time immemorial India has been vulnerable to vagaries such as droughts, floods, heat waves, and cyclones (High Powered Committee, 2002). Such vagaries left behind death and devastation, with tremendous effects on the country's growing economy. India receives an average annual rainfall of around 1190 mm, of which more than 75 per cent is received from June to September over a four-month period. The Indian agrarian economy's success is based heavily on those four months (Agriculture and Cooperation Department 2004). Sinha and Swaminathan (1991) recorded that a 2°C rise in mean air temperature could reduce rice yield in the high yield area by about 0.75 3 ton / hectare and in the low yield coastal areas by about 0.6 ton / hectare.

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Rice production in Odisha is exposed to a high weather vagaries. High Yield Varieties (HYVs) grown in Cuttack (CR1018 and CR1077) react differently to temperature increases by showing yield decreases and yield increases respectively. Traditional varieties (Jagannath) have not been found to withstand the effects of higher temperatures, and this is possibly the reason why yields tend to decrease as temperature increases. (Srivastava *et al*., 2009). Ray *et al.* (2018) using crop simulation method in Swarna variety observed that increasing maximum and minimum temperatures above optimal rice production temperatures contributed to a reduction in yield, and increases in minimum temperatures had deeper negative impacts compared to overall changes in temperature. The proper knowledge about climate change and its adaptation and mitigation practices of the farmers is the need of the hour as reported by Mallick *et al.* (2021) 62 per cent rice growers have medium level knowledge about mitigation and adaptation practices. Accessing the right information can help the farming community to deal with climate change and enhance productivity and profitability. According to IPCC, farmers should adopt mitigation and adaptation practices to avoid the effect of climate change and maintain the productivity. But to adapt the practices farmers should have information about the practices. So, to assess the extent of rice growers information need about climate change adaptation and mitigation practise the study was conducted.

MATERIALS AND METHODS

The Indian coastline runs upto 7500 kilometres when the two island territories are included. This huge coastline stretches from the Gulf of Kutch in the west to the Sunderbans in the east. Eastern and western halves of the country are clearly separated. According to Patwardhan *et al.* (2003), when it comes to the frequency of storms, the eastern coast is more vulnerable than the western shore with extreme phenomena such as cyclones and depressions are more likely to occur. From the four eastern coast states Tamil Nadu, Andhra Pradesh, Odisha and West Bengal; Odisha is purposively selected for having the lowest productivity than other four states according to NFSM, 2016. In Odisha from all the coastal districts Balasore is randomly selected and two blocks are randomly selected from the district as Remuna and Oupada respectively. 60 farmers were selected from each of the block making the total respondents to 120 for the study. Information need of the respondents regarding climate change adaptation and mitigation practices was analysed where information need is operationalized as the information needed to the rice growers on climate adaptation and mitigation practices from in weather information, soil and nutrient management information, cropping system information, water management information, pest and disease management information and risk management information. By the process of extensive literature review and discussion with various stakeholders from state agriculture department staffs, scientists, extension educationists, farmers these six criteria were taken.

Weather parameters: Information about daily temperature data, rainfall data, rainfall prediction, relative humidity, sunshine hours are needed for sowing to harvesting every cultivation practice in agriculture.

Soil and nutrient management: To adapt climate change with maintaining the soil health farmers need information about contour ploughing, zero tillage, slow release fertilizer, cover crops, organic nutrient management, crop residue management and integrated nutrient management to reduce the effect of chemical fertilizers.

Cropping system management: To resist and tolerate during the crop growth period farmers need information about crop rotation, crop diversification, seed treatment and proper selection of drought and water logging varieties. In severity condition farmers should have information about proper contingency planning to rescue from the effect.

Water management: To manage the crop with water deficit situation the farmers should have information about drip irrigation, water harvesting and SRI (system of rice intensification and alternative wetting and drying methods especially in rice.

Pest and disease management: Disease and pest outbreak and severity increases with changing climate change scenario which makes conducive for certain pathogens.in this situation farmers need information about disease and pest resistant variety, pest outbreak information and integrated pest management practices to reduce use of pesticides.

Risk management: Manage risk in the farmers should have knowledge about different insurance programmes and the ICT tools and extension agencies providing authentic information.

Respondents were asked to give their response on these above parameters on these items on a 5 point continuum from strongly needed to strongly not needed. The collected response was factor analysed to find out the correlations among the factors. The essential purpose of factor analysis is to describe the covariance relationship among many variables in terms of few underlying but unobservable, random quantities called factors. The most popular method of factor analysis is Principal Component Method, which is classified as a multivariate statistical technique.

Factors are linear combination of data and coordinates of each variable is measured to obtain factor loadings which shows the correlation between particular variable and the factor. Communality reveals how much a variable accounted for the underlying factor. Eigen value is the sum of squared values of factor loadings relating to a factor. In the present study, Kaiser varimax rotation was used which ensures maximisation of variance of a variable under a particular factor. In the present study, factor analysis using principal component method was used for analysis of determining the key factors in the information need about climate change adaptation and mitigation practices about climate change among farmers

RESULTS AND DISCUSSION

Six indicators were chosen to study the extent of information need about climate change mitigation and adaptation practices of rice growers. Principal component analysis was done to identify those factors which contribute to information in the study area. Principal component analysis was carried out and Kaiser-Meyer-Olkin Measure of Sampling Adequacy value was 0.538 which indicate that the data set is suitable for principal component analysis as it is higher than 0.5 shown in the Table 1. Further analysis of Table 1 revealed that following Bartlett's Test of Sphericity shows that there is some redundancy between indicators which can be summarised into factors. The result for Eigen values is presented in Table 2 which shows the Eigen values and percentage of variation explained by the factors. The factors were taken out which has Eigen values more than one and near about 63 per cent variance explained by those factors. By this method three factors were carried out which is also shown in the Figure 1 in the scree plot. From Table 2 three factors with Eigen values greater than one and which accounts for 62.60 per cent of the variation in information need were extracted for further analysis. From Table 3, each factor column was analysed for identifying the indicators which are more significantly correlated with the particular factor. Thus, from each factor column, the indicators having factor loading were identified. Factor I has been identified as prime factor, as it explained 25.76 per cent variation in information need.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.518
Bartlett's Test of Sphericity	Approx. Chi-Square	32.082
	Df	15
	Sig.	.006

Table 2: Extraction of significant indicators of information need using eigen values

Factor	Eigen values	Percentage of variance	Cumulative percentage of variance
I	1.546	25.764	25.764
II	1.165	19.415	45.179
III	1.046	17.426	62.604
IV	0.875	14.580	77.184
V	0.773	12.885	90.069
VI	0.596	9.931	100.00

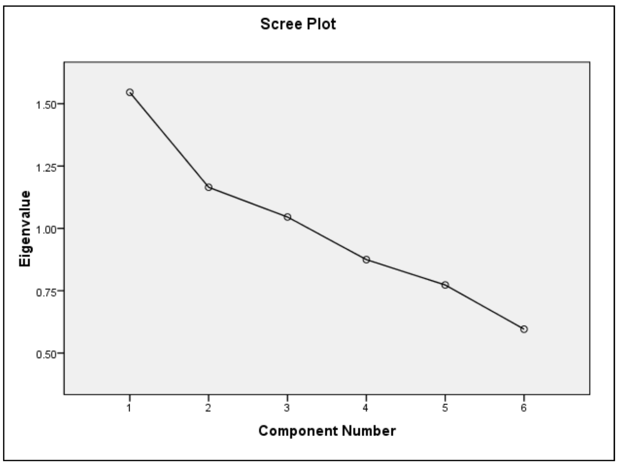

Figure 1: Scree plot showing the factors eigen value

Table 3: Extraction of factors using structure matrix by Principal component analysis method and oblimin with Kaiser Normalization rotation method

Indicators of information need	Factors		
	I	II	III
Water management	0.784		
Soil and nutrient management	0.729		
Risk management		0.827	
Cropping practices		0.533	0.486
Weather parameters			0.768
Disease and pest management	0.410	-0.372	0.561

A critical analysis of Table 3 reveals that for factor I impact is contributed by three indicators which shows 0.784 factor loading by water management practices, 0.729 by soil management practices and 0.410 by disease and pest management practices. For factor II 0.827 factor loading is contributed by risk management practices followed by 0.533 by cropping practices and -0.372 by disease and pest management practices. For factor III weather parameter contributed 0.768 factor loading followed by disease and pest management 0.561 and 0.486 by cropping practices.

Factor I (Crop period information): From Table 3, it could be inferred that under factor I, water management, soil and nutrient management and disease and pest management impact to information need in greater extent with the highest factor loading of 0.784 for water management followed by soil and nutrient management (0.729) and disease and pest management (0.410) naming it Crop Period Information the information critically needed during the crop growing season show that growers can take proper steps to reduce the effect of climate change in growing crops.

Factor II (Decision information): Among the total variation of 62.60 per cent, the second factor alone explained the information need variation to the extent of 19.41 per cent. Thus, factors one and two together contributed 45.17 per cent variation in information need (Table 3). From the results, it could be concluded that risk management have been found to manipulate information need to a greater extent with the highest factor loadings of 0.827 followed by cropping practices with factor loading 0.533 naming it decision information as these are the factors which contribute towards the risk management and crop and cropping practice selection to manage the catastrophic effect.

Factor III (Weather information): It could be observed from the Table 3 that three indicators namely cropping practices, weather parameters and disease and pest management were in factor III and had higher loadings of 0.486, 0.768 and 0.561 respectively. This factor accounted for 17.42 per cent of variance. As weather parameters has maximum contribution so naming it weather information to manage their practices with up to ate weather information.

Exploratory factor analysis gives result according to the variables that come into one factor according to their factor loadings and the 1st factor describe maximum variance. Farmers need crop period information as priority for adaptation and mitigation information and next to that decision information as 2nd factor followed by weather information as 3rd factor. The result of the study goes in line with Bharat *et al.* (2022) reported that first factor for climate change adaptation and mitigation came out to be soil and integrated farming management and second factor as contingency crop planning.

The respondents are classified into three groups based on mean and standard deviation such as low, medium and high according to the extent of information need. It was found from Table 4 that 68.33 per cent of respondents felt medium level of information need followed by 18.3 per cent respondents felt high level of information need and 13.3 per cent felt low level of information need about climate change adaptation and mitigation practices. The results on the level of information need on climate change go in line with the results of Barakoti (2019) which was conducted on apple growers. However the result show some deviations from the study of Raghuvanshi and Ansari (2020) reported that drought/

Table 4: Distribution of respondents according to information need on climate change adaptation and mitigation practices

Dependent variable	Category	Frequency	Percentage
Information need	Low	16	13.3
	Medium	82	68.3
	High	22	18.3

frost tolerance strategies, changing planting times, diversification from farming to non-farming activities, and crop and variety diversification were all practises that 90% of respondents were aware of as the study was on the hilly region which is different from the current study of coastal region.

CONCLUSION

The study analysed information need of rice growers, right from the weather parameters, soil and nutrient management, water management, cropping practices, risk management. Information need of the coastal rice growers are of medium range to take proper measure to manage the weather vagaries. Principal component analysis resulted that during crop period information growers need more information as it showed maximum variation in the extent of information need. Next most important factor as management practices like cropping and risk management information play a major role. Third component of information need was weather parameters as it is the most crucial for everyday as well as further crop planning. Proper training and demonstration and field day for farmers' knowledge empowerment, information enrichment and skill development can help to develop their adaptation and mitigation practice to manage the crop. Farmers more access to ICT media and extension participation as well as from the extension agency effort to deliver proper information can empower farmers. Further government policies can focus on the information delivery as a package combination with several programmes as climate change adaptation and mitigation practices a special component in long term basis.

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Construction of Knowledge Test to Assess Knowledge Level of Farmers of Northern India regarding Conservation Agricultural Practices in Wheat

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ABSTRACT

Post green revolution era has countersigned a number of alterations and challenges in Indian agriculture due to practicing of intensive cultivation techniques. Sustainability issues with respect to agro-ecology and soil health were questioned seriously. Conservation Agriculture (CA) practices were looked upon as next best alternative to regain sustainability. But still the extent of CA cultivation in India is at a budding stage. At this juncture, farmers' awareness and knowledge about CA play a very crucial in deciding the upcoming course of actions. So it is very important to measure knowledge level of farmers for its greater adoption. With this goal, the present study aimed at construction of standardized knowledge test to assess knowledge level of farmers regarding CA practices in wheat. For tool development, pilot study was conducted in Kalampura village of Karnal, Haryana which was excluded during final data collection. The steps included- item collection, item selection, item analysis, finding reliability and validity of the test items and then finalization of items. The reliability coefficient value of 0.756 indicated that test was highly significant. The final knowledge tool containing 20 items was set for data collection. This standardized test can be used by other researchers or academicians to measure knowledge level of farmers regarding various other aspects of CA.

Keywords: Conservation agriculture, Knowledge test, Difficulty index, Discrimination index

INTRODUCTION

Conservation Agriculture (CA) as defined by FAO (2014) is an approach to manage agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. South Asian agriculture being the global hotspot of climate change faces the challenges of depleting natural resources, declining soil health, water erosion and volatile food prices. Intensive tillage based cultivation is the major reason behind these complications. At this juncture, CA acts as a paradigm shift in the farming practices of Indian sub-continent by eliminating the unsustainable parts of conventional agriculture and hence paving the way for future productivity gains (Bhan and Behera, 2014).

Understanding the prospects of CA, significant efforts have been made by CGIAR institutes in close collaboration with National Agricultural Research and Extension Systems (NARES) resulting in its adoption in the Indo-Gangetic plains of India. Based on the three interlinked principles of (1) zero tillage or no tillage, (2) crop residue retention and (3) crop diversification, CA helps to enrich the natural resource base and thereby preserving and sustaining the eco-system. In north-western Indo-Gangetic plains, major advantage of adopting CA in rice-wheat cropping system is that it shortens the duration between rice harvesting and wheat planting, leading to improved wheat productivity. But in-spite of having these multi-dimensional benefits, the adoption of CA in India is only at a nascent stage. Majority of the farmers are having a mental blockage about the superiority of tillage

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based conventional agriculture. Many of them do not have a clear vision and understanding regarding the potential benefits of zero tillage and alternate uses of crop residue. Some farmers have doubts regarding the risks associated with adopting zero-tillage. So, it is need of the hour to understand the dynamics of CA practices for its rapid adoption.

Rapid and full-fledged adoption of CA practices can only be achieved if farmers possess sufficient knowledge about Conservation Agricultural practices and its underlying issues. So far very few studies have been conducted on this aspect. For this, development of a standardized knowledge test is essential. Past study by Gurjar (2013) about knowledge level of farmers regarding CA practices in Rajasthan, highlights the necessity of constructing standardized knowledge test to calculate knowledge level of farmers. After that several studies were conducted but most of them highlighted only one or two aspects underlying CA. Kumar and Godara (2017) in their study measured knowledge of farmers regarding zero-tillage in Haryana and it lacked the construction part. Recent study by Ramasubramaniyan *et al.* (2016) regarding knowledge and adoption of CA technologies in Tamil Nadu covered majority of the aspects under CA but lacked methodological construction part.

Taking the aforementioned issues into consideration, the present research paper aims to construct a standardized knowledge test to measure knowledge level of farmers regarding CA practices in wheat in Northern India. In this paper knowledge regarding CA practices has been operationalized as the amount of facts, information, matter or contents possessed by respondent farmers about CA practices, its underlying principles and various related agronomic management practices. The current research highlights the crucial steps in developing a knowledge test to enumerate the knowledge level of wheat growing farmers. Scientifically constructing such knowledge test will help us to know the existing knowledge breach and thereby will help in formulation of appropriate policies and strategies for rapid adoption of CA.

MATERIALS AND METHODS

Locale of the study: In India, Conservation Agriculture (CA) is being practiced in rice-wheat cropping systems of northern India, especially in the states of Punjab and Haryana where farmers can expect getting positive outcome out of this (Bhan and Behera, 2014). The states of Punjab and Haryana are facing the problems of declining soil fertility, stubble burning, reduced ground water levels and decline in the wheat productivity due to intensive cultivation of rice and wheat in a cropping system. Then again adoption of CA is very sporadic in nature in these two states. Hence purposively these two states of Punjab and Haryana

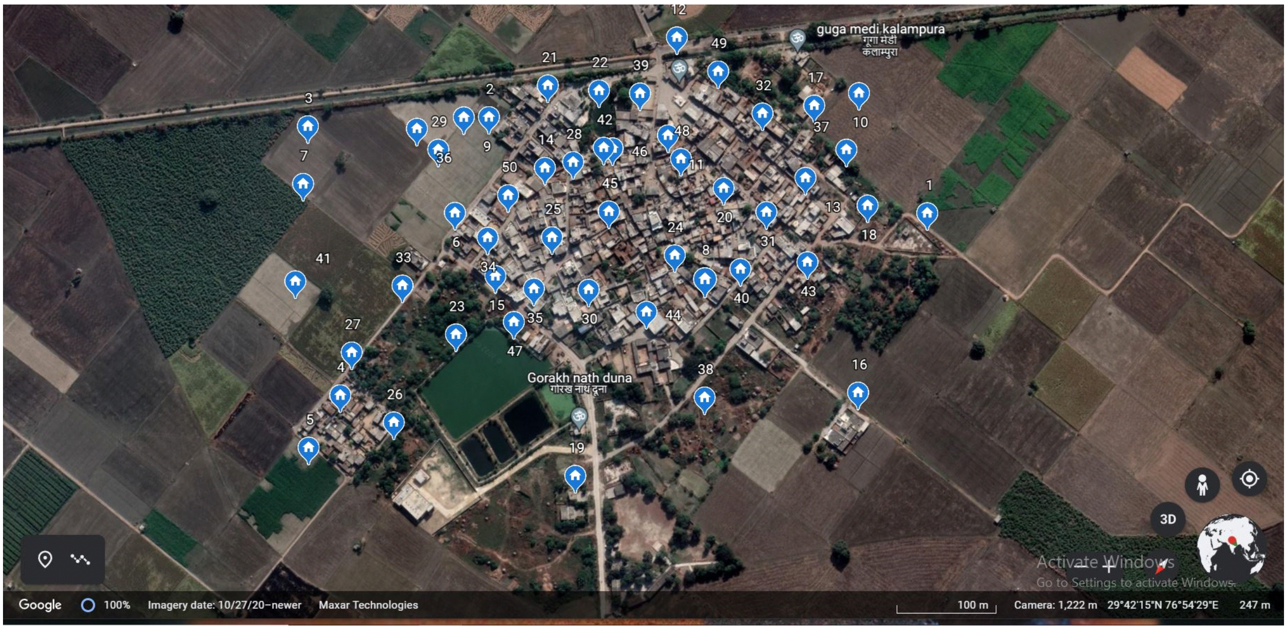

Figure 1: Locale map of pilot study area Kalampura Village

were chosen as study area to assess knowledge level of farmers.

But for the development of knowledge test, pilot survey was conducted by randomly selecting sixty non-sample respondents from Kalampura village (29°69 E, 76°99 N) of Karnal district of Haryana (Figure 1). Kalampura village was not included during the final data collection. The developed knowledge test was further administered to the sample respondents of the two states for quantitative analysis.

Construction of knowledge test: The development of present research tool was done in a line explicated by Sagar (1983). The method followed for constructing a standardized knowledge test is vividly described in Figure 2.

Item collection: The very first step in constructing a knowledge test is framing a set of questions on relevant topic. In this particular case, questions are known as "knowledge items". For the present research, the thematic area of item collection was on "Principle and Practices of Conservation agriculture". The items were collected from a number of sources like research papers, review papers, popular articles, book chapters etc. published in different journals; discussion with experts and subject matter specialists in the relevant field, researchers' own experience.

Item selection: Selection of appropriate items is an important step after item collection. The items should be selected in such a manner that they should stimulate thinking rather than memorization and should have the capacity to distinguish the well informed respondents

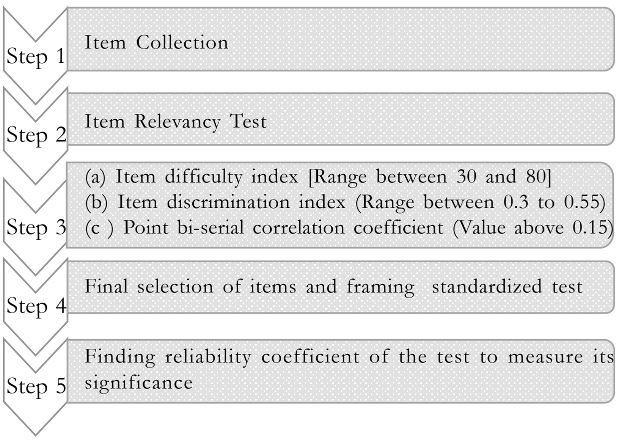

Figure 2: Steps in constructing standardized knowledge test

from the poorly informed ones. Hence this stage demands critical thinking and logical understanding of the researcher about the topic. The selected item should be a factual statement. Based on the aforesaid criterion, initially forty five items were framed covering all the aspects of CA, its principles and various management practices (land preparation, irrigation management, nutrient management, weed management, government policies etc.). The items selected were objective in nature with answers in Yes/No and multiple choice form

Screening of items: After selection of items, screening was done to reach final set of items for assessing the knowledge level of targeted sample. At the very first level, forty five items were mailed to experts for relevancy checking. Out of fifty five experts, only thirty five experts replied back. For this study, researchers or scientists having minimum 5 years of experience in the field of CA were chosen as experts. Relevancy scores were calculated on a three point continuum with 'most relevant' item rated 3 and 'irrelevant' item rated 1. Items with average relevancy score of 2.5 or more were carefully chosen for next round of screening.

At the next level, a total of twenty eight items were administered to sixty non-sample respondents for analysing difficulty and discrimination level of the knowledge items. The pilot survey was conducted by the interviewer with 28 selected items during the month of July, 2021. Data collection was done using Google forms. The pervasiveness of COVID-19 pandemic made it compulsory for the interviewer to take utmost precaution during survey and hence pen-paper mode of collecting data was shifted to smart-phone based mode.

RESULTS AND DISCUSSION

Item analysis: Generally an item analysis of a knowledge test ends up with three kinds of information- item difficulty index, item discrimination index and item validity index (Ray and Mandal, 2014). Here thirty test items were administered to 60 non-sample respondents (who were not included in final study) to nullify the testing effect. Thus maximum possible score was 30 and minimum score was 0. With a sample size of 60, two different scores were calculated- summed up score of each item as well as for each respondent. After calculating the aggregate score of each respondent, the sample was re-arranged in descending order of total score. These 60 respondents were then divided into six equal groups each having 10 respondents (G1, G2, G3, G4, G5 and G6). Out of these six groups, only four extreme groups (with high and low scores) were considered for computing difficulty and discrimination index and middle two groups *i.e.* G3 and G4 were eliminated. The range of scores of six groups are presented in Table 1.

Item difficulty index: The item difficulty index was defined as the proportion of respondent farmers giving correct answer to that particular item. The basic assumption in this case was that the difficulty in answering any question was linearly related to knowledge level of farmers regarding Conservation Agriculture *i.e.* more the knowledge level, the easier the farmer finds to answer the question and vice-versa. Difficulty Index was calculated using the following formula:

$$P_i = (n_i / N_i) \times 100$$

Where, P_i= difficulty index in percentage of i^{th} item

n_i= number of farmers who correctly answered i^{th} item

N_i= total number of respondents to whom i^{th} item was administered (for present study it is 60)

Item discrimination index: Calculation of discrimination index results in identifying the extent to which a specific item discriminates the farmers having more knowledge regarding the topic with those having poor knowledge level. The items which are either answered by all correctly or incorrectly are supposed to have no power of discri-mination. The item discrimination index is calculate by "$E^{1/3}$" formula given by Mehta (1958). It is represented as:

$$E^{1/3} = \{(S1+S2) - (S5+S6)\} / (N/3)$$

Where, S1, S2, S5 and S6 are frequencies of correct answers from groups G1, G2, G5 and G6 respectively and N denotes the total sample size for item analysis. The discrimination index varies from 0 to 1.

Item validity: The assurance of good test validity rests upon good item validity. The methods employed to analyse item validity were expert/jury opinion and point bi-serial correlation (Table 2). At the beginning content validity was ensured by administering the test items to different experts to assess the exemplification of the universe by the test and approve its face validity.

Point bi-serial correlation coefficient (r_{pbi}) is a statistics used to work out the internal consistency of items of dichotomous nature. Hence, apart from face validity, construct validity was measured using point bi-serial correlation method. For each knowledge item r_{pbi} value was calculated. Although r_{pbi} value of 0.15 is recommendable but a value of 0.25 or above is good. The r_{pbi} value was calculated using the following formula:

$$r_{pbi} = \frac{(\overline{y_1} - \overline{y_2}).\sqrt{pq}}{S_y}$$

Where, $\overline{y_1}$ = conditional mean of quantitative variable y when nominal score is 1 *i.e.* mean of the total scores of respondents who answered the item correctly

$\overline{y_2}$ = conditional mean of quantitative variable y when nominal score is 0 *i.e.* mean of the total scores of respondents who answered the item incorrectly

S_y = standard deviation of the entire set of items

p= proportion of respondents giving correct answer to ith item

q= proportion of respondents giving incorrect answer to ith item

Reliability of the test: For calculating reliability of the test, split half method was employed due to its superiority over other methods. The benefit is that all data for computing reliability are obtained upon one occasion that helped to eliminate the variations due to two different testing situations (Garret, 2007). In this method, all the items were first randomly arranged

Table 1: Range of scores obtained by the respondents

Group No	G1	G2	G3	G4	G5	G6
Range of Scores	27-24	23-22	21-20	20-19	18-17	16-7
Number of respondents	10	10	10	10	10	10

Table 2: Difficulty index, discrimination index and point bi-serial correlation coefficient values of preliminary set of knowledge items

S. No.	Knowledge items	Discrimination index	Difficulty index	r_{pb}
1.	What are the principles of conservation agriculture?	0.50	79.66	0.56
2.	Do you think crop residue retention improves soil health?	0.25	78.33	0.46
3.	What is the effect of mulching on soil temperature?	0.4	71.66	0.41
4.	What is the effect of CA practices on lodging of wheat?	0.05(×)	21.66(×)	0.09(×)
5.	What is the effect of mulching on soil microbial population?	0.25(×)	98.33(×)	-0.023(×)
6.	Up to what extent land preparation is shortened due to direct sowing of wheat just after rice harvest in CA?	0.33	70.00	0.18
7.	What is the effect of practicing zero tillage on *Phalaris minor* problem in wheat?	0.45	31.66	0.37
8.	Do you agree that replacing rice in rice-wheat cropping system with maize, sorghum, legumes, oils or soybean save the ground water?	0.05(×)	96.66(×)	0.11(×)
9.	Do you agree incorporating 1 ton of crop residues in the soil releases nutrients in the soil?	0.31	61.66	0.37
10.	What is the effect of CA on nutrient requirement of wheat?	0.15(×)	38.33	0.18
11.	To what extent requirement of irrigation water and fuel, changes when CA is practiced in wheat?	0.40	30.00	0.23
12.	What is the ideal field size for working of laser land leveller?	0.10(×)	35.00	0.25
13.	Which type of tractor is needed for working of happy seeder?	0.31	78.33	0.45
14.	Which of the following is an automated laser guided beam operated+ machine that is used mainly in CA practices?	0.3	43.33	0.19
15.	On what depth of crop stubble in a rice harvested field, a zero tillage machine can be operated for sowing of wheat?	-0.05(×)	20.00(×)	0.05(×)
16.	Do you think use of laser land leveller for land preparation saves energy and enhances water productivity?	0.30	75.00	0.17
17.	What is the operation mechanism of zero tillage machine?	0.30	76.66	0.21
18.	Which of the following are used for real time nitrogen management in CA practices of wheat?	0.3	78.66	0.32
19.	Are you aware that soil test based nutrient management is essential to utilize the full potential of CA?	0.45	45.00	0.49
20.	What is the effect of zero tillage on the growth of weeds in CA practices of wheat?	0.10(×)	85.00(×)	0.26
21.	What is the best measure of weed control under minimal tillage condition of wheat?	0.40	70.00	0.47
22.	What is the pre requisite for applying zero tillage in wheat?	0.30	51.66	0.44
23.	What type of planting technique saves irrigation water in CA practice of wheat?	0.25(×)	21.66(×)	0.24
24.	Which mobile app has been launched by government to get all kinds of agro-machineries on rent?	0.37	65.66	0.28
25.	Which irrigation technique provides an 'opportunity for saving water in CA cultivated wheat?	0.35	61.66	0.55
26.	Can you specify the role of straw management system when used along with combine harvester?	0.05(×)	83.33(×)	0.14(×)
27.	Which recently launched scheme helps in promoting *in-situ* management of crop residue?	0.45	78.33	0.32
28.	What amount of subsidy is provided by state government for purchase of CA specific machineries?	0.41	80.00	0.25

and then divided into two equal halves containing odd and even number of items. Then correlation coefficient between two sets of values was calculated and a value of 0.756 was obtained which was significant at 1% level of significance. This value point out that the knowledge test is highly significant (Table 3).

Final selection of knowledge items: The ultimate selection of items was based on the following criterion (Table 2): (a) The statements with difficulty index score between 30 and 80 were accepted. (b) Eligibility criteria of items with respect to discrimination index was between 0.30 and 0.55. (c) Items with point bi-serial correlation coefficient values of 0.15 and above were nominated.

Table 3: Correlation coefficient value in Split-half method

		Odd item	Even item
Odd Item	Pearson Correlation	1	.756**
	Sig. (2-tailed)		.001
	N	10	10
Even Item	Pearson Correlation	.756**	1
	Sig. (2-tailed)	.001	
	N	10	10

Based on the aforesaid benchmark, finally 20 knowledge items out of 28 were selected to be included in the final schedule (Table 4). This resulted in development of a standardized knowledge test for assessing the knowledge level of farmers regarding CA practices in wheat.

CONCLUSION

Comprehending the knowledge of individuals regarding any particular topic is of utmost importance in social science research domain as it directly influence the attitude formation and thereby impacts ones behaviour. Also according to Bloom *et al.* (1956), knowledge is considered as a key element out of different arenas of educational activities. For this purpose, construction of a reliable and valid knowledge

Table 4: Final list of screened knowledge items which are included in the standardized test

S.No.	Knowledge items
1.	What are the principles of conservation agriculture?
2.	Do you know crop residue retention in the field improves the soil health?
3.	What is the effect of mulching on soil temperature?
4.	Up to what extent land preparation is shortened due to direct sowing of wheat just after rice harvest in conservation agriculture?
5.	What is the effect of practicing zero tillage on ***Phalaris minor*** problem in wheat?
6.	Do you know incorporating 1 ton of crop residues in the soil releases nutrients in the soil?
7.	To what extent requirement of irrigation water and fuel changes when CA is practiced in wheat?
8.	Which type of tractor is needed for working of happy seeder?
9.	Which of the following is an automated laser guided beam operated machine that is used mainly in CA practices?
10.	Do you think use of laser land leveller for land preparation saves energy and enhances water productivity?
11.	Which of the following are used for real time nitrogen management in CA practices of wheat?
12.	What is the operation mechanism of zero tillage machine?
13.	Are you aware that soil test based nutrient management is essential to utilize the full potential of CA?
14.	What is the best measure of weed control under minimal tillage condition of wheat?
15.	What is the pre requisite for applying zero tillage technology in wheat?
16.	Do you know that retention of rice stubble adds nutrients to the soil and would reduce N requirement of the wheat crop by 10 per cent?
17.	Which mobile app has been launched by government to get all kinds of agro-machineries on rent?
18.	Which irrigation technique provides 'opportunity for saving water in CA cultivated wheat?
19.	Which recently launched scheme helps in promoting in-situ management of crop residue?
20.	What amount of subsidy is provided by state government for purchase of CA specific machineries?

tool is essential. The present study calls for developing a standardized test on CA practices in wheat which will help the researchers, academicians, different stakeholders and policy makers to formulate and refine policy guidelines and new strategies that will augment the adoption of CA by farmers. This study tried covering all the possible aspects of Conservation Agricultural practices and developed knowledge tool can be used by researchers in other related fields with needed modification.

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Health Risk Assessment of Workers Engaged in Flour Mills

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ABSTRACT

Flour mills are the epicentre of occupational health hazards resulting from the unorganised workplace and exhaustive activities carried out by the flour mill workers without any regard for safety. Taking into account the extent of difficulties faced by the workers of flour mills the present study was undertaken to know more about the different types of activities and various risks associated with the activities carried out in flour mills. The study was conducted through a properly framed research in Ludhiana city on 100 workers selected randomly from two zones of the city, who were vigorously involved in different tasks performed in the flour mills. An interview schedule was designed in order to obtain information from the selected respondents about their personal and professional backgrounds, as well as the challenges they faced while working in flour mills. Scales used for postural analysis of the respondents were Postural Discomfort Scale (Corlett and Bishop, 1976), Standardized Nordic Musculoskeletal Questionnaire (Kuorinka *et al.,* 1987) and Rating of Perceived Exertion Scale (Varghese *et al.,* 1994). Results revealed that factors contributing to worker health decline were working in filthy conditions without using any personal protective equipment leading to respiratory issues whereas injuries like dislocations, slips, cuts, falls were also reported due to carrying heavy load on slippery floor and due to unguarded machines. Postural analysis showed that lower back, upper back, neck and shoulders were the most affected body parts of the respondents.

Keywords: Flour mill workers, Flour mills, Occupational health hazards, Postural discomfort, Workplace

INTRODUCTION

Indian flour mills are one of the most primitive industry used to convert cereals and grains into flour for the consumption. In flour mills, loading and unloading of grains into the machine required human efforts which included loading the heavy sacs of grains into the machine. Workers have to lift the heavy bags above their shoulder level for loading it into the machine/ grinder thereafter packing the converted flour and then reloading/delivering it for the sales to the consumers. Mishandling of equipment can lead to injuries such as by ejection of part of the machine that could fly off and hit the body of the worker, impact, entanglement, contact and entrapment in which parts of the body could be trapped in the part of the machine. Specific occupational safety and health risk factors differ depending upon the type of activities performed in the industry (Nordlöf *et al.,* 2017). Despite of the availability of so many machines it has been observed that most of the work is still carried out by the workers manually. Slippery floor and carrying heavy loads on backs seems to be the prime reason behind accidents like dislocation, slips and falls. It has been observed that the workers perform tasks without knowing anything about the specific postures and their significance to avoid postural deformity. According to the reports of Health Division of Biomedical and Behavioural Science (1981) among commonly reported injuries in flour mills, musculoskeletal disorders have been observed as one of the major outcome of work related diseases and injuries. Working repetitively with forceful exertion along with the adoption of the wrong postures are the things that are fundamental for developing work related musculoskeletal disorders. It was perceived that manual material handling (MMH)

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play a vital role in flour mills as a number of MMH tasks such as loading, unloading, lifting, packing are performed by the workers therefore they are the prime sufferers of severe risks and experience occupational health hazards to a greater extent. Among the injuries reported in flour mills, musculoskeletal disorders have been observed as one of the major outcome of work related diseases and injuries. Ali *et al.* (2012) conducted an ergonomic study on the musculoskeletal disorders faced by the saw mill workers of Karnataka working in unorganised sectors and it was observed that 80 per cent workers discomforted with the thigh, leg and back pain and 50 per cent suffered from arm and shoulder pain.

Although work provides financial assistance and other benefits, but one cannot neglect the workplace hazards and safety of the workers at workplace. The negligence towards the health and safety of the flour mill workers may lead to the steady development of various health impairments. Attention towards health of every individual working in the flour mill is a pre requisite. As per the study by Qutubuddin *et al.* (2013) it has been illustrated that the small scale industries and the unorganized sector like flour mills and their workers have very little awareness about ergonomics, good work environment, good postures etc. The awareness of occupational health and safety by the supervisors/ owners of the flour mill along with their workers is critical for the functional and effective practice of services regarding occupational health at their workplace. Furthermore, awareness regarding various risks associated with adopting wrong postures and occupying the workplace well with the hazard control measures is a must. This will not only increase the productivity of the organization but also reduce the risk of accidents and will definitely lead towards better health of the workers.

MATERIALS AND METHODS

The purpose of this study was to better understand the various activities that flour mill workers engage in. It was conducted in the flour mills of two randomly selected zones of Ludhiana city. A sample of 100 respondents from selected flour mills was selected randomly. A self structured interview schedule was prepared for collecting the data to know about various tasks performed by the flour mill workers and the risks associated with the activities. Every respondent was interviewed personally for getting better information related to their opinions about mill job. Interview schedule was prepared in accordance with the objective of the study. Part one dealt with the background information which included personal profile of the respondents with respect to age, education, family size, family income, years of working, employment characteristics, and reasons for taking up employment etc. Subsequently, the next part covered the specific information related to different type of activities performed in the flour mills, working hours, various work related risk factors faced by respondents and hazards experienced by respondents as well as ergonomic assessment of postural and musculoskeletal discomforts experienced by the respondents. Postural discomfort was assessed by following scales:

Corlett and Bishop (1976) Scale for Postural Discomfort: The musculoskeletal complaints, localized uneasiness and level of pain in various body parts caused due to postural discomfort was measured using this scale. The level of pain felt in each of the reported body part was determined on the basis of a 5 point scale. The maximum level of pain i.e. very severe is given a score of 5 followed by 4, 3, 2 and 1 representing severe, moderate, mild and very mild respectively. The total score was obtained by adding and taking average of the body part discomfort scores.

Standard Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987): The Standard Nordic Musculoskeletal Questionnaire emphasizes on overall body, lower back, and neck/shoulder grievances. It helps to identify the type, severity and extent of various musculoskeletal problems related to different body parts faced by respondents.

Rating of perceived exertion scale by Varghese et al. (1994): The extent of exertion felt by respondents for each body part was identified by using this scale. It is a 5 point scale, where very heavy exertion is given a rating of 5, followed by 4, 3, 2 and 1 for heavy exertions, moderate exertions, light exertions and very light exertion respectively.

RESULTS AND DISCUSSION

Table 1 shows distribution of the respondents according to the variables including age, educational

Table 1: Distribution of respondents as per the socio-economic profile

Variables	Frequency	Percentage
Age (years)		
18-25	30	30.00
26-35	35	35.00
36-45	25	25.00
46-55	10	10.00
Educational qualifications		
Illiterate	43	43.00
Primary	25	25.00
High school	17	17.00
Senior secondary	12	12.00
Graduation	03	03.00
Family size		
Small (1 to 4 members)	25	25.00
Medium (5 to 7 members)	35	35.00
Large (8 and above)	40	40.00
Work duration		
8-9 hours	30	30.00
10 -12 hours	65	65.00
More than 12 hours	05	05.00
Duration of rest time		
1.5- 2 hours	100	100.00
Monthly income of respondent (Rs)		
5,000-15,000	68	68.00
15,000-20,000	24	24.00
20,000-30,000	08	08.00
Average	**Rs 12530/-**	

qualification, family size, work duration, resting hours and their monthly income. It has been concluded that majority of respondents belonged to the age group of 26-35 years (35%), most of the respondents were illiterate (43%) and only 3 per cent of the selected respondents were graduated who were actually the owner and worker in the same flour mill. Forty percent were having a joint family type with more than 8 family members. In terms of working hours, it was noted that the majority of respondents (65%) worked for 10-12 hours per day, while 5 per cent worked for more than 12 hours per day, with only 1.5-2 hours of relaxation for the entire day. In terms of monthly income, it was shown that 68 per cent of the respondents earned between Rs. 5,000 and Rs. 15,000 per month. After conducting interviews, it was found that the workers' reasons for choosing the flour mill job were their illiteracy and the fact that they were not eligible for any other job; therefore they picked the mill job.

Table 2 shows information on the tasks performed as well as the equipment used in flour mills. Loading, unloading, stacking, cleaning, packing, and delivery were found to be the most common tasks carried out in flour mills. Table 2 shows that 92 per cent of the respondents were involved in activities such as loading and unloading of grains and flour. Stacking, cleaning and packaging were performed by 100 per cent of the respondents, followed by 79 per cent respondents who performed activities like lifting grain and flour sacks and 65 per cent who delivered the finished product from the mill to the customers. When asked what type of apparatus or equipment they use in their flour mills, 35 per cent said they use a weighing scale to weigh bags of grains and prepared flour, and 10 per cent said they use a trolley to drag and move the sacs from one place to another, furthermore 45 per cent of the respondents use to work on wheel barrow to run the main machine/grinder and only 10 per cent of the respondents were engaged in other activities like checking the movement of the machine, proper working of the other equipment in the flour mills etc.

Concerning about the problems and challenges faced by the respondents while working in the flour

Table 2: Activities performed and equipment used by the respondents in the flour mills (n=100)

Activities	Frequency	Percentage
Loading and unloading	92	92.00
Stacking	100	100.00
Cleaning	100	100.00
Lifting	79	79.00
Packaging	100	100.00
Delivery	65	65.00
Equipment used		
Weighing scale	35	35.00
Trolley	10	10.00
Wheel barrow	45	45.00
Any other	10	10.00

*Multiple responses

mills Table 3 indicates that 27 per cent of the respondents experienced dislocation at different parts of their body while performing tasks at the workplace. Subsequently 27 per cent of the respondents suffered from bruises while 30 per cent of the respondents experienced cuts on hands and feet while being present at workplace. According to the Table 3, eighteen percent of the respondents slipped at their workplace while performing one or the other task because of the slippery floor, thirty three percent of the respondents experienced falls while performing activities at the flour mill due to one or the other reason. Table 3 also shows that 11 per cent of the selected respondents agreed that they had injuries because of handling unguarded machines or had impact with any sharp object while working. According to the data shown in Table 4, it has been observed that 44 per cent of the respondents agreed that they experienced injuries due to lifting heavy loads; impact with the machine makes the workers vulnerable from getting injuries like cuts and bruises. It has been observed that according to 35 per cent of the respondents unguarded machines are very much responsible for the injuries at workplace. As per the data shown in Table 4, twenty two percent of the respondents agreed with the statement that slippery flooring is dangerous for such a workplace where they have to walk with carrying heavy loads on their back and shoulders.

Table 3: Injuries faced by the workers while working in the flour mills (n=100)

Injuries	Frequency	Percentage
Dislocation	27	27.00
Bruises	27	27.00
Cuts	30	30.00
Slip	18	18.00
Fall	33	33.00
Impact with sharp object	11	11.00

*Multiple responses

Table 4: Reasons of injuries (n=100)

Reasons	Frequency	Percentage
Heavy load	44	44.00
Unguarded machines	35	35.00
Slippery floor	22	22.00

*Multiple responses

Assessment of postural discomfort of the respondents: MSDs (musculoskeletal disorders) are injuries or pain in the joints, ligaments, and muscles that support the limbs, neck, and back. MSDs can result from a sudden physical exertion (e.g. lifting a large object), repetitive strain, or repeated exposure to force, vibration or an unpleasant posture (Mehrdad *et al.,* 2010).

A questionnaire was used to quantify the severity of pain in various body locations while undertaking work activities to determine the amount of respondents' subjective musculoskeletal pain. The mean ratings for the amount of pain in different bodily locations were obtained on a five-point scale ranging from one to five, with one indicating very moderate pain and five indicating extremely severe pain in the affected part. A mean rank was assigned to the calculated mean score. Selected respondents reported higher pain in their lower back, neck, upper back, and shoulder joints, as shown in Table 5 and were assigned I (3.06), II (2.98), III (2.32) and IV (2.28) scores, respectively. Respondents rated their knees, legs, ankles/ feet and thighs as V (1.64), VI (1.09), VII (1.08) and VIII (1.00) respectively, as having low or no pain.

The Standardized Nordic Musculoskeletal Questionnaire was used to determine the respondents' musculoskeletal problems and bodily pain. The Z–test was used to analyze respondent responses, which were collected using a standard worksheet. According to the statistics, a large number of respondents had issues (ache, pain, discomfort) in numerous bodily locations such as the neck, shoulders, upper back and lower back

Table 5 Postural discomfort experienced by respondents by using Corlett and Bishop Scale 1976 (n=100)

Body parts	Mean Score	Mean rank
Lower back	3.06	I
Neck	2.98	II
Upper back	2.32	III
Shoulder joints	2.28	IV
Knees	1.64	V
Legs	1.09	VI
Ankles/feet	1.08	VII
Thighs	1.00	VIII

*Multiple responses

Table 6: Assessment of musculoskeletal problems of respondents by using Standardized Nordic Musculoskeletal Questionnaire (Kuorinka *et al.,* 1987) (n=100)

Body parts	I		II		III	
	Percentage	Z Score	Percentage	Z Score	Percentage	Z Score
Neck	68.00	5.72*	56.00	9.00*	47.00	12.33*
Shoulders	48.00	1.63**	45.00	6.25*	21.00	3.67*
Elbows	35.00	1.02**	NIL	5.00*	NIL	3.33*
Wrist/hands	29.00	2.25*	27.00	1.75**	20.00	3.33*
Upper back	45.00	1.02**	45.00	6.25*	25.00	5.00*
Lower back	72.00	6.53*	70.00	12.50*	44.00	11.33*
Hip/thighs	26.00	2.86*	NIL	5.00*	NIL	3.33*
Both knees	29.00	2.25*	28.00	2.00*	04.00	2.00*
Ankles	25.00	3.06*	NIL	5.00*	NIL	3.33*

Multiple responses; ** Non Significant * Significant at 5% level of significance

in the previous 12 months. The ankles were the least painful. Respondents were unable to conduct normal job due to pain in their lower back (70%), neck (56%), shoulders (45%) and upper back (45%). Respondents reported pain in their neck (47%), lower back (44%) and upper back (25%) in the past seven days, while respondents reported discomfort in numerous body regions; ergonomic intervention was found to be necessary for the prevention and treatment of various risk factors caused by incorrect postures, which were primarily used during flour mill work.

Respondents' evaluations of felt exertion in various body locations while performing work-related tasks were depicted on this scale. It was a five-point scale with a mean of five to one ranging from "Very Severe" to "Mild" respectively. On the basis of mean scores, rankings were assigned. According to Table 7, respondents reported mild to moderate exertion in their lower backs, upper back and shoulder joints and so I (4.00), II (3.23) and III (3.16) ranks were assigned. This could be due to the unnatural positions that they used while performing activities. Light exertion was felt by respondents in neck, followed by ankle/feet and no or very less exertion was felt by respondents in calf muscles and given IV (2.98), V (1.08) and VI (1.01) ranks respectively. Carayon *et al.* (2000) presented pathways for a theoretical correlation between job stress and WRMDs. The pathways highlighted the physiological, psychological and behavioural reactions to stress that can affect work related musculoskeletal disorders (WRMDs) directly or indirectly. One model specified that psychosocial work factors (pressure of work and lack of control) might be associated with ergonomic factors such as force repetition and posture that have been recognized as threatening factors for WRMDs. Practical implementation of this research contained practitioners considering psychosocial work factors and job stress in their attempt to lessen the growth of WRMDs.

Table 7: Postural discomfort experienced by respondents by using rating of Perceived Exertion Scale Varghese *et al.* (1994) (n=100)

Body parts	Mean Score	Mean rank
Lower back	4.00	I
Upper back	3.23	II
Shoulder joints	3.16	III
Neck	2.98	IV
Ankles/feet	1.08	V
Calf muscles	1.01	VI

*Multiple responses

CONCLUSION

On the basis of foregoing results it can be concluded that flour milling is a time-consuming activity that requires a lot of manual labour, workers working in flour mills perform activities in a very repetitious and fast-paced environment and exposed to a variety of health concerns for little remuneration. Workers in flour mills work nonstop for 12 hours, exerting the same amount of physical effort. Flour mills were also found to be lacking in amenities such as separate rest areas, drinking water, and sanitary facilities for the workers. They are more prone to injuries from unguarded equipment, cuts, slips and falls due to the unhygienic conditions and lack of proper spacing. Subjective scales used for assessing the postural discomfort of the selected respondents revealed that respondents' faced severe exertion in their lower back, upper back, shoulder joints and neck. The role of owners and stake holders is very vital towards the health of their workers, it is very important that the flour mill workers are provided with some guidelines for their better work environment and also to reduce health risks while performing different activities in the flour mills. Proper training should be provided to the workers regarding the safe use of machines or any new equipment installed in the workplace to prevent future accidents. Awareness programs should be planned by the owners for their workers to inform them regarding the accidental risks and adoption of wrong postures and how to correct them. One should be keen towards observing the basic necessities related to the job and the workplace so that there will be no compromise with the health and productivity of the enterprise.

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Constraints for Crop Diversification in FCV Tobacco Growing Regions of Andhra Pradesh and Karnataka

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ABSTRACT

Crop diversification intends to bring about a shift from the regional dominance of one crop to a number of crops and also from traditionally grown less remunerative crops to high value crops. The present study was carried out in the FCV (Flue Cured Virginia) tobacco growing regions in selected auction platforms of Northern Light Soils (NLS) and Southern Light & Black Soils (SL&BS) in Andhra Pradesh and Karnataka Light Soils (KLS) of Karnataka during 2019-20 with an objective to measure the constraints perceived by the FCV tobacco growers on crop diversification. *Expost facto* research design was used and random sampling technique was employed in selection of respondents. Thirty respondents in each of 3 tobacco regions were selected to make the total sample size of 90 respondents. To measure the constraints faced by the respondents in crop diversification, a suitable schedule was developed and the constraints were ranked accordingly based on the total score by using Henry Garette method of constraint analysis. The findings revealed that infrastructure related factors such as inadequate facilities for value addition, lack of proper storage facilities at harvesting time and lack of drying yards are the severe constraints for crop diversification in NLS region. Resource related challenges *viz.,* rainfed nature and lack of irrigation facilities, timely non-availability of inputs and low input subsidies were identified as key factors hindering the process of crop diversification in SL&BS regions. In case of KLS farmers, socio-psychological factors *i.e* specific attitude of farmers towards particular crops, demographic conditions mainly small and marginal land holdings of farmers and illiteracy were perceived as major constraints for crop diversification.

Keyword: Farmer-perceived constraints, Crop diversification, FCV tobacco, Income, Market

INTRODUCTION

Doubling of Farmers Income (DFI) by the year 2022-23 has been one of the main agendas of the Government of India to promote farmers' welfare, reduce agrarian distress and bring parity between income of farmers and those working in non-agricultural professions. According to NITI Aayog reports, doubling real income of farmers till 2022-23 over the base year of 2015-16, requires annual growth of 10.41 per cent in farmers' income (Chand, 2017). At the national level, the DFI committee constituted to recommend strategies for doubling of farmers' income has identified seven sources of income growth. Among these identified sources, the 'diversification towards high value crops' is one strategy that offers a great scope to improve farmers' income. In agriculture, diversification can be defined as shift from the regional dominance of one crop to another or from one enterprise to another or to engage in other complimentary activities (Bansal *et al.,* 2020). The process of crop diversification involves a shift of the resources particularly in cultivated area from low value to high value crops. Besides, introducing a greater range of varieties in a particular agro-ecosystem leads to diversification of agricultural production which can also increase natural biodiversity and strengthens the ability of the agro-ecosystem to respond to any type of stress (Khanam, 2018). The diversification towards high value

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crops compatible with the comparative advantage of the region is suggested as a viable solution to stabilize and raise farm income, increase employment opportunities particularly for small and marginal farmers (Singh *et al.*, 2009).

The analysis on growth sources in Indian agriculture by Birthal *et al.* (2013) showed that the contribution of crop diversification to the growth of the crop sector over the periods were 26.3 per cent in 1980's, 33.3 per cent in 1990's and 31.2 per cent, in 2000-01 to 2009-10. The findings by region wise indicated that crop diversification has contributed the most to the growth of the crop sector during the period 2000-01 to 2009-10 in the southern region (48.6%), followed by the eastern (42.1%), western (37.9%) and northern (26.2%) regions of India.

Besides, Crop Diversification Programme (CDP), a sub scheme of Rashtriya Krishi Vikas Yojana (RKVY) is also being implemented in tobacco growing states to encourage tobacco farmers to shift to alternate crops/cropping system. Under CDP, tobacco growing states have been given flexibility to take suitable activities/interventions for growing alternative agricultural/horticultural crops. The per cent budget share in the total CDP for tobacco growing areas to shift from tobacco to other crops was increased from 16.67 per cent in 2015-16 to 33.35 per cent in 2019-20, which shows success in implementation of the programme (Hema *et al.,* 2020). Besides, an amount of Rs 10 crore to CDP for replacing tobacco farming has been earmarked for implementation of the programme during 2021-22 (DAC&FW 2021). Moreover, present anti-tobacco policies are also going to throw new challenges on tobacco farming. Thus, promotion of crop diversification can be one of the best strategies to increase agricultural productivity, mitigate risk and raise income of farmers in the country in general and tobacco growing regions in particular. But FCV (Flue Cured Virginia) tobacco is more remunerative than other crops grown in tobacco growing regions (Hema *et al.,* 2019). Due to positive benefits from cultivation of FCV tobacco, farmers are unwilling and also facing some constraints towards shift from tobacco to other crops. Against this backdrop, the present study was undertaken with an objective to identify farmer-perceived constraints for crop diversification in FCV tobacco growing regions of Andhra Pradesh and Karnataka.

MATERIALS AND METHODS

The study was conducted with *Expost facto* research design by collecting data from FCV tobacco farmers of Northern Light Soils (NLS) region in West Godavari district, Southern Light & Black Soils (SL&BS) region in Prakasam and Nellore districts of Andhra Pradesh and Karnataka Light Soils (KLS) region in Mysuru district of Karnataka during 2019-20. Random sampling technique was employed in selection of respondents. Altogether, 90 farmers (30 from Gopalapuram and Koyyalgudem auction floors in NLS; 30 from Kandukur & Tangutur auction floors in SL&BS; and 30 from Periyapatna and Chilkunda auction floors in KLS) were selected and data were collected. To identify the key constraints faced by the respondents in crop diversification, a suitable schedule was developed by way of enlisting all the possible constraints based on the discussion with farmers and also through data from relevant review of literature. The data collected were coded, tabulated and to measure the intensity of constraints intervening in the crop diversification, Friedman's non-parametric test and Henry Garette constraint analysis were used for analysis to identify the major constraints to crop diversification in FCV tobacco growing areas of AP and Karnataka.

Friedman's test for related samples: It is a non-parametric statistical test used for comparing more than two samples that are related. When the Friedman's test leads to significant results, then at least one of the samples is different from the other samples. This analysis was carried out by using SPSS software.

Henry Garette constraint analysis: As per this method, respondents have been asked to assign the rank for all the constraints and the per cent position is calculated with the following formula

$$\text{Per cent position} = \frac{100\,(R_{ij}-0.5)}{N_j}$$

Where, R_{ij} = Rank given for the i^{th} variable by j^{th} respondents

N_j = Number of variable ranked by j^{th} respondents

The per cent position estimated is converted into scores by referring to the Garrett's Table (Garrett *et al.,* 1969). Then for each factor, the scores of each individual are added and then total value of scores and mean values of score is calculated. The factors having highest mean value is considered to be the most important factor. The constraints were ranked according to the total Garette's mean score obtained.

RESULTS AND DISCUSSION

All the possible constraints being faced by the FCV tobacco farmers for crop diversification were grouped into seven major categories *viz.* resource, technological, socio-psychological, infrastructural, institutional, marketing and financial constraints. In order to analyze various types of constraints, the farmers were asked to give the response on five point continuum and non-parametric Friedman's test was carried out. On the basis of mean ranks, severe challenges in each category were identified and the results were presented in Table 1.

Resource constraints: Data in Table 1 depicted that, among the resource constraints, scarcity of human labour in NLS; rainfed condition and lack of irrigation facilities in SL&BS; and small and marginal land holdings in KLS were ranked high. One of the major bottlenecks especially in irrigated areas of NLS region of AP is labour shortage. Although labour scarcity affects the agriculture sector as a whole, but the impact is more pronounced in case of certain crops that require significant amount of labour hours per unit area. For instance, paddy, sugarcane and groundnut are among the most likely crops to be affected by labour scarcity cultivated in NLS region. FICCI (2015) reports also highlighted the impact of labour shortage on some of the major crops across various states. For example, 5 per cent of agricultural workforce in rural areas of AP migrated to other sectors during 2004-12 witnessed significant labour shortage in paddy cultivation. Rainfed condition and scarcity of water resources were the primary constraints which needed immediate attention in SL&BS regions. Similar findings were reported by Vani *et al.* (2021). SL&BS regions of Prakasam and Nellore districts of AP are deficit rainfall regions. The yield of different crops is dependent on the rainfall received. In case of KLS region, crop diversification depends upon the size of farm holdings to a large extent. As the farmers are having meager land holdings, their decision to shift from tobacco depends on the market demand of the other crops.

Technological constraints: In case of constraints related to technological, inadequate information on viable diversification technologies holds the first rank and seriously hinders the process of crop diversification in NLS, SL&BS regions of AP. Except few progressive farmers, majority of the farmers have not undergone any specific training regarding crop diversification which made farmers disinterested to diversify towards other crops and were reliable on knowledge from other farmers. Singh *et al.* (2020) and Singh *et al.* (2021) found that 55 per cent of respondents perceived and expressed reason for non-adoption of crop diversification was lesser availability of specialized expertise. Whereas, lack of published literature on crop diversification in local language holds the first rank in the constraints hierarchy in KLS region.

Socio-psychological constraints: When it comes to socio-psychological constraints, illiteracy/ lack of awareness, less risk bearing capacity/motivation, attitude of farmers towards specified crops are the major constraints. It is a fact that many farmers have only vague ideas about crop diversification and its benefits. As most of them are illiterate, they lack knowledge on diversification. Similar results were reported by Kaur *et al.* (2020). It was observed from the study area that farmers change the crop as followed by progressive farmers in the village. In the study by Nitin (2012) on information needs of the rural farmers, it was found that 66.86 per cent of farmers rely on fellow farmers for obtaining the farm information. Farmers are of the opinion that as compared to FCV tobacco, demand for other crops is low, production is not easy, yield is not certain and more risk is involved in case of alternative crops. This is similar to the findings of Gangubai *et al.* (2019).

Infrastructural constraints: The major infrastructural constraints hindering crop diversification are inadequate facilities for value addition, poor basic infrastructure like roads/power/ communication and lack of proper storage facilities at harvesting time in NLS, SL&BS and KLS, respectively. Lack of proper facilities for value addition and transportation facilities causes post-harvest losses. According to the findings reported by Pandey (2018), the Indian farmers incur Rs 92,651 crore/year in post-harvest losses, the primary causes of which are poor storage and transportation facilities. Chaturvedi *et al.* (2015) stated that the warehousing capacity available

Table 1: Constraints Perceived by Farmers on Crop Diversification in FCV Tobacco growing regions in Andhra Pradesh and Karnataka (N=90)

Category	Mean ranks of Friedman's Test		
	NLS	SL&BS	KLS
Resource constraints			
Small and marginal land holdings	2.45	3.00	**3.43**
Scarcity of human labour	**3.22**	2.60	2.77
Rainfed condition and lack of irrigation facilities	2.95	**3.40**	2.97
Lack of draught power/farm implements	3.18	2.83	2.90
Timely non-availability of inputs & low input subsidies	3.20	3.17	2.93
Technological constraints			
Lack of HYV/ lack of resistant varieties	3.05	2.72	2.93
Non- availability of good quality seeds	2.52	3.13	3.07
Inadequate information on viable diversification technologies	**3.22**	**3.22**	2.65
Lack of published literature in local language/poor data base	3.10	3.07	**3.32**
Lack of knowledge on MSP (Minimum Support Price)	3.12	2.87	3.03
Socio-psychological constraints			
Less risk bearing capacity/motivation	2.88	**3.30**	2.82
Illiteracy/ lack of awareness	**3.17**	3.13	3.10
Attitude of farmers towards specified crops	2.83	2.80	**3.15**
Lack of planning and motivation	3.12	2.97	2.82
Demographic conditions	3.00	2.80	3.12
Infrastructural constraints			
Lack of soil-testing facilities nearby	2.75	3.20	2.82
Inadequate facilities for value addition	**3.43**	2.95	2.97
Lack of proper storage facilities at harvesting time	3.12	2.67	**3.27**
Lack of drying yards in the villages	2.97	2.98	2.93
Poor basic infrastructure like roads/power/ communication	2.73	**3.21**	3.02
Institutional constraints			
Weak research - extension - farmer linkages	3.05	**3.18**	3.05
Lack of public/private custom hiring centers nearby	**3.32**	3.08	**3.06**
Weak agro-based industry tie ups	3.17	2.87	3.05
Lack of supporting societies/FPO	2.87	3.07	3.02
Government regulatory policies	2.60	2.80	2.83
Marketing constraints			
Intermediaries exploitation	**3.18**	2.87	3.13
Price fluctuations/low prices	3.12	**3.25**	2.75
Lack of regulated market	2.80	3.02	**3.33**
Delay in procurement	2.75	2.72	2.82
Distress selling	3.15	3.15	2.97
Financial constraints			
Non-availability of credit and complex procedures	**3.25**	3.05	2.87
High cost of inputs	3.22	**3.50**	3.07
High Transport cost	2.80	2.72	3.03
Delayed payment of sale proceeds	2.85	2.35	2.82
Lack of government loan or subsidy to diversify	2.88	3.38	**3.22**

Note: NLS-Northern Light Soils of AP; SL&BS-Southern Light & Black Soils of AP; KLS-Karnataka Light Soils.

in India, from public, cooperative and private sector is about 945.26 lakh metric tonnes and additional 35 million metric tonnes warehousing capacity is required for the storage of all major crops.

Institutional constraints: Farmers expressed lack of custom hiring centers nearby and weak linkages are the severe constraints among institutional category. Small and Marginal farmers cannot afford higher cost machinery. During 2014-21, an amount of Rs. 621.23 crore have been released to AP by DAC&FW and during 2021-22 Rs.32.93 crores released as 1st installment under Sub-Mission on Agricultural Mechanization (SMAM) scheme for the establishment of 525 Custom Hiring centres and 34 High Tech Hubs (PIB, 2021). As most of the farmers rely on progressive farmers for information, farmers expressed there is weak linkage with different agencies for getting information on crop diversification. Similar findings reported by Vani *et al.* (2021).

Marketing constraints: Intermediaries' exploitation, heavy price fluctuations and lack of regulated market are ranked high. This is in support with the findings of Manas *et al.* (2019). Chatterjee (2018) stated that although several layers of intermediation before the output reaches the consumer is a major hindrance but 37 per cent of the overall variation in prices is due to region-specific factors; 20 per cent of the spatial variation is due to aggregate shocks like fluctuations in global demand and 4 per cent is due to regional differences in rainfall. All the tobacco farmers (100%) expressed concern that there is no regulated market in case of other crops cultivated in the tobacco growing regions. Similar findings reported by Sahu *et al.* (2020) and Hema *et al.* (2018).

Financial constraints: Non-availability of credit and complex procedures in obtaining loan and high cost of inputs are the severe financial constraints. Loans from banks require collateral guarantee, economically backward cannot offer and therefore cannot get loan at appropriate time. Bansal *et al.* (2020) also observed that more than half of the total respondents were facing many difficulties due to the inadequate availability of credit. SL&BS farmers expressed concern that as adequate labour were not available in the locality, the existing labour demanding higher wages resulting in high cost of inputs. Further, respondents opined that there is no separate financial support or subsidy from the government to diversify the farms.

To get an overall view of the constraints experienced, with respect to crop diversification in tobacco growing areas, Henry Garette's ranking technique was carried out and the results were presented below.

Perusal of the Table 2 revealed that infrastructural related factors such as inadequate facilities for value addition, lack of proper storage facilities at harvesting time and lack of drying yards were the severe constraints for crop diversification in NLS region. Resource related factors mainly rainfed nature and lack of irrigation facilities, timely non-availability of inputs and low input subsidies were the major constraints in SL&BS regions. In case of KLS farmers, socio-psychological factors *i.e.* specific attitude of farmers to grow particular crops, demographic conditions mainly small and marginal land holdings of farmers and illiteracy were perceived as major constraints for crop diversification.

Table 2: Ranking of constraints by using Garette's Ranking Technique (N=90)

Constraints for Crop Diversification	NLS		SL&BS		KLS	
	Garette's mean score	Rank	Garette's mean score	Rank	Garette's mean score	Rank
Resource	43.00	V	65.83	I	62.17	II
Technological	48.80	IV	50.67	IV	39.77	VI
Socio-psychological	35.93	VI	34.83	VII	66.50	I
Infrastructural	67.83	I	59.30	II	34.00	VII
Institutional	30.47	VII	52.60	III	62.13	III
Marketing	64.17	II	44.57	V	40.97	V
Financial	60.80	III	43.20	VI	45.47	IV

CONCLUSION

The present study explored challenges of crop diversification in the FCV tobacco growing areas of Andhra Pradesh and Karnataka. On the basis of above findings, it was concluded that the key constraints faced by the respondents for crop diversification are infrastructural and market linked factors in NLS; resource and infrastructural related factors in SL&BS; and socio-psychological and resource related factors in KLS. The various infrastructural related reasons were inadequate facilities for value addition, lack of proper storage facilities at harvesting time and lack of drying yards. Whereas, resource related issues that hinder the adoption of crop diversification were rainfed nature and lack of irrigation facilities, timely non-availability of inputs and low input subsidies. In case of KLS, socio-psychological factors *i.e.* specific attitude of farmers to grow particular crops, demographic conditions mainly small and marginal land holdings of farmers and illiteracy were the major challenges. The results obtained through this study are of immense utility for the policy makers for developing need based action plans to promote crop diversification. Necessary measures should be implemented as early as possible for mitigating the constraints experienced by FCV tobacco growers, to scale up crop diversification in major FCV tobacco growing regions of Andhra Pradesh and Karnataka.

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Physiological and Growth Responses of Tomato Plants to Different Delivery Methods of Biocontrol Agent *Chaetomium globosum*

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ABSTRACT

Chaetomium globosum is a cosmopolitan fungus which has great potential as a biocontrol agent. Apart from being an effective biocontrol agent, *C. globosum* is reported to have promising effects on plant growth and development. In this study, we evaluated effect of five delivery methods of *C. globosum* Cg-2 (seed treatment, drenching of rhizosphere and various combination of seed treatment and drenching) on growth and physiological parameters of tomato plants. Seed treatment supplemented with double drenching with suspension and seed treatment supplemented with single drenching with suspension showed highest increase in plant growth among five treatments, 36.70 per cent and 36.79 per cent increase in plant height; 65 per cent and 53 per cent increase in root length, respectively. The physiological parameters like photosynthesis, stomatal conductance and transpiration increased in Cg-2 treated plants and were found highest in seed treatment supplemented with double drenching with suspension which was 9.72 μmol m^{-2} s^{-1}, 0.216 mol m^{-2} s^{-1} and 0.03 mol m^{-2} s^{-1} respectively whereas internal CO_2 concentration decreased in Cg-2 treated plants. The combination of treatments performed better over single treatment (either seed treatment or drenching) for plant growth promotion and enhancement of physiological parameters. Among these combinations, the seed treatment supplemented with single drenching is recommended for use at field level as it is economically sound and best in performance.

Keywords: *Chaetomium globosum,* Tomato, Physiology, IRGA, PGPF

INTRODUCTION

In current scenario, intensive agriculture is highly dependent on the fertilizers and chemical pesticides to get better yield and to prevent the losses by various diseases or insect-pests. The food requirement of 7.8 billion population is met by chemical intensive agriculture at the cost of the environment and increasing the area of degraded land (Motaher Hossain and Sultana, 2020). In the long run, soil health which determines plant health, animal health, human health and environment health is very crucial. Soil health can be maintained by avoiding excessive use of chemicals, ensuring adequate amounts of organic matter in soil and rich microbial population in the soil. The use of biofertilizers and biopesticides is the best alternative to agrochemicals. Numerous PGPRs and PGPFs are reported to enhance the growth and development of the plants. These root colonizing microbes establish mutualistic relationships with plants. Various biocontrol agents like *Trichoderma*, *Chaetomium* which are antagonistic against various plant pathogens also promote plant growth (Bharadwaj, 2012). Root colonization by beneficial fungi improves the plant health by enhancing the growth, improving the microbiome of the rhizosphere, and increasing the nutrient uptake by secreting various organic acids that enhance the solubility of nutrients in soil (Upadhyay *et*

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al., 2014). A PGPF can be applied to the plant as seed treatment, suspension to soil, or combination of both and booster dose at different time points. Methods of application of the biofertilizer plant have significantly variable results for promoting the growth. It was reported that PGPFs when applied by combination of delivery methods show high efficiency in promoting wheat growth (Al-Taie *et al.,* 2019).

C. globosum is a cosmopolitan fungus which has great potential as a biocontrol agent (Aggarwal *et al.,* 2015). *C. globosum* on PDA media appears as white cottony growth, which on maturation turns grey, and later red to black in color. Microscopically, *C. globosum* is characterized by production of superficial flask to sub-globose shaped perithecia, tangled by dark-stiff hairs. Asci are often clavate and evanescent, bearing lemon-shaped ascospores. Apart from being an effective biocontrol agent, *C. globosum* is reported to have promising effects on plant growth and development (Aggarwal *et al.,* 2015; Darshan *et al.,* 2020). It has been reported that few strains of *C. globosum* produce substantial amounts of ergosterol, which improves the humus layer in soils that boost up the soil fertility (Soytong *et al.,* 2001; Aggarwal *et al.,* 2004) . The *C. globosum* is used as biofertilizer in various plants such as kales, tomato, chilli, corn, citrus, potato etc., to increase plant growth and yield (Soytong *et al.,* 2017; Singh *et al.,* 2019). The application of *C. globosum* ND35 biofertilizer to poplar improves the root physiological activity and enhances the photosynthetic efficiency (Xia *et al.,* 2017). Endophytic *C. globosum* LK4 improves the plant growth by production of gibberellins and indole acetic acid (Khan *et al.,* 2012; Singh *et al.,* 2020). Plant growth and development directly depends on the physiological processes of the plant such as photosynthesis rate, water use efficiency, CO_2 assimilation. Various scientific reports are available stating the effect of *C. globosum* on the plant growth through increase in nutrient uptake or plant hormones, but none state about physiological function of the plants. Our study is the first of its type in *C. globosum* research that provides insight into alteration in physiological parameters of plants by application of Cg-2.

Tomato (*Lycopersicon esculentum* Mill.) is an important horticulture crop in the world as well as in India. India is the second largest producer in the world with 19 million metric tons production from 781 ('000) hectares land (Statista.com). Tomato productivity is affected by various plant diseases and low productivity of land, which is supplemented by use of agrochemicals in the form of fertilizers and pesticides. Biofertilizers and biopesticides are promising alternatives to get better yield in organic farming without much reduction in yield. *C. globosum* is an effective biocontrol agent and biopesticide which enhances the plant growth as well as provides protection against plant diseases.

In this study we evaluated various delivery methods of Cg-2 for tomato plant growth and physiological parameters such as photosynthesis, transpiration, stomatal conductance, internal CO_2 concentration, water use efficiency and stomatal limitations to CO_2 uptake.

MATERIALS AND METHODS

Seed material and fungal culture: This study was carried out at Division of Plant Pathology, ICAR-IARI, New Delhi. The seeds of tomato variety PUSA Rohini

(a) (b)

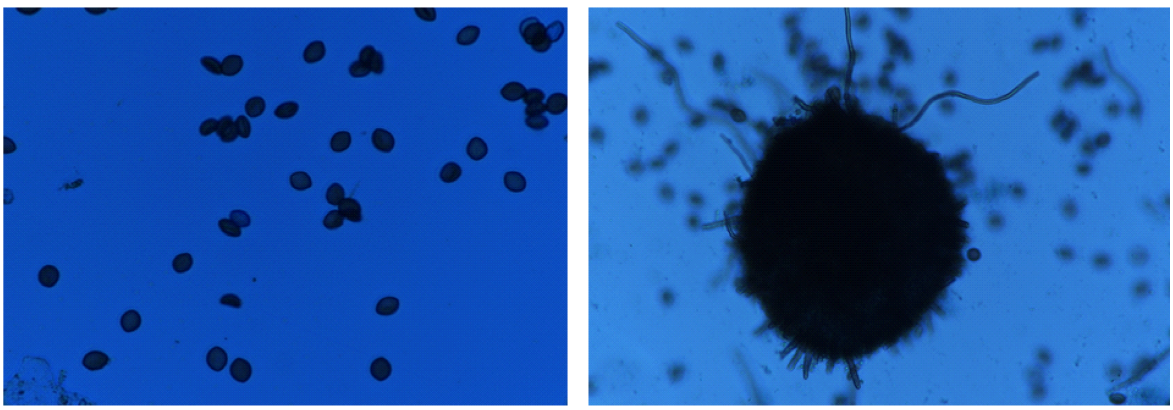

Figure 1: *Chaetomium globosum* under light microscope (a) Ascospores (b) Ascomata

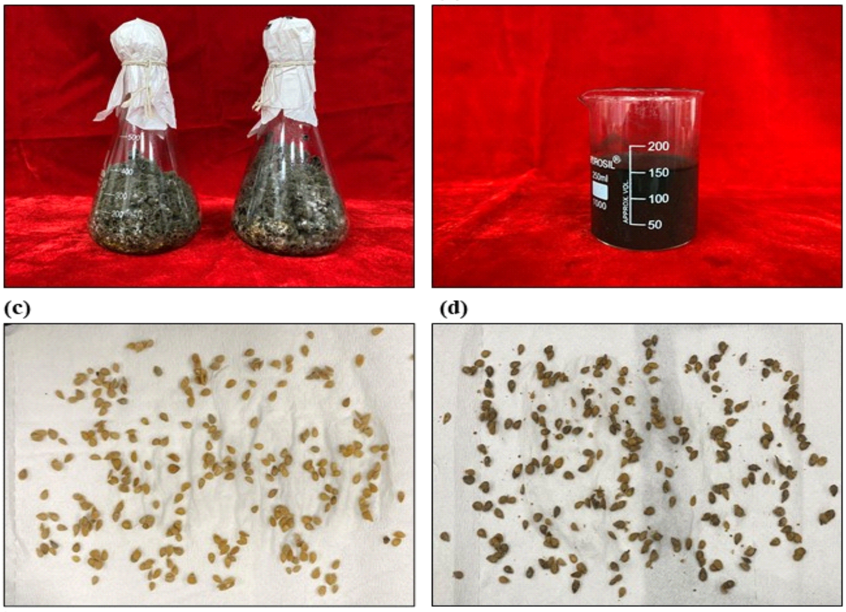

Figure 2: (a) *Chaetomium globosum* mass multiplication on sorghum grains, (b) Cg-2 spore suspension, (c) Untreated tomato seed and (d) Tomato seeds treated with Cg-2

were procured from Division of Vegetable Science, ICAR-IARI, New Delhi. *Chaetomium globosum* (Cg-2) a potential biocontrol agent and biofertilizer fungus isolated from wheat fields in Delhi (ITCC accession nos. 6210) maintained in fungal molecular biology lab was subcultured on Potato Dextrose Agar (PDA) medium and incubated at medium at 25 ± 2°C in 16-hour light and 8 hours dark.

Mass multiplication of Chaetomium globosum (Cg-2): The *C. globosum* (Cg-2) inoculum was mass multiplied on sorghum grains used as substrate (Niranjana *et al.,* 2009). The 400 g sorghum grains were soaked in water for 12 hrs. Later, sorghum grains were dried and autoclaved in volumetric flasks for 15 min at 121 ºC. Each flask was inoculated with a mycelial disc (8 mm in diameter) of 7-day-old culture of Cg-2 and were incubated at 25 ± 2 ºC until filled with black fungal spore mass (Figure 2a). The sorghum grains covered with black spores' mass were grounded to prepare spore suspension of $1{\times}10^6$ spores per ml (Figure 2b).

Tomato inoculation with Chaetomium globosum: The experiment of *C. globosum* Cg-2 treatment to tomato plants was designed based on CRD setup with six treatments and six replications for each treatment. The treatments were based on delivery method of Cg-2 to the tomato plants such as seed treatment, drenching spore suspension to rhizosphere or combinations as seed treatment and suspension (Table 1). The drenching was done by using spore suspension ($1{\times}10^6$ spores per ml) @ 100 ml per pot. The control plants were mock inoculated with distilled water.

Twelve-gram tomato seeds were taken and divided into two lots of six grams each. Both the seed lots were sterilized by 1% (VsV) sodium hypochloride and subsequently washed with distilled water. One of the lots was further dipped in *C. globosum* spore suspension ($1{\times}10^6$ spores per ml) and another lot in distilled water for overnight. The excess water was removed, and seeds were air dried in shade (Figure 2c and 2d). The

Table 1: The description of *Chaetomium globosum* Cg-2 treatment to tomato plants

Treatments	Description
T1	Control plants were mock inoculated with distilled water
T2	Seed treatment
T3	Drenching spore suspension to rhizosphere at 5 leaf stage
T4	Seed treatment and drenching with spore suspension
T5	Drenching with spore suspension at 5 leaf stage and another suspension as booster dose after 21 days
T6	Seed treatment, drenching with spore suspension and second drenching as booster dose

seeds were separately sown at depths of 3 cm in two 12-inch plastic pots filled with double autoclaved garden soil. The three-week-old seedlings were transplanted to pots filled with sterilized garden soil with 2 seedlings per pot, only a single plant was retained. The tomato plants were drenched with Cg-2 spore suspension at 5 leaf stage and with the booster dose of Cg-2 spore suspension at 21 days of first suspension to get six treatments based on combination of delivery methods as mentioned in Table 1.

Plant growth measurements: The biocontrol treated plants were analyzed for shoot and root length to determine the effect of *Chaetomium globosum* and its delivery method on the tomato plant growth. The plant height and root length were recorded for four months old plants for six treatments based on delivery method and six replications were taken for each treatment.

Assessment of physiological parameters: The IRGA LI-6400XT Portable Photosynthesis System was used to record the physiological parameters. The four months old tomato plants pretreated with Cg-2 were taken for assessment. The physiological parameters such as stomatal conductance, photosynthesis rate and internal CO_2 concentration were recorded as per manufacturer's protocol.

The IRGA instrument was set up connecting the sensor head to the console by uncoiled cable and attaching the CO_2 cartridge (Figure 3). The instrument was calibrated before use; zeroing was done before each experiment; that takes 15-20 min (Evans and Santiago, 2014). The leaf area standard was set 2 ×3 cm leaf chamber, light source (6400-02B LED light) and the flow rate of 300-400 µmol m^{-2} s^{-1}. The CO_2 entering the leaf chamber was 415 µmol mol^{-1} that maintains 400 µmol mol^{-1} in the leaf chamber head (Mujawamariya *et al.,* 2018). The three youngest fully expanded, healthy leaves of each plant were taken for measurements and 6 replicate plants for each treatment, so in total 18 measurements were taken for each treatment. The leaf was placed in the head chamber and enclosed properly without any leakage. The physiological parameters were allowed to reach the steady state to prevent the variability due to the fluctuating environment. The readings were recorded when the values for the photosynthesis and stomatal conductance stabilized.

Figure 3: The IRGALI-6400XT Portable Photosynthesis System used to record physiological parameters of tomato plant

Photosynthesis rate: The difference of CO_2 and water flux between reference and sample circuit is measured and is used to calculate rate of photosynthesis (A_N) or rate of CO_2 assimilation (Douthe *et al.,* 2018; von Caemmerer and Farquhar, 1981) .

$$A_N = u_e \frac{C_e - C_o}{L_a} - c_o EAn$$

Where, C_e and C_o are the CO_2 mole fraction at the chamber entrance and output, respectively; u_e is the incoming flow air (mol air s^{-1}), La is the leaf area surface (m^2), and E is the transpiration rate (mol H_2O m^{-2} s^{-1}).

Transpiration rate: The rate of transpiration depicted as E is calculated as differences in H_2O concentration, based on the readings of the IRGAs in the reference and sample circuits, as per following formula:

$$E = F\ (We\text{-}Wo)/La$$

Where, We and Wo are the H_2O mole fraction at the chamber entrance and output respectively; F-flow and La- the leaf area surface (m^2).

Stomatal conductance: The transpiration rate (E) and relative humidity in the substomatal cavity is used to calculate the stomatal conductance to water vapour (gs) by using the first Fick's law of diffusion (Douthe *et al.,* 2018), as per following formula:

$$gsw = E/(Wi - Wa)$$

Where, W_i -H_2O in the substomatal cavity, W_a- H_2O in the atmosphere (chamber head) and E- rate of transpiration.

Water use efficiency: The water use efficiency (WUE), which represents the CO_2 assimilation as biomass per unit of water used by plant WUE is simply calculated as ratio between A_N and E (Mujawamariya *et al.,* 2018), as per following formula:

$$WUE = A_N/E$$

Where A_N- rate of CO_2 assimilation or rate of photosynthesis and E-rate of transpiration.

Internal CO_2 concentration: Stomatal conductance is expressed as gsw in terms of H_2O and gsc in terms of CO_2. The relationship between the two depicted as

$$gsw = 1.6 \ gsc$$

Where, 1.6 factor is derived from the variation in the diffusivity of H_2O and CO_2.

The CO_2 concentration in the substomatal cavities (Ci) is calculated from CO_2 concentration in the atmosphere, rate of photosynthesis and stomatal conductance in terms of CO_2 by using the first Fick's law of diffusion, as per following formula:

$$Ci = Ca - A_N/gsc$$

Where, Ca is the atmospheric CO_2 (in chamber head) (Von Caemmerer and Farquhar, 1981).

Statistical data analysis: The differences between means of the treatments for the different growth and physiological parameters were tested using one-way ANOVA using the student's t-test. The mean of data values from different leaves on the same plant and plants with the same treatment were considered as a statistical unit. Differences were considered statistically significant at $p < 0.05$. Statistical analysis of physiological data was performed using SPSS software (IBM SPSS Statistics version 27.0)

RESULTS AND DISCUSSION

The PGPRs and PGPFs enhance the plant growth and development as observed in different crops, mostly in vegetable crops like potato, pepper, cucumber, eggplant, peas and tomato. The biocontrol fungi like Trichoderma have proliferated effect on the plant growth is reported in vegetables, arable, ornamental and forestry crops. Much of the early work focused on glasshouse vegetable crops including cucumber, bean, eggplant, lettuce, pea, radish, pepper and tomato (Baker, 1988; Kleifeld and Chet, 1992; Sandhu *et al.,* 2021a; Sandhu *et al.,* 2021b; Paulitz *et al.,* 1986). It is found that results do not show consistency in plant growth promotion, but varies with crop type, growth conditions (environment), amount of inoculum and type of inoculum or method of application. *Chaetomium globosum* is also reported to promote plant growth in various trees such as poplar (*Populus* spp.), *Malus hupehensis* and *Salvia miltiorrhiza* (Xia *et al.,* 2017). Our study evaluated the different methods of application of Cg-2 to tomato plants for plant growth and physiological parameters. The Cg-2 was applied to tomato plants as seed treatment, suspension and various combinations of seed treatment and suspension.

Plant growth parameters: The plant growth parameters showed statistically significant differences when treated with biocontrol agent *C. globosum* (Cg-2) on analysis with SPSS version 27.0. In treatment T6, plants had promising effects on plant growth which was evident from the 36.70 per cent increase in plant height as compared to control plants (Figure 4a). The T4 and T6 had a mean plant height 117.5 cm and 119.17 cm respectively, with no significant difference between them. The seed primed plants (T2) had greater mean

Table 2: Effect of methods of Cg-2 application on plant growth parameters (plant height and plant root length) (Different letters within the same column represent significant difference at 0.05 probability levels)

Treatments	Plant height (cm)	Increase in plant height	Root length	Increase in root length
Control (T1)	87.17^a		25.50^a	
T2	102.67^{bc}	17.78%	27.17^a	6.55%
T3	97.17^b	11.47%	27.33^a	7.17%
T4	117.5^d	34.79%	39.16^b	53.57%
T5	108.5^c	24.47%	29.50^a	15.6%
T6	119.17^d	34.70%	41.83^b	64.03%

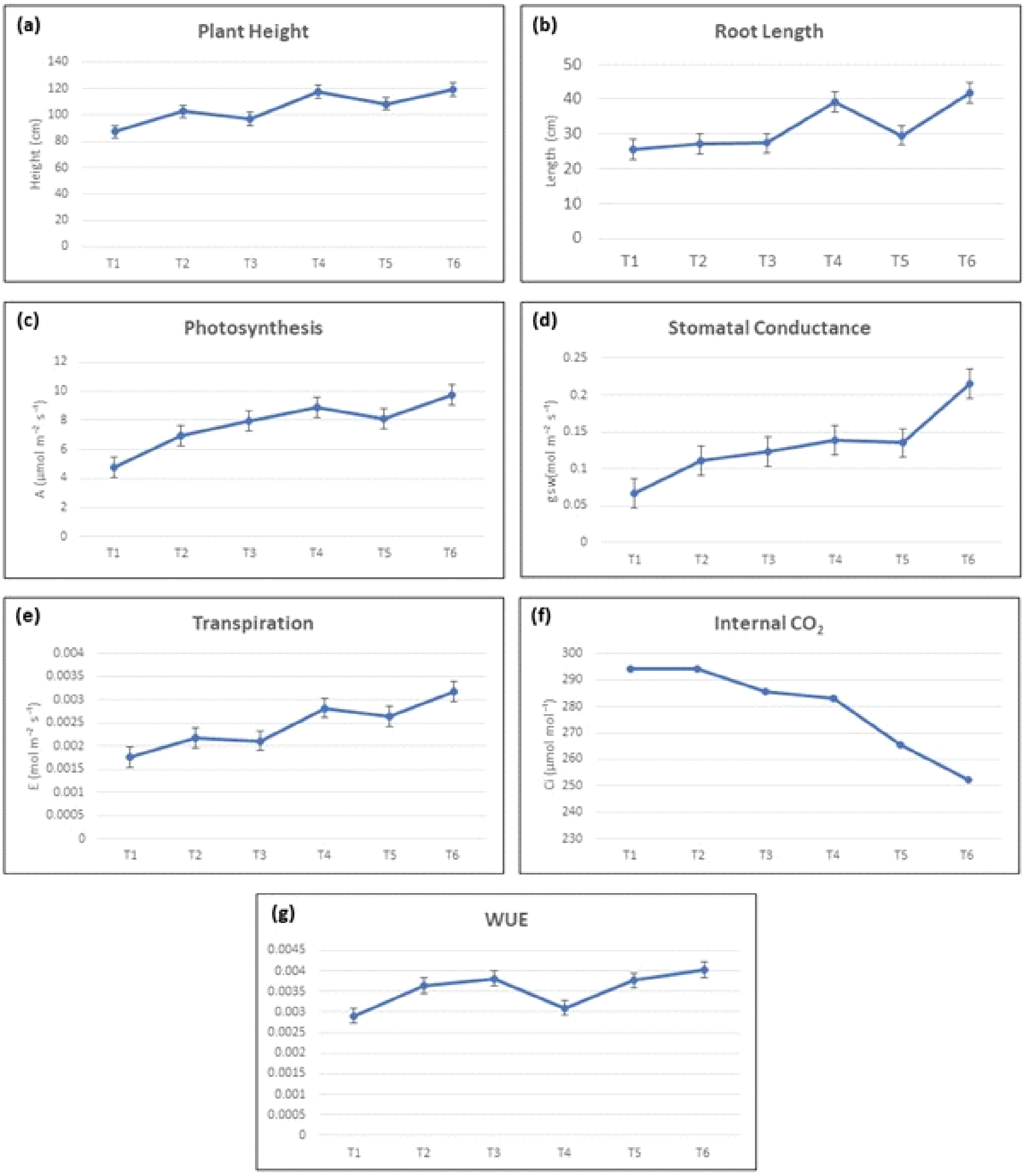

Figure 4: The effect of delivery method of Cg-2 on (a) Plant Height, (b) Root Length, (c) Photosynthesis, (d) Stomatal Conductance, (e) Transcription, (f) Internal CO_2 and (g) Water Use Efficiency (WUE) of tomato plant

plant height (102.67 cm) than control plants (T1) (87.17 cm) and those drenched with suspension (T3) (97.17 cm). There was no significant difference between the means of single Cg-2 treatment as seed priming (T2) or drenching with spore suspension (T3) or double drenching with Cg-2 (T4), though all the treated plants by either way showed better plant height than control plants (Table 2).

The Cg-2 treatment significantly increased plant root length which was evident from the 64% increase in the plant root length in T6 as compared to control plant (T1) (Figure 4b). There was a significant difference in the mean root length among the various methods of Cg-2 application. The T4 and T6 were outperforming as compared to single dose methods i.e., T2 & T3 (Table 2).

Table 3: Effect of methods of Cg-2 application on plant physiological parameters: photosynthesis (A), transpiration (E), stomatal conductance (gsw), internal CO_2 in substomatal cavity (Ci) and water use efficiency (WUE)

Treatments	A (µmol m^{-2} s^{-1})	E (mol m^{-2} s^{-1})	gsw (mol m^{-2} s^{-1})	Ci (µmol mol^{-1})	WUE
Control (T1)	4.785^{a}	0.002^{a}	0.066^{a}	294.178^{c}	0.003
T2	6.928^{b}	0.002^{a}	0.111^{b}	294.018^{b}	0.003
T3	7.922^{b}	0.002^{a}	0.124^{b}	285.743^{b}	0.003
T4	8.843^{cd}	0.003^{b}	0.139^{b}	283.259^{b}	0.003
T5	8.084^{c}	0.003^{a}	0.135^{b}	265.404^{ab}	0.003
T6	9.715^{d}	0.003^{b}	0.216^{c}	252.238^{a}	0.003

(Different letters within the same column represent significant difference at 0.05 probability levels)

It was observed that combination of treatments to give better results than single treatment because seed treated plants establish of the endophytic relationship between Cg-2 and tomato plant roots and suspension applied later gives a boosting effect by increasing the Cg-2 inoculum load in later stages. At the same time single treatment such as seed treatment or suspension also enhanced plant growth in comparison to control but lesser than the combinations. Seed treatment was observed to perform better than single drenching as inoculum load at germination stage or at plant establishment stage get a better chance of imbibing into the rhizosphere of the plant. In seed treatment, *Chaetomium* mycelium colonizes the root at early stages and continues to grow along with the root length. Overall, T4 and T6 showed best performance with no significant difference between them. So, it is better to follow T4, which is more economically sound than T6.

Physiological parameters: The physiological parameters such as photosynthesis, stomatal conductance, transcription, internal CO_2 and WUE were observed for all the delivery methods of Cg-2. The increase in plant growth is directly related to physiological factors especially to the rate of the photosynthesis.

Photosynthesis: As shown in Figure 4c, the photosynthesis rate was statistically significantly higher in Cg-2 treated plants as compared to the control plants (T1). The rate of photosynthesis (A_N) was highest in T6 (9.7 µmol m^{-2} s^{-1}), followed by T4 with no significant difference between T6 and T4. The increasing trend in rate of CO_2 assimilation was observed from T1 to T6 with slight bend in the curve at T5. The CO_2 assimilation rate increased in Cg-2 treated plants in T6 and T4 as compared to control (T1) by 2.02 and 1.83 times, respectively (Table 3). The photosynthesis rate was in correlation with plant growth. It was observed that seed treatment supplemented with suspension enhanced photosynthesis to maximum extent in comparison to single treatment and double suspension. The photosynthesis determines the assimilation of CO_2 which gives the plant enough food for its growth and development.

Stomatal conductance: The stomatal conductance showed significant variation among the means of the treatments. The stomatal conductance curve depicts an increasing trend with peak at T6 (0.2 mol m^{-2} s^{-1}) as shown in Figure 4d. All the Cg-2 treatments showed higher stomatal conductance than control plants. The treatment T2, T3, T4, T5 did not show any significant difference among each other, though higher than non-treated plants (Table 3). The stomatal conductance followed the same trend as photosynthesis, though variation was not as much as in photosynthesis. This represents that the opening of stomata for longer time and allows higher exchange of gases that enhance the photosynthesis rate.

Transpiration: The rate of transpiration was statistically significantly varying among the treatments and divides into two groups. The T4 and T6 showed a significantly higher transpiration rate than rest of the treatments as 2.82 mmol m^{-2} s^{-1} and 3.18 mmol m^{-2} s^{-1} respectively. There was no significant difference in the transpiration rate of treatment T2, T3, T5 and control (T1) (Figure 4e and Table 3). Similarly, transpiration was in the same trend as stomatal conductance because longer opening of stomata leads to greater loss of water content from the leaf surface.

Internal CO_2 in substomatal cavity: The internal CO_2 in the substomatal cavity curve depicts a decreasing trend form T1 to T6 is shown Figure 4f. The internal CO_2 decreases by 15 per cent and 9 per cent in T6 and T5 respectively as compared to the Cg-2 non treated plants. The Ci in control plants was measured as 294.18 µmol mol^{-1} whereas it was recorded lowest in T6 (252.24 µmol mol^{-1}) (Table 3). The Ci decreased in treated plant as compared to control plants. It marked a regular decrease starting from single Cg-2 application to double or triple application as seed treatment, suspension, and booster dose. The Ci level was lowered as an ample amount of CO_2 available in the substomatal cavity was assimilated by the process of photosynthesis. Therefore, it was inversible trend of Ci and P_N.

Water use efficiency: The WUE curve is observed flattened with a small peak at T3 as shown in Figure 4g. The calculated value of WUE was highest in T3 as 3751.8, which is 37.9 per cent higher than control. But the WUE data showed no statistically significant difference among the means of the treatments when analyzed by SPSS Version 27.0 (Table 3). It is reported that *Trichoderma* treatments have better WUE under drought stress conditions, whereas they perform similarly under normal conditions. It is expected that WUE may increase in Cg-2 treated tomato plants when subjected to drought stress.

CONCLUSION

The Cg-2 treatment enhances the plant growth in the tomato plant variety Pusa Rohini. The delivery method has significance where Cg-2 seed treatment supplement with single and double drenching with suspension is at par. It is recommended to follow seed treatment and supplement single drenching with suspension at 5 leaf stage which is economically sound and best in performance.

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Effect of Different Pre and Post Emergence Herbicides on Growth, Yield and Weed Indices in Urdbean Crop under Sub-tropical Conditions of Jammu

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ABSTRACT

A field study was conducted at Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during summer seasons of 2015 and 2016 to study the effect of pre and post-emergence application of herbicides on growth, yield and weed indices in urdbean crop. The results revealed that the application of Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence significantly increased the growth parameters *i.e.* plant height, dry matter accumulation, leaf area index and crop growth rate of summer urdbean which was however statistically at par with Imazethapyr + imazamox (RM) @ 80 g/ha at 3-4 leaf stage), Imazethapyr @ 80 g/ha at 3-4 leaf stage, Imazethapyr + imazamox (RM) @ 70 g/ha at 3-4 leaf stage and Imazethapyr @ 70 g/ha at 3-4 leaf stage. Further, among the herbicidal treatment, imazethapyr + pendimethalin @ 1000 g/ha as pre-emergence and imazethapyr + imazamox 80 g/ha as post-emergence significantly reduced the weed density and weed biomass. The highest seed and stover yield of urdbean crop was recorded with pre emergence application of imazethapyr + pendimethalin @ 1000 g/ha coupled with highest net returns (Rs. 45205/ha and Rs. 41364/ha) and B: C ratio (2.56 and 2.29).

Keywords: Economics, Herbicides, Urdbean, Weed management, Yield

INTRODUCTION

Urdbean is the third most widely produced pulse crop in India after chickpea and pigeonpea. It can be grown during both rainy and summer seasons. Being a short duration crop, it fits well in traditional rice-wheat cropping systems and provides farmers with additional income. Being a leguminous crop, it can play a major role in nitrogen fixation from 20-80 kg/ha (Hayat *et al.,* 2008), thus improving system sustainability. Among the various factors responsible for poor yield in urdbean, weed infestation is one of the major constraints in urdbean cultivation and causes 43.2-64.1 per cent yield loss (Rathi *et al.,* 2004). Competition with the weeds leads to 50 to 70 per cent reduction in grain yield of urdbean. Therefore, removal of weeds at appropriate time using a suitable method is essential to obtain high yields of urdbean. Traditional practice of hand weeding requires dependence on increased number of labour during peak period of sowing and harvesting and becoming expensive. Timely weeding is most important to minimize the yield of losses and therefore under such circumstances the only effective tool left is to control weeds through the use of chemicals. Management of weeds through the use of chemicals has also been found as effective as realized under manual eradication in various urdbean including over and above benefits in saving extra costs involved in use of labour on manual eradication of weeds. For controlling weeds in urdbean, number of pre- and post emergence herbicides have already found their

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place in cultivation package of urdbean. Hence, keeping the above facts in view, the present investigation was undertaken to assess the performance of herbicidal weed management for providing effective control in urdbean.

MATERIALS AND METHODS

A field experiment was conducted during summer seasons of 2015 and 2016 at research farm of Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu. The experimental site is located at 32°40′N latitude and 74°58′E longitude with an altitude of 332 m above mean sea level in the Shiwalik foothills of North-Western Himalayas. The soil of the experimental field was sandy clay loam in texture with slightly alkaline in reaction (pH 7.81), medium in organic carbon (0.51%), available phosphorus (11.63 kg/ha) and potassium (147.3 kg/ha) and low in available nitrogen (246.5 kg/ha). The experiment was conducted in randomized block design with three replications. The treatments comprised of imazethapyr 70 g/ha as pre-emergence, imazethapyr 80 g/ha as pre-emergence, imazethapyr 70 g/ha at 3-4 leaf stage, imazethapyr 80 g/ha at 3-4 leaf stage, imazethapyr + imazamox 70 g/ha as preemergence, imazethapyr + imazamox (RM) 80 g/ha as pre-emergence, imazethapyr + imazamox (RM) 70 g/ha at 3-4 leaf stage, imazethapyr + imazamox (RM) 80 g/ha at 3-4 leaf stage, pendimethalin 1000 g/ha as pre-emergence, imazethapyr + pendimethalin (RM) 1000 g/ha as pre-emergence, two hoeings 15 and 30 DAS, weedy check and weed free. Urdbean variety *'Uttara'* was sown in the month of April using seed rate of 20 kg/ha. Furrows were opened manually with the help of liners at a specified row to row distance of 30 cm and plant to plant distance of 10 cm. Among the different time of herbicides application, pre-emergence (PE) application was made on next day of sowing and post-emergence (PoE) application was done at 18 DAS (3-4 leaf stage of weeds) by knapsack sprayer fitted with flat fan nozzle by using 500 l/ha of water. Weedy check plots remained infested with native population of weeds till harvest. However, data related to weed density were recorded from an area enclosed in the quadrate of 0.5 m^2 randomly selected at two places in each plot. Weeds collected from 0.5 m^2 area at two places were first sun dried for 2-3 days and then oven dried at 70°C till the constant weight was recorded. The weed dry matter was expressed in gram per square meter (g/m^2). The data on weed density and weed dry weight thus obtained were subjected to square root transformation ($\sqrt{x+1}$) before statistical analysis.

RESULTS AND DISCUSSION

Data related to growth of urdbean in terms of plant height, dry matter accumulation, leaf area index and crop growth rate recorded at 60 DAS, revealed that the growth characters of urdbean showed a pronounced improvement with the different weed management treatments over weedy check. At 60 DAS, among the weed management treatments, significantly higher plant height, dry matter accumulation, leaf area index and crop growth rate were recorded in weed free situations whereas lowest plant height, dry matter accumulation, leaf area index and crop growth rate were observed in weedy check plots (Table 1). The increase in growth parameters was probably due to the reduction in weed competitiveness with the crop, which ultimately favored better environment for growth and development of crop. Similar findings were reported by Kaur *et al.* (2009). In the herbicidal treatments, application of Imazethapyr + pendimethalin (RM) @1000 g/ha as pre-emergence significantly increased the growth parameters i.e. plant height, dry matter accumulation, leaf area index and crop growth rate which was however statistically at par with Imazethapyr + imazamox (RM) @ 80 g/ha at 3-4 leaf stage, Imazethapyr @ 80 g/ha at 3-4 leaf stage, Imazethapyr + imazamox (RM) @ 70 g/ha at 3-4 leaf stage and Imazethapyr @ 70 g/ha at 3-4 leaf stage during both the years of cropping. The increasing trend in terms of growth parameters might have happened due to better control of both grassy as well as broad leaved weeds during early crop growth period and also due to safe behaviour of herbicides against crop plants and phytotoxic effects on weeds. These results are in close confirmity with those reported by Yadav *et al.* (2015); Khairnar *et al.* (2014); Komal *et al.* (2015); Punia *et al.* (2015) and Kaur *et al.* (2016).

The performance of crops is directly related to the weed control efficiency and therefore inversely associated with the weed index. Maximum yield loss was observed in weedy check plots (Table 2) as

Table 1: Effect of different weed management practices on growth attributes of Urdbean at 60 DAS

Treatments	Plant height (cm)		Dry matter accumulation (g/m^2)		Leaf area index		Crop growth rate (g/m^2 /day)	
	2015	2016	2015	2016	2015	2016	2015	2016
Imazethapyr @ 70g (Pre-emergence)	42.50	44.77	188.23	192.13	2.50	2.57	7.73	7.75
Imazethapyr @ 80g (Pre-emergence)	43.00	46.34	192.39	198.09	2.60	2.72	7.90	7.94
Imazethapyr @ 70g (3-4 leaf stage)	44.73	48.15	228.62	234.92	2.91	3.04	9.38	9.40
Imazethapyr @ 80g (3-4 leaf stage)	45.27	49.06	231.35	238.55	3.01	3.22	9.49	9.56
Imazethapyr + imazamox (RM) @ 70 g (Pre-emergence)	42.70	45.70	189.76	194.86	2.57	2.68	7.79	7.81
Imazethapyr + imazamox (RM) @ 80g (Pre-emergence)	43.29	46.66	198.15	204.15	2.72	2.76	8.13	8.17
Imazethapyr + imazamox (RM) @ 70g (3-4 leaf stage)	44.90	48.40	229.47	236.07	2.94	3.02	9.41	9.45
Imazethapyr + imazamox (RM) @ 80g (3-4 leaf stage)	45.60	49.36	233.05	240.25	3.11	3.20	9.56	9.62
Pendimethalin @ 1000g (Pre-emergence)	42.37	44.51	187.21	191.11	2.40	2.56	7.68	7.72
Imazethapyr+pendimethalin (RM)@1000g (Pre-emergence)	46.20	50.46	236.12	244.22	3.21	3.44	9.69	9.77
Hoeing (2) 15 & 30 DAS	47.03	51.47	240.39	248.79	3.35	3.60	9.86	9.95
Weedy check	40.03	41.62	164.38	167.38	1.89	2.09	6.74	6.76
Weed free	48.00	52.71	245.32	254.02	3.67	3.90	10.06	10.14
SEm (±)	1.59	1.60	10.34	10.38	0.12	0.22	0.42	0.43
CD (5%)	4.63	4.66	30.18	30.30	0.36	0.65	1.24	1.27

compared to weed free plots which recorded almost negligible yield loss due to absence of weeds, provided there are no other limiting factors. This can be probably ascribed to the competition offered by unchecked weed growth for nutrients, moisture and light as indicated by poor growth and yield components under weedy conditions. Among the different weed management treatments, lowest weed index was noticed with 2 Hoeing at 15 & 30 DAS and Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence in the increasing order whereas, Pendimethalin @ 1000g/ha as pre-emergence and Weedy check recorded highest value of weed index. This can probably be ascribed to improved growth of crops as a consequence of effective control of weeds and reduction in the crop weed competition which might have enabled the crop to achieve better resource utilization and can be associated with lower weed count and dry weight. These results corroborate with the findings of Komal *et al.* (2015) and Gupta *et al.* (2014).

Weed persistence index expresses the tolerance of weeds to different herbicide treatments as well as their efficacy to eradicate the weeds. A lower weed persistence index value meant a higher level of weed control efficacy of tested treatment. Among the herbicidal treatments at harvest, lowest weed persistence index was recorded with the application of Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence. Pendimethalin @ 1000 g/ha as pre-emergence recorded numerically highest weed persistance index as compred to all other herbicidal treatments. The relatively lower weed persistence index in efficient herbicidal treatments can probably be ascribed to minimized weed density but also averted weed dry matter and reduction in crop-weed competition and hence resulting in better crop growth. These results corroborate with the findings of Khaliq *et al.* (2011).

Crop resistance index at harvest clearly indicated that among the herbicidal treatments, higher crop resistance index (Table 2) was recorded with the application of Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence. Pendimethalin (RM) @ 1000 g/ha as pre-emergence recorded lower crop resistance index value among the herbicidal treatments. The results so obtained can be ascribed to ability of the crop plants to tolerate particular dose of herbicide which might have led to suppression of weed

Table 2: Effect of different weed management practices on weed persistence index (%), crop resistance index (%), weed index (%), weed management index (%), agronomic management index (%) and integrated weed management index (%) in summer Urdbean

Treatments	Weed persistence index (%)		Crop resistance index (%)		Weed index (%)		Weed management index (%)		Agronomic management index (%)		Integrated weed management index (%)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Imazethapyr @ 70g (Pre-emergence)	1.00	1.04	2.25	2.16	31.54	34.24	2.05	1.99	1.05	0.99	1.55	1.49
Imazethapyr @ 80g (Pre-emergence)	1.00	1.05	2.54	2.54	24.62	27.29	2.42	2.39	1.42	1.39	1.92	1.89
Imazethapyr @ 70g (3-4 leaf stage)	0.83	0.86	3.81	3.88	19.78	21.86	2.09	2.10	1.09	1.10	1.59	1.60
Imazethapyr @ 80g (3-4 leaf stage)	0.84	0.87	4.25	4.39	18.02	21.29	2.10	2.07	1.10	1.07	1.60	1.57
Imazethapyr + imazamox (RM) @ 70 g (Pre-emergence)	1.02	1.03	2.42	2.42	26.78	29.63	2.36	2.31	1.36	1.31	1.86	1.81
Imazethapyr + imazamox (RM) @ 80g (Pre-emergence)	0.98	0.99	2.73	2.81	24.43	26.88	2.38	2.37	1.38	1.37	1.88	1.87
Imazethapyr + imazamox (RM) @ 70g (3-4 leaf stage)	0.87	0.86	3.99	4.11	18.32	21.82	2.08	2.05	1.08	1.05	1.58	1.55
Imazethapyr + imazamox (RM) @ 80g (3-4 leaf stage)	0.84	0.86	4.44	4.56	16.56	19.44	2.10	2.08	1.10	1.08	1.60	1.58
Pendimethalin @ 1000g (Pre-emergence)	1.05	1.07	2.15	2.07	31.87	36.01	2.12	1.98	1.12	0.98	1.62	1.48
Imazethapyr + pendimethalin (RM) @ 1000g (Pre-emergence)	0.78	0.93	5.01	5.21	13.63	15.89	2.16	2.17	1.16	1.17	1.66	1.67
Hoeing (2) 15 & 30 DAS	0.84	0.88	6.96	7.21	9.89	11.44	2.23	2.31	1.23	1.31	1.73	1.81
Weedy check	1.00	1.00	1.00	1.00	65.27	66.33	-	-	-	-	-	-
Weed free	-	-	-	-	-	-	-	-	-	-	-	-

demography thus recording lower weed dry weight induced by competitive environment created by the overwhelming canopy of crop plants in a unit area thus preventing the weeds to flourish and attain interfering growth. These findings were in close conformity to that of Subhas and Jitendra (2007) and Khaliq *et al.* (2011).

The weed management index in urdbean under different herbicidal treatments showed that application of Imazethapyr @ 80 g/ha as pre-emergence recorded highest value of weed management index. Lower values of weed management index recorded in treatments with higher weed control efficiency and seed yield could be ascribed to the fact that although increase in yield over control or weedy check was higher but in the mean time the per cent control of weeds which was the dividing factor, was in turn higher than the increase of that treatment as compared to weedy situations.

The agronomic management index indicating the effect of herbicides on environmental parameters in urdbean revealed that among different herbicidal treatments, Imazethapyr @ 80 g/ha as pre-emergence recorded highest value of agronomic management index. Lower values of agronomic management index recorded in treatments with higher weed control efficiency and seed yield could be ascribed to the fact that increase in yield over control or weedy check was higher yield improvement in relation to weed suppression.

Amongst the different herbicidal treatments at harvest, numerically higher value of integrated weed management index was recorded with Imazethapyr @ 80 g/ha as pre-emergence. Lower values of integrated weed management index recorded in treatments with higher weed control efficiency and seed yield could be ascribed to the fact that increase in yield over control or weedy check was higher

Seed and stover yield of urdbean recorded significant variations with respect to different weed management treatments (Table 3). It was observed that among the different weed management treatments, Weed free recorded significantly highest seed and stover yield which was statistically at par with 2 hand hoeing at 15 & 30 DAS. The increase in seed and stover yield of urdbean under weed free conditions were

Table 3: Effect of different weed management practices on yield and economics of summer Urdbean

Treatments	Seed yield (kg/ha)		Stover yield (kg/ha)		Net return (Rs./ha)		B:C ratio	
	2015	2016	2015	2016	2015	2016	2015	2016
Imazethapyr @ 70g (Pre-emergence)	623	581	1363	1581	33067	29306	1.97	1.71
Imazethapyr @ 80g (Pre-emergence)	686	642	1501	1741	37908	34014	2.23	1.96
Imazethapyr @ 70g (3-4 leaf stage)	730	690	1814	2105	41627	38053	2.48	2.22
Imazethapyr @ 80g (3-4 leaf stage)	746	695	1849	2145	42708	38254	2.52	2.21
Imazethapyr + imazamox (RM) @ 70 g (Pre-emergence)	666	621	1383	1604	35989	32042	2.08	1.81
Imazethapyr + imazamox (RM) @ 80g (Pre-emergence)	688	646	1615	1874	37472	33711	2.13	1.88
Imazethapyr + imazamox (RM) @ 70g (3-4 leaf stage)	743	690	1824	2116	42149	37562	2.44	2.13
Imazethapyr + imazamox (RM) @ 80g (3-4 leaf stage)	759	711	1877	2177	43152	38965	2.46	2.17
Pendimethalin @ 1000g (Pre-emergence)	620	565	1236	1434	32722	27948	1.94	1.62
Imazethapyr+pendimethalin (RM)@1000g (Pre-emergence)	786	743	1881	2182	45205	41364	2.56	2.29
Hoeing (2) 15 & 30 DAS	820	782	1905	2210	43116	39702	1.92	1.74
Weedy check	316	297	1087	1261	10276	8409	0.68	0.55
Weed free	910	883	2146	2490	42836	40302	1.43	1.33
SEm (±)	33	34	81	94	-	-	-	-
CD (5%)	96	100	236	273	-	-	-	-

obviously due to reduced crop weed competition, higher weed control efficiency by providing below threshold weed situation resulting in higher yield attributes and finally the higher biological yields. Thus, the crop plants being vigorous efficiently utilized nutrients, moisture, sunlight, space and other input factors hence, gave better yield. Whereas, the weedy check plots recorded significantly lowest yields due to heavy competition for nutrients, moisture and light between the crop and weeds at critical phenophases of crop. Similar findings were reported by Chand *et al.* (2003); Mirjha *et al.* (2013) and Yadav *et al.* (2015). Among the herbicidal weed management treatments, significantly highest seed and stover yield was recorded with the Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence which was statistically at par with (Imazethapyr + imazamox (RM) @ 80 g/ha at 3-4 leaf stage, Imazethapyr @ 80 g/ha at 3-4 leaf stage), Imazethapyr + imazamox (RM) @ 70 g/ha at 3-4 leaf stage, Imazethapyr @ 70 g/ha at 3-4 leaf stage. The treatments Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence, Imazethapyr + imazamox (RM) @ 80 g/ha at 3-4 leaf stage, Imazethapyr @ 80 g/ha at 3-4 leaf stage, Imazethapyr + imazamox (RM) @ 70 g/ha at 3-4 leaf stage and (Imazethapyr @ 70 g/ha at 3-4 leaf stage registered 148.73, 140.19, 136.08, 135.13 and 131.01 per cent higher seed yield of summer urdbean as compared to weedy check plots. This might have happened probably due to better control of both grassy as well as broad-leaved weeds during early crop growth stages, higher weed control efficiency, higher nutrient uptake by the crop and better yield attributes (Yadav *et al.,* 2015). The results are in close confirmity with Khairnar *et al.* (2014).

The economic feasibility and usefulness of a treatment could be effectively adjudged in terms of B: C ratio and net returns (Table 3). Maximum net return were obtained in weed free which was followed in the decresing order by treatment 2 hand hoeing at 15 & 30 DAS. Amongst weed management treatments, highest net returns were obtained with (Imazethapyr + pendimethalin (RM) at 1000 g/ha as pre-emergence followed by Imazethapyr + imazamox (RM) at 80 g/ha at 3-4 leaf stage, 2 hand hoeing at 15 & 30 DAS and weed free. Higher seed yields of urdbean might have been responsible for the corresponding higher net returns of all weed management treatments as compared to weedy check treatment. Similar findings were reported by Yadav *et al.* (2015). Also, the highest benefit: cost ratio (2.56) was obtained with application of Imazethapyr + pendimethalin (RM) @ 1000 g/ha as pre-emergence. Pendimethalin (RM) @ 1000 g/ha as pre-emergence recorded significantly lowest benefit: cost ratio. Higher B : C ratio and net returns in efficient weed management treatments could be attributed to their higher seed yields which were the major factors that caused variation in net returns and B:C ratio. These results are in conformity with the findings of Kaur *et al.* (2016).

CONCLUSION

It can be concluded that application of imazethapyr + pendimethalin @ 1000 g as pre-emergence or imazethapyr 80 g at 3-4 leaf stage was found suitable not only for weed control but also enhance crop growth, yield and economics in summer urdbean.

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Marginal Farmers' Information Literacy About Modern Agricultural Enterprises: A Case from Kalibari Village, Meghalaya

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ABSTRACT

The primary purpose of the present study is to explore the information literacy among the marginal farmers with regards to the primarily adopted modern agricultural enterprises in Kalibari village of East Khasi Hills district of Meghalaya state in India. Primary data was collected from randomly 100 respondents using survey method and a pre tested structured questionnaire. The demographic profile shows male dominancy with an average age of 40.50 years, education level up to primary level (68.00%) and possessing an average land holding of 0.22 ha. The study revealed that farmers have very rudimentary knowledge of the numerous scientific growing and raising methods and are unaware of the different opportunities for entrepreneurial development in their chosen agricultural operations, and as a result, they are unable to reap the benefits of high economic returns. Furthermore, majority (78.00%) depended on Public Extension services provided by agriculture and veterinary officers of the district for their main source of information but are unable to utilize this information practically to reap profitable economic returns. Therefore, it is evident that agricultural information literacy contributes to productivity, profitability, and good quality, and has a beneficial impact on these parameters.

Keywords: Information literacy, Marginal farmers, Agricultural enterprises, Entrepreneurship

INTRODUCTION

The transformation of Indian agriculture from food deficit to sufficient stage has crossed many challenges from many perspectives. Indian agriculture is normally characterized by small and fragmented landholdings; rain fed and by mixed type of farming; regional inequalities in food production etc.; but low productivity is the main concern. Modern agricultural enterprises have a great promise for the economic development of a region. Many modern agricultural enterprises have enough potential to make the farmers income double especially for small and marginal land holders. Agri-preneurship development in these modern agricultural firms is critical for a region's economic development. Actually, in small and marginal land holdings vertical integration of these enterprises is a possible way to enhance the productivity of the farming system. Different modern agricultural enterprises may characterized as lucrative, productive, and make income in short duration. In the recent past among the different agricultural enterprises poultry farming, piggery, fishery and mushroom cultivation has gained importance especially from economic and resource use perspective. These modern enterprises are practicable to incorporate in an intensive or integrated way at the farm level. (Awasthi *et al*., 2015) revealed that vanaraja eggs was sold by farmers @ Rs. 15/- and meat @ Rs. 250-350/- per kg in local market of Sikkim, earning around Rs. 30,000/- to Rs. 35,000/- as a subsidiary income from the backyard poultry farming. (Singh *et al.* 2018) from Nagaland revealed that the farmers have sold Vanaraja and Srinidhi birds (2.5-3.0 kg) at 3-4 months of age with net income of Rs. 71,31,525/-, B:C ratio of 2.93 and Rs. 302.00/- per bird.

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Agricultural Information Literacy are as a set of skills and competencies for identifying, accessing, and utilizing agricultural information for enhanced agricultural productivity (Mashroofa and Senevirathne, 2014). It is evident that in this era, information plays an immense role in every sector including agriculture and allied. Farmers' information literacy and awareness is also an important aspect to consider for proper incorporation of any enterprises in their farming system. According to (Jamison and Lau, 1982), farmers' performance is affected by human capital, which encompasses both innate and learned skills, including the ability to process information. Access to agricultural information ensures that stakeholders in the farming system can make informed decisions towards increasing agricultural productivity (Malapela and Keizer, 2014). In general, different extension services assist the farming community in minimizing the gap between potential and actual, which in turn leads to rising productivity, even it has argued that the least expensive input to improve rural agricultural development is access to knowledge and information in areas of new agricultural techniques (Balit, 1996). With this backdrop, the purpose of this study was to assess the farmers' information literacy about modern agricultural operations such as mushroom cultivation, poultry & fishery farming as these is the 3 most common enterprises adopted by farmers in the study area.

MATERIALS AND METHODS

Research design: This study followed ex-post facto research design, as this study was committed to know about the information literacy and awareness towards modern agricultural enterprises among the farmers. Amid the many modern agricultural enterprises, mushroom cultivation, poultry and fishery farming was considered in this study.

Sampling plan: The Kalibari village, which is situated in the valley of Cherrapunji, East Khasi Hills district in the state of Meghalaya, one of the North–Eastern states of India was considered as locale of the study. Using random sampling method a total of 100 respondents comprising of farmers, farm women and youth were considered for the study as these were the three primarily adopted enterprises among the farmers.

Data collection and statistical tools applied: With the help of a specifically designed pre-tested and validated semi-structured interview schedule primary data was collected. Further, focus group discussion (FGD); key informants interview was conducted to understand the scenario of farmer's information literacy and awareness about the modern agricultural enterprises. Collected data were analyzed using appropriate descriptive statistical tools.

RESULTS AND DISCUSSION

Socio–economic and farming scenario: The Table 1 reveals that the average age of the farmers was 40.50 years, education level up to primary level (68.00%) possessing an average land size of 0.22 hectare with majority (71.00) of the respondents comprising of joint

Table 1: Socio-economic profile of the respondents

Average Age (years)	40.50
Sex (%)	
• Male	65.00
• Female	35.00
Average Land Holding (in ha)	0.22
Monthly average income (Rs./month)	5532/-
Family type (%)	
• Joint	71.00
• Nuclear	29.00
Average number of family members	6
Education (%)	
• Illiterate	32.00
• Primary Level	68.00
Possession of implements (large/small) (%)	
• Khurpi/Sickle	62.00
• Spade	83.00
• Hoe	40.00
Livestock assets (%)	
• Cattle	86.00
• Goats	14.00
Cropping pattern	Kharif (July-October): Paddy Rabi (Nov-Feb): Vegetables cultivation; potato, Radish, Eggplant, Pumpkin, Ladies finger, Chili, Bitter Gourd etc.

families, this can be attributed to the fact that the farmers of Kalibari village mostly belonged to the Schedule caste. The average monthly farm income was Rs. 5532/-. A majority of the farmers don't possess any large farm machineries and in most cases, possess small farm implements viz. khurpi/sickle and spade. Majority of the farmers own cattle particularly bullocks (86.00%) and use them primarily for agricultural purposes. The findings in the current study are in line with those obtained by Kumar and Devi 2020. Further investigation revealed that farmers' primary cropping pattern was the cultivation of two crops in one season. As paddy is the staple food for the villagers, farmers cultivate paddy as one consistent crop every year. After paddy they would cultivate and grow different types of vegetables. But reported productivity aspect of the farming was very low which portrays a serious matter of concern. Even the constraints experienced by the farmers also reported that high cost of cultivation combined with lack of awareness and training on improved production technologies are serious problems which inhibit the expected production and productivity; as a result the field condition indicates a serious yield gap problem *i.e.* difference between expected and actual.

Information literacy among the farmers about poultry farming: The farmers of Kalibari village were assessed about how far they were informed about the different small scale modern enterprises. The first enterprise considered in this study was mushroom cultivation; accordingly the farmers were asked different questions on the various aspects of mushroom cultivation. The Table 2 reveals that despite mushroom cultivation being a major enterprise, only 8.00 percent of the farmers were aware that different species of mushroom required different cultivation technique; this can be attributed to the fact that most farmers cultivate only oyster mushroom. Further, more than half (52.00%) of the farmers were aware that all mushroom species were not edible. Almost all the farmers (96.00%) were well aware that mushroom farming is a profitable enterprise with manifold economic advantages and were of the opinion that mushroom should be added in their food basket despite not being fully aware of the nutritional benefits as they feel that mushroom is an alternative to meat as they are very fond of non-vegetarian food items. Despite the fact that 62.00 per cent of farmers were aware of the potential for entrepreneurship development in mushroom farming, no one has received any training in mushroom cultivation, which could have aided the farmers in obtaining higher economic returns through proper scientific cultivation methods.

Information literacy among the farmers about poultry farming: Farmers' information literacy on poultry farming found (Table 3) that 93.00 per cent of farmers were unaware of improved housing systems, while only 10.00 per cent were aware of scientific feeding techniques and only 15.00 per cent would provide immunizations to their poultry at regular intervals. This could be one of the explanations for the high mortality rate reported among young chicks. According to the survey, 95.00 per cent of farmers were aware of proper disease/parasite prevention and control measures, but none had a strong understanding of breed selection, nor did they keep proper records of their poultry's vaccination status and health. Farmers in Kalibari mostly practice backyard poultry farming for meat production; therefore they are unaware of dual-purpose poultry breeds (79.00%) or the potential

Table 2: Information literacy among the farmers about mushroom cultivation

Particulars	Yes (%)	No (%)
Are you aware that different species of mushrooms require different cultivation techniques?	8.00	92.00
Do you think that all mushroom species are edible?	48.00	52.00
Are you aware that the spawn/seed required for cultivation of different mushrooms is not the same?	12.00	88.00
Are you aware about the nutritional benefits of the different types of mushroom?	6.00	94.00
According to you do you think mushroom should be added in your food basket?	82.00	18.00
Are you aware that mushroom can be grown throughout the year under controlled conditions?	0.00	100.00
Are you aware about the economic advantages of mushroom cultivation?	96.00	4.00
Do you know about the scope of entrepreneurship development in mushroom?	62.00	38.00

Table 3: Information literacy among the farmers about poultry farming

Particulars	Yes (%)	No (%)
Do you know about improved housing system in poultry?	7.00	93.00
Do you follow scientific feeding practices in your poultry farming?	10.00	90.00
Do you administer vaccines at regular intervals to the poultry?	15.00	85.00
Are you aware about proper disease/parasites prevention and control techniques?	5.00	95.00
Whether you have good knowledge in breed selection?	0.00	100.00
Are you in practice of proper record keeping of the vaccination status and health of the poultry?	0.00	100.00
Do you have any idea on dual purpose poultry breed?	21.00	79.00
Do you know about the scope of entrepreneurship development in poultry?	6.00	94.00
Are you aware about suitable marketing strategies to follow in poultry farming?	25.00	75.00

Table 4: Information literacy among the farmers about Fishery farming

Particulars	Yes (%)	No (%)
Are your aware of composite fish culture method of rearing fishes?	12.00	88.00
Are you aware of polyculture in fisheries?	8.00	92.00
Do you know the difference between a rearing pond and nursery pond?	63.00	37.00
Are you aware of the different methods of preserving fishes?	65.00	35.00
Do you know about incubation period of eggs in fish breeding?	36.00	64.00
Do you know about the major diseases affecting fishes in fish farming?	18.00	82.00
According to you, do you think the quality of the pond soil and water is an important factor for obtaining good quality fish breeds and growth?	50.00	50.00
Do you know about the scope of entrepreneurship development in fishery farming?	42.00	58.00

for entrepreneurship development in the poultry industry. Farmers' rear poultry for self-consumption and sale in the local market solely, as mentioned, and as a result, only 25.00 per cent of the farmers had a thorough understanding of the various marketing strategies to increase profits.

Information literacy among the farmers about fishery farming: Kalibari's farmers enjoy having fish in their food baskets, and practically every household rears fish. Despite the fact that fishing is a commodity, only 88.00 per cent of people are aware of composite fish culture (Table 4). Monoculture is practiced by the majority of farmers, while only 8.0 percent are aware of or have adopted polyculture in fish farming. However, because they have been producing fish for a long time, 63.00 per cent and 65.00 per cent of the farmers, respectively, are familiar with the differences between a rearing pond and a nursery pond, as well as the various techniques of preserving fish. Only 36.00 per cent of farmers are aware of the incubation period of eggs in fish breeding since they have been using the traditional method of fish culture for generations, similarly only 18.00 per cent possess some knowledge about the major diseases affecting fishes in fish farming. About 50.00 per cent of respondents feel that pond soil and water quality is a significant aspect in attaining high-quality fish breeds and growth. Despite all of these variables, farmers are unaware of the potential for entrepreneurship development in fish farming, despite the fact that it is a highly commoditized industry.

Main sources of information on the various adopted agricultural enterprises: The farmers who took part in the study were questioned to learn more about their main sources of information for the many contemporary agricultural operations they use (Table 5). The bulk of the respondents depended on Public Extension services provided by agriculture and veterinary officers of the district, which were regarded as the six main sources of information (78.00%). Another 54.00 per cent of the interviewees depended

Table 5: Main Sources of Information on the various modern agricultural enterprise

Source	Percentage
Public extension (Agriculture & Veterinary Officer)	78.00
Fellow farmer	54.00
Panchayat personnel	10.00
NGOs	41.00
Private company	15.00
Internet/mass media	56.00

on information from other farmers, and 41.00 per cent relied on non-governmental organization services (NGOs). Only 15.00 per cent relied on private enterprises that sell farm inputs and buy farm produce, while 56.00 per cent relied on information gleaned from the internet and the media. The findings in the current study are in line with those obtained by (Kumar and Devi, 2020) which indicate that the Kalibari farmers have a wide variety of information sources from which they can obtain agricultural information. The study further reveals that the public extension sector is the most utilized source of agricultural information.

CONCLUSION

The study concludes that most farmers are unaware of the different opportunities for entrepreneurial development in their chosen agricultural operations, and as a result, they are unable to reap the benefits of high economic returns. Furthermore, they have very rudimentary knowledge of the numerous scientific growing and raising procedures. They acquire knowledge from a variety of sources, including public extension, fellow farmers, NGOs, the internet, and the news media, but they are unable to put it into reality. From marginal, small to large agricultural farms and enterprises, agricultural information literacy contributes to productivity, profitability, and good quality, and has a beneficial impact on productivity, profitability, and produce quality. Farmers, extension agents, and politicians will benefit from this research. It is suggested that policymakers make a concerted effort to invest in the information literacy system and assist public extension services and other service providers in order to increase information literacy among marginal farmers, who are frequently overlooked. As a result, information is a crucial resource for effective socioeconomic operations; it is necessary in all sectors of human effort for increased performance, particularly when it is translated into knowledge and utilized positively.

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Effect of Growth Promoting Substances on Barseem (*Trifolium alexandrinum*) Seed Production in North-Western India

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ABSTRACT

The study was conducted to assess the effect of growth promoting substances viz. salicylic acid (SA) and a mixture of potassium nitrate & muriate of potash (KNO_3 + MOP) on the seed yield of barseem at Seed Production Farm, KVK Faridkot, Romana Albel Singh and Ghuduwala in District Faridkot during rabi 2017-18 and 2018-19. The fertilizer was applied as 25-75-00 (NPK kg/ha) at the time of sowing to T_1 (Control), T_2 (KNO_3) & T_3 (SA) treatments while in case of T_4, MOP @ 30 kg/ha was applied along with N+P. Later on, two spays of KNO_3 @ 2% and SA @ 7.5 g in 100 litre of water were given at weekly interval after the initiation of flowering in T_2 & T_3 plots. Application of KNO_3 and SA increased the number of shoots (7.3-17.4%), head density (7.6-15.9%), number of seeds per head (5.8-28%) and 1000- seed weight (7.9-27.7%) contributing to improvement in barseem seed yield (28.1-46%) over control whereas wheat equivalent yield (WEY) increased by 30-51.4 per cent over control. Basel Application of MOP also enhanced barseem seed production and increased wheat equivalent yield by 31.4 per cent over control.

Keywords: Barseem seed production, Potassium nitrate, Salicylic acid, MOP, Economic performance

INTRODUCTION

Berseem (*Trifolium alexandrinum)* is one of the most important fodder crops and is considered as the king of fodders. It is highly esteemed fodder which has a special place in animal husbandry programmes throughout the country. In India, it occupies two million hectares. In Punjab, the area under this crop is more than 65 per cent of the total area under fodder crops and also known as milk multiplier (Rani *et al.,* 2017) The merit of the crop lies in its multicut nature (4-6 cuts), long duration of green fodder availability (November to May), high green fodder yield (80 t/ha), good forage quality (20% crude protein), and digestibility (up to 65%) and high palatability (Vijay *et al.,* 2017). As a winter crop it provides soil cover and prevents erosion. Moreover, being an N-fixing legume, berseem intercropped with oats in a maize/soybean/oat + berseem rotation increased maize yield by 10 per cent and returned 43 kg N/ha (Ghaffarzadeh, 1997).

Studies show that berseem can be used for phytoremediation of heavy metals viz., Cd, Pb, Cu and Zn due to its multi-cut nature, short life cycle and production of considerable biomass (Ali *et al.,* 2012). It is reported that mere 40 per cent of green fodder demand is fulfilled and the most of dairy farmers rely on concentrated feed, causing a tremendous hike in cost of milk production under already debt ridden farming situations. The reason behind low availability of green fodder is the lack of availability of quality seed of forage crops. The productivity of berseem in India is far lower than the major berseem producing countries of the world especially, Egypt. Another main reason for the shortage is growing of berseem for forage instead of seed by majority of the Indian farmers. Enhancement of biomass production to the tune of 30-40 per cent was observed by using quality seed material (Pande, 1995). Besides, success of application of any technological intervention entirely depends on the quality of available seed. Therefore, in time availability of quality seed at a lower price ensures

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successful cultivation. It is estimated that 5-10 per cent area of fodder crops is grown with improved seed (Muhammad Shoaib *et al.,* 2017). Currently, India is facing acute shortage in availability of seeds of many forage crops, berseem being foremost of those. India imports approx. 10000 t of berseem seed annually resulting in huge loss to foreign exchequer (Vijay *et al.,* 2017).

Hence, there is a great potential of barseem seed production, especially for dairy farmers, and it is an economically reliable enterprise (Sukhwinder *et al.,* 2017) and fits well in realizing our diversification goals. However, the difficulty in producing high seed yields in forages is due to the failure of seed setting in flowers, whereas, lack of pollination, poor soil health and disease and pest incidence may be involved. Its seed productivity is generally low because farmers pay less attention to seed production causing serious seed shortages. Farmers continue fodder cuttings till late March to mid April, which results in low foliage retention, poor flowering and finally low seed production (Kumar *et al.,* 2013). Furthermore, clover seed production also depends on the environmental conditions such as temperature and relative humidity, prevailing during the reproductive phase (Bakheit *et al.,* 2012). The seed yield could be enhanced through proper cutting management and optimum irrigation scheduling after the last forage cut (Bakheit *et al.,* 2012; Singh and Kang 2004). However, reduced viability of pollen grain due to high temperature and low relative humidity at the reproductive period are the major factors responsible for low seed yield of barseem (El-Naby *et al.,* 2012). Temperature beyond 32^{o}C affects the seed setting and seed yield adversely. Day temperatures during flower initiation to seed development in May and June in north-west India generally remain around 40^{o}C, which adversely affects flowering and seed setting of Egyptian clover. Abiotic stresses like heat stress in field crops can be managed by applying bio-regulators such as Sodium Benzoate ($NaC_7H_5O_2$), Salicylic Acid ($C_6H_4(OH)COOH$), Calcium Chloride ($CaCl_2$) and Potassium Nitrate (KNO_3), which are able to induce long term thermo-tolerance (Beltrano *et al.,* 1999; Wahid *et al.,* 2007; Rab and Haq, 2012) and helps to increase the flowering and pod formation in a number of crops including clovers. Salicylic acid plays diverse physiological roles in plants including thermo genesis, flower induction, nutrient uptake, stomatal movements, ethylene production inhibition, stimulation of photosynthetic machinery, and hence increase in seed yield (Wahid *et al.,* 2007; Hayat *et al.,* 2009; Mohammed and Tarpley, 2011). Potassium Nitrate (KNO_3), an osmoprotectants, play an important role in the adaptation of cells to abiotic stresses through their effect on water uptake, root growth, maintenance of turgor pressure and thereby can help in normal functioning of plants (Rab and Haq 2012). Studies have shown that foliar application of potassium is considered to play a vital role in seed setting as well as quantitative improvement in seed yield of barseem (Beena *et al.,* 2011). Aboelgoud *et al.* (2015) reported its stimulating affect on photosynthetic pigments and enzyme activity which in turn manifest significant effect on yield and quality of forages.

Therefore, it is imperative to create awareness and sensitize the growers to come forward for berseem seed production while simultaneously making available the production technology in crisp form. We have conducted a total of 20 demonstrations to popularize barseem seed production and also to assess the effect of growth promoting substances viz. SA and KNO_3 on the seed yield so as not only to diversify rice-wheat system, but also to economize the farming in south–western Punjab.

MATERIALS AND METHODS

The study was conducted at three different locations i.e. Seed Production Farm, KVK Faridkot (30° 40' 41.4696" N and 74° 44' 22.3980" E) and Farmers' field of villages Romana Albel Singh (RAS) (30° 31' 00" N and 74° 50' 00" E) and Ghuduwala (30° 41' 59" N and 74° 33' 13" E) of Kotkapoora and Faridkot blocks respectively, in District Faridkot for two consecutive Rabi seasons (2017-18 and 2018-19). All the demonstrations sites were kept same for the two experimental years. The soil samples for testing of fertility status of the study area were collected and analyzed before sowing (Table 1). The variety BL- 42 was used. The sowing was done in first week of October. The basal dose of fertilizer was applied as 25-75-00 (NPK kg/ha) at the time of sowing to T_1 (Control), T_2 (KNO_3) & T_3 (SA) treatments while in case of T_4, Potassium (MOP @ 30 kg/ha) was applied

Table 1: Physical and chemical properties of the soil before conducting the experiment

Soil parameter	Faridkot	Romana Albel Singh	Ghuduwala
Texture	Loam	Sandy Loam	Sandy Loam
pH (suspension 1:2)	7.93	8.21	8.15
E.C. (dS m^{-1})	0.21	0.34	0.45
Soil organic carbon (%)	0.81	0.57	0.64
Available P (kg/ha)	18.4	15.2	15.7
Available K (kg/ha)	312.2	234.5	262.4

along with N&P. All other packages of practices were followed as per recommendations. The crop was ready for first cut of forage in 50-55 DAS, subsequently, after getting third cut of green forage, the crop was left for seed production by 10th April. Later on, two foliar spays of potassium nitrate (KNO_3) @ 2% (T_2) and salysalic acid (SA) @ 7.5 g (T_3) in 100 L of water were given at weekly interval after the initiation of flowering, keeping T_1 plot unsprayed (Control). The record of green forage yield of each cutting of all locations was kept. The data pertaining to plant height, number of branches, number of heads, number of seeds per head, 1000 grain weight, biomass and seed yield were collected from one square meter area for all treatments. The harvested produce was air dried and threshed manually to gather seed. The wheat equivalent yield of barseem seed was calculated using formula:

$$\text{WEY (q/ha)} = \frac{\text{Seed yield (q/ha) x Price of seed (Rs/q)}}{\text{Price of Wheat (Rs/q)}}$$

RESULTS AND DISCUSSION

Seed yield and attributes: The study revealed the synergistic effect of application of bio regulators on ancillary attributes which in turn contributed to the increase in barseem seed yield. The data recorded at maturity shows that potassium had a pronounced effect on plant height, although results were at par with SA (Table 2). However, the plant height recorded at Faridkot was more than that of Roman Albel Singh and Ghudduwla. This might be due to the higher organic C content and improved physical conditions of soil as affected by continuous incorporation of crop residue (Table 1) at KVK farm. Since, KNO_3 and SA were applied after third cutting and available potassium was in higher range but, irrespective of location, application of potassium as a basal dose increased plant height as compared to control. This may be attributed to fact that availability of potassium enhanced the adaptability of cells to abiotic stress through their effect on root growth thereby improving the functioning of plants. (Wahid *et al.,* 2007). Moreover, plant height is a function of genotype and environmental conditions and there may a little competition for potassium in plants Beena *et al.* (2011).

The number of shoots per plant and thereafter, number of heads is a vegetative trait, influenced by environment (Beena *et al.,* 2011). At KVK Farm, the highest number of heads ware recorded in case of KNO_3 followed by MOP and SA which was respectively, 17.4 per cent, 12.0 per cent and 7.31 per cent higher than control. In terms of location specificity, it was observed that at KVK Farm KNO_3 perform better and produced 18.9 per cent and 13.4 per cent more number of shoots as compared to RAS and Ghuduwala, respectively, whereas, at RAS and Ghudduwala application of SA produced more number of shoots (Table 2). These differences may be attributed to the heterogeneity of soil and prevailing environmental condition. It is reported that application of bio regulators increase the head density in barseem (Kumar *et al.,* 2013). Similar results were also observed in present study (Table 2). At KVK farm, the highest number of heads was recorded in KNO_3 which were 15.9 per cent more than control while application of SA produced 7.58 more number of heads as compared to control. At RAS, as the number of shoots were the highest under SA treatment, similarly, 13.7 per cent more number of heads were recorded than that of control while at Ghuduwala SA produced 12.4 per cent more head than control. The incremental count of heads at RAS and Ghuduwala were lower in KNO_3 than SA but increased by 9.71 and 12.0 per cent as compared to control, respectively, at both locations. This may also happened due to the fact that SA & KNO_3 are supposed to be associated with tolerance of terminal heat effect and improving photosynthetic activity, thereby help to retain more number of heads per plant. Sarkar and Malik (2001) reported that foliar spray of 0.5% solution of KNO_3 at 50% flowering stage in grass pea (*Lathyrus sativus*) caused marked increase in pods $plant^{-1}$, seeds pod^{-1} and 1000-seed weight compared to water spray and unsprayed control.

Data (Table 2) indicated that application of bio regulators significantly increased the number of seed per head over control. At KVK farm, the percentile increase was observed the highest under KNO_3 (10.9), followed by SA (7.54) and the least under MOP (5.76) as compared to control. Similar trend in number of seeds per head was recorded at RAS and Ghuduwala, however, percent increase was 22.9, 12.9 and 7.84 per cent for KNO_3, SA and MOP, respectively at RAS while it was 28.0, 25.4 and 24.0 per cent under respective treatments at Ghuduwala. The difference in results among different locations might be due to spatial variability and worth of technological interventions. Moreover, improvement of chlorophyll content enzyme activity, maintenance of water balance and sufficient build up of food reserves for formation of seeds might be reason for increase in seeds per head with foliar application of SA and KNO_3 (Kumar *et al.,* 2013). The data purported that foliar application of KNO_3 and SA has a pronounced effect on 1000 seed weight (Table 2). The highest 1000 seed weight was recorded under KNO_3 at KVK farm which was 27.7 per cent higher than control where as it was 23.5 per cent higher than control under SA while application of MOP contributed 21.2 per cent increase in 1000 seed eight over control. Similar results were reported at Ghudduwala. However, at RAS, it was observed that SA proved superior to KNO_3 where SA increased the 1000 seed weight by 20.0 per cent than control while KNO_3 resulted in 17.6 per cent increase in 1000 seed weight over control. The increase in translocation of photosynthates to the seed under foliar application of SA, might be responsible for increasing the 1000-seed weight (Mohammed and Tarpley 2011) where as being an osmoprotectant, application of KNO_3 recorded 7.9–13.5 per cent increase in 1000-seed weight due to its positive effects on regulation of osmotic turgor and water balance of cell under stress condition. (Kumar *et al.,* 2013). Similarly, Beena *et al.* (2011) reported that application of potassium and

Table 2: Effect of different treatments on plant height, number of shoots/m^2, number of heads/ m^2, seeds/ head, 1000-seed weight, seed yield and biomass of barseem (pooled data)

Treatment	Plant height (cm)	No. of shoots/m^2	No. of heads/m^2	No. of seeds/head	1000 seed weight (g)	Seed yield (q/ ha)	Biomass (q/ha)
Location 1 (Faridkot)							
Control	52.7	431	390	49	2.9	6.47	440
SA	62.4	465	422	52	3.4	7.75	471
KNO_3	63.5	522	464	61	3.6	9.34	465
MOP	64.5	490	435	55	3.4	7.41	450
LSD ($p< 0.05$)	2.05	17.79	9.46	5.99	0.34	0.09	22.36
Location 2 (Romana Albel Singh)							
Control	39.5	412	372	53	2.6	5.25	344
SA	47.6	429	395	59	3.2	7.11	427
KNO_3	50.5	437	412	61	3.5	6.78	451
MOP	43.4	426	390	54	2.9	6.25	410
LSD ($p< 0.05$)	2.55	10.24	16.38	2.31	2.86	0.18	11.71
Location 3 (Ghuduwala)							
Control	38.2	428	374	52	2.7	5.50	378
SA	49.2	445	421	55	3.2	7.55	435
KNO_3	51.5	452	427	57	3.3	8.03	510
MOP	45.7	442	408	54	3.2	7.05	427
LSD ($p< 0.05$)	1.48	18.87	28.73	3.05	0.20	0.18	15.61
LSD ($p< 0.05$) Treatments X Location	1.78	16.67	15.05	4.56	0.22	0.12	12.99

Phosphorous resulted in healthier and plump seed formation thereby, significantly enhanced 1000 seed weight of barseem.

All treatments i.e. foliar application of KNO_3 and SA as well as basal application of MOP showed a significantly positive effect on the seed yield of barseem. The data (Table 2) advocated that the highest seed yield (9.31 q/ha) was obtained under KNO_3 application which was 29.9 per cent higher than control while spray of SA produced 16.2 per cent more seed yield than control. It was recorded that basal application of MOP also proved beneficial as the practice enhance the seed yield by 12.6 per cent over control at KVK Farm. The similar trend of seed yield was observed at Ghuduwala where application of KNO_3, SA and MOP produced 37.2, 46 and 28.2 per cent higher seed than control. However, at RAS, application of SA perform better than KNO_3 and produced 35.1 per cent higher seed yield than control while later yielded 28.2 per cent increase in seed yield over control, whereas, Basel application of MOP produced 19 per cent higher seed than control, might be due to fact that KNO_3 and SA induced terminal heat tolerance in plants and improved water and nutrient uptake under stress thereby, contributed to produce more shoots, bearing more number of heads, retaining more number of seeds per head, and healthier seeds as compared to control, resulting in increased seed yield.

Similarly, MOP enhanced availability of K in soil, synergistically effecting root growth, improved uptake of water, nutrients and osmoregulation which imparted tolerance towards abiotic stresses (Gattward *et al.,* 2012). Misra *et al.* (2012) reported that application of potassium in alfisols increased the seed yield and fodder yield of berseem.

Economic efficiency: The potential use of multipurpose crops as a sustainable strategy to overcome the problems associated with the agricultural intensification is certain to cope soil depletion and decline in yields. However, diversification through barseem seed production illustrated an example of economically viable and practically feasible option where, 70.1 to 145.1 q/ha yield equivalent to wheat can be obtained (Table 3). The data given in Table 3 purported that MOP facilitated the increase in green fodder production from 9.3 to 18.7 per cent over control whereas fodder yield in case of KNO_3 and SA was comparable to control, as these were applied on initiation of flowering after third cut. As the green fodder was sold @ Rs. 100 per quintal, therefore, generated income to the tune of Rs. 52550-59250 per ha. The Table 3 also showed the economic superiority of KNO_3, SA and MOP over control. At Faridkot, as per earlier discussion, seed yield increased due to application of KNO_3 and SA, as a result of which wheat equivalent yield (WEY) was increased to the tune of 51.4 and 30.0 per cent over control respectively. Basal Application of MOP also enhanced wheat equivalent yield by 31.4 per cent as compared to control. Similarly, an increase in remuneration by 63200-113700 per ha was recorded in various treatments as compared to control. The similar trend in terms of WEY was observed at RAS and Ghuduwala. The data purported that 30.6 and 51.4 per cent higher income was obtained due to synergistic effect of KNO_3 and SA as compared to control at Faridkot over control respectively, whereas it varied from Rs. 211720 to Rs. 267650 per ha at RAS and Rs. 188750 to Rs. 294420. It was

Table 3: Economic analysis of barseem seed production as effected by different treatments

Treatment	Green fodder (q/ ha)	Wheat equivalent yield* (q/ha)	Gross income (Rs/ha)	B:C ratio
Location 1 (Faridkot)				
Control	558.5	86.0	221450	3.97
SA	560.0	121.2	289400	5.06
KNO_3	562.5	145.0	335450	5.94
MOP	572.5	116.3	291050	5.11
Location 2 (Romana Albel Singh)				
Control	537.2	81.8	211720	3.80
SA	545.0	105.7	257900	4.50
KNO_3	542.5	110.8	267650	4.74
MOP	567.5	97.4	254250	4.46
Location 3 (Ghudu wala)				
Control	525.5	70.1	188750	3.39
SA	537.0	117.7	280200	4.89
KNO_3	527.2	125.1	294420	5.21
MOP	592.5	109.9	270750	4.75
Mean	552.3	107.3	263582	4.70

*MSP of wheat – Rs. 1925/- per quintal (2019-20) observed that application of KNO_3 increased the gross income by 51.4, 26.4 and 55.9 and while increment in gross income of 30.6, 21.8 and 48.4 per cent was recorded due to SA at Faridkot, RAS and Ghuduwala, respectively. The data revealed that application of MOP also enhance the gross income by 31.4, 20.0 and 43.4 per cent over control at Faridkot, RAS and Ghuduwala respectively. The range of benefit: cost varied from 5.06 to 5.94, 4.46 to 4.74 and 4.75 to 4.89 under various treatments at Faridkot, RAS and Ghuduwala while the same ranged between 3.89 to 3.97 under control plots.

CONCLUSION

In order to cope up with the depleting soil health, increasing cost of cultivation and debt ridden unemployed rural populous, there is a dire need to popularize an economically feasible enterprise i.e. the seed production of barseem. It may also be concluded that application of KNO_3 and SA significantly enhanced the seed yield of barseem, which imparted a significant increase in income per unit of inputs applied. Moreover, irrespective soil status of available K, application of MOP proved effective to increase the seed yield. The location specific application of KNO_3, SA and MOP will further economize the suitability of enterprise.

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Evaluation of Technical Knowledge of Apple Growers about Recommended Apple Production Technology in Different Regions of Kashmir Valley

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ABSTRACT

The study examines the technical knowledge of the apple growers about recommended apple production technology. The study was conducted in three districts of Kashmir division selected purposively, having maximum area under apple cultivation. A multistage sampling procedure was adopted for the study. The study used mixed methods, combining focus group discussions, key informant interviews, and a household survey. From the study it was found, that majority of the apple growers from all the three districts were having medium level of knowledge in almost all the practice such as "preparation of land and planting", "training and pruning of apple trees "Orchard management", "nutrient management", "harvesting and picking", "packaging and storage". The study revealed that area under apple fruit has increased, but the productivity has not improved to a satisfactory level. Different methods (trainings, demonstrations, workshops, field-days) need to be employed by the extension officials to update the technical knowledge of apple growers

Keywords: Apple, Evaluation, Growers, Knowledge, Technology

INTRODUCTION

Apple is considered as one of the most important and widely grown fruit in temperate zones of the world with regard to its acreage, production, economic returns, high nutritive value and popularity (Shah *et al.,* 2017a). Apple is one of the most important temperate fruit grown all over the world and occupies the fourth (4^{th}) position in the world in terms of production after banana, orange and grapes. China, USA and Poland are the top three countries in the world as for as apple production is concerned, followed by Turkey, India and Iran. According to USDA (United States Department of Agriculture), China is the top-most producer of apple, producing 44 million tonnes annually, followed by United States, which produced 4.6 million tonnes of apple. The third apple producing country in the world is Poland, which produced 3.6 million tonnes of apple in the year 2016-17. Turkey produces one of the finest apples in the world. It produced 2.92 million tonnes of apples, which are being exported throughout the world. India is the fifth (5^{th}) apple producing country in the world, which produced 2.87 million tonnes of apples in the same year (Sheth, 2018).

The area under apple cultivation in Jammu and Kashmir has estimated to be the second largest in the world and second largest producer in Asia, thereby making it the largest contributor to the state GDP. J&K has the highest average yield and accounts 67 per cent of total apple production and 50 per cent of its export in the country, hence a substantial foreign exchange earner and important for economic growth (Parrey

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and Hakeem, 2015). Jammu and Kashmir is rightly known as an apple state of India. Kashmir is India's main apple basket, as almost 89 per cent of the horticulture land in Kashmir is under apple cultivation. With more than Rs. 9000 crore turnover, the apple cart is the main mover and shaker of Kashmir's economy (Ashraf, 2018). In Kashmir it is estimated that the area and production of apple in Kashmir division during the year 2018-19 was 146327 hectares and 1851723 metric tonnes respectively (Government of J&K 2019). It is estimated that area under apple cultivation is increasing day by day, but its production as well as productivity is not upto mark. The main reason for this lower production is due to use of faulty cultivation practices, following of tradition practices in the age of technology and science and low level of knowledge about apple cultivation.

Knowledge is generally understood as an intimate acquaintance of an individual with facts. Knowledge is one of the important components of behavior and as such plays an important role in the covert and overt behavior of an individual. Knowledge is the extent to which an individual possesses understanding and comprehension on various dimensions of apple cultivation. It also refers to the farmers understanding of the recommended cultivation practices of apple cultivation or it refers to the body of information understood and retained by the farmers about recommended apple cultivation practices (Shah *et al.,* 2017b). Knowledge about innovation may be an important factor affecting the adoption behaviour of farmers. The farmers who have more knowledge about newly developed technology also have more level of adoption of technology compared to those who have low knowledge (Choudhary *et al.,* 2019). So the basic thing to increase the production and productivity of apple all over the world in general and state of Jammu and Kashmir in particular is to timely update the knowledge level of farmers about different innovative technologies developed at research stations. The need of the hour is that both print and electronic media should be made easily available to the apple growers at local level. More efforts are required by the extension agencies to increase as well as update the knowledge of apple growers about recommended cultivation practices of apple production and to motivate them for their proper use to obtain higher yields (Shah *et al.,* 2020).

MATERIALS AND METHODS

The present study was conducted in the state of Jammu and Kashmir, the northern most state of India. Three districts from Kashmir valley namely district Shopian, district Budgam, and district Baramulla were selected purposively. A multistage sampling procedure was adopted for the selection of districts, horticultural zones, villages and sample apple growers. From the selected districts, three horticultural zones from each district having maximum area under apple cultivation were selected purposively. From each horticultural zone, one village was selected purposively having maximum area under apple cultivation. A sample of different apple growers (orchardists) having marginal, small, medium and large land holdings, were selected proportionately from selected villages. Thus, a total of 300 apple growers (orchardists) were selected purposively from nine (9) selected villages by using the following formula.

$$n_i = \frac{N_i}{N} n$$

Farooq and Khan (2019)

Where: n_i = Number of sampled apple growers in each village.

n = Total number of apple growers selected for the present study (300).

N = Total number of apple growers in sampled villages.

N_1 = Total number of apple growers in i^{th} village.

The structured interview schedule was prepared which include relevant questions for seeking information about different aspects of technical knowledge of apple growers. The interview schedule was pretested prior to its finalization by the researcher in the non-sampled area for its practicability and relevancy. The data was collected by administering the pretested interview schedule to the apple growers. The apple growers were personally interviewed by the investigator which enabled him to get first-hand information and an opportunity to observe the apple growers response. The qualitative data was converted into quantitative data by giving scores. Different statistical tools were employed to obtain logical conclusion.

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that for preparation of land and planting, it was observed, that

Table 1: Distribution of the apple growers according to practice-wise knowledge level in recommended apple production technology

Recommended Practices	Frequency of Knowledge level											
	Shopian (n_1=101)			Budgam (n_2=86)			Baramulla (n_3=113)			Overall (N=300)		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Preparation of land and planting	17 (16.83)	58 (57.43)	26 (25.74)	23 (26.74)	55 (63.95)	08 (09.30)	19 (16.81)	79 (69.91)	15 (13.27)	59 (19.66)	192 (64.00)	49 (16.34)
Training and pruning of apple trees												
Pruning of young non-bearing trees	20 (19.80)	64 (63.36)	17 (16.83)	27 (31.40)	51 (59.30)	08 (09.30)	14 (12.39)	87 (76.99)	12 (10.62)	61 (20.34)	202 (67.33)	37 (12.33)
Pruning of bearing trees	14 (13.86)	60 (59.40)	27 (26.73)	19 (22.09)	60 (69.76)	07 (08.14)	12 (10.62)	83 (73.45)	18 (15.93)	45 (15.00)	203 (67.66)	52 (17.34)
Training and pruning of dwarf trees	20 (19.80)	48 (47.52)	33 (32.67)	32 (37.21)	44 (51.16)	10 (11.63)	27 (23.89)	67 (59.29)	19 (16.81)	79 (26.34)	159 (53.00)	62 (20.66)
Cultivation and Mulching	13 (12.87)	66 (65.34)	22 (21.78)	33 (38.37)	45 (52.33)	08 (09.30)	20 (17.70)	81 (71.68)	12 (10.62)	66 (22.00)	192 (64.00)	42 (14.00)
Thinning and rejuvenation of unproductive orchards	25 (24.75)	58 (57.42)	18 (17.82)	33 (38.37)	46 (53.49)	07 (08.14)	27 (23.89)	69 (61.06)	17 (15.04)	85 (28.34)	173 (57.66)	42 (14.00)
Irrigation and drainage	26 (25.74)	55 (54.45)	20 (19.80)	34 (39.53)	40 (46.51)	12 (13.95)	29 (25.66)	69 (61.06)	15 (13.27)	89 (29.67)	164 (54.67)	47 (15.66)
Pollination and pre-harvest fruit drop	09 (08.91)	65 (64.36)	27 (26.73)	14 (16.27)	56 (65.12)	16 (18.60)	12 (10.62)	77 (68.14)	24 (21.24)	35 (11.67)	198 (66.00)	67 (22.33)
Nutrient Management												
Organic manure (Fully decomposed FYM)	20 (19.80)	60 (59.41)	21 (20.79)	34 (39.53)	40 (46.51)	12 (13.95)	27 (23.89)	70 (61.95)	16 (14.16)	81 (27.00)	170 (56.67)	49 (16.33)
Inorganic fertilizers	17 (16.83)	61 (60.39)	23 (22.77)	36 (41.86)	33 (38.37)	17 (19.77)	27 (23.89)	64 (56.64)	22 (19.47)	80 (26.67)	158 (52.67)	62 (20.66)
Methods of fertilizer application	11 (10.89)	63 (62.37)	27 (26.73)	28 (32.56)	46 (53.48)	12 (13.95)	17 (15.04)	69 (61.06)	27 (23.89)	56 (18.67)	178 (59.33)	66 (22.00)
Methods to overcome nutritional deficiencies	61 (60.39)	25 (24.75)	15 (14.85)	58 (67.44)	18 (20.93)	10 (11.63)	71 (62.84)	26 (23.00)	16 (14.16)	190 (63.33)	69 (23.00)	41 (13.67)
Pests and disease management	14 (13.86)	22 (21.78)	65 (64.35)	28 (32.56)	16 (18.60)	42 (48.84)	17 (15.04)	33 (29.20)	63 (55.75)	59 (19.67)	71 (23.67)	170 (56.66)
Harvesting and picking	14 (13.86)	47 (46.53)	40 (39.60)	20 (23.25)	37 (43.02)	29 (33.72)	17 (15.04)	64 (56.64)	32 (28.32)	51 (17.00)	148 (49.34)	101 (33.66)
Packaging and storage	18 (17.82)	47 (46.53)	36 (35.64)	24 (27.90)	54 (62.79)	08 (09.30)	21 (18.58)	68 (60.17)	24 (21.23)	63 (21.00)	169 (56.34)	68 (22.66)

Figures within parenthesis indicate respective per centage.
(Note: Mean and Standard Deviation in Table 2)

among all the three districts, majority of the apple growers were having medium level of knowledge regarding this practice, 69.91 per cent in district Baramulla, followed by 57.43 per cent in district Shopian and 63.95 per cent in district Budgam. However, it was revealed from the data, that a majority (64.00%) of the apple growers from all the three districts (overall knowledge level) were having medium level of knowledge about preparation of land and planting of apple trees. For training and pruning of apple trees, Orchard management, harvesting and picking, packaging and storage, it was observed that among all the three districts, majority of the apple growers were having medium level of knowledge regarding all the practices of apple cultivation.

In case of nutrient management aspect of apple cultivation, it was revealed, that majority of the apple growers, in organic manures and methods of fertilizer application were having medium level of knowledge in all the three districts However, in case of inorganic fertilizers aspect of apple cultivation, majority of the apple growers were having medium level of knowledge in district Shopian (60.39%), followed by district Baramulla (56.64%). While as, in district Budgam, a majority (41.86%) of the apple growers were having low level of knowledge about inorganic fertilizer aspect of apple cultivation. However, it was also observed from the data, that a majority (52.67%) of the apple growers from all the three districts (overall knowledge level) were having medium level of knowledge about inorganic fertilizers. As for as nutrient management aspect of apple cultivation is concerned, it was found that majority of the apple growers from all the three districts were having low level of knowledge about "methods to overcome nutritional deficiencies" aspect of apple cultivation, 67.44 per cent in district Budgam, followed by 62.84 per cent in district Baramulla and 60.39 per cent in district Shopian. However, it was also revealed from the data, that a majority (63.33%) of apple growers from all the three districts (overall Knowledge level) were having low level of knowledge about methods to overcome nutritional deficiencies of apple trees.

For pest and disease management, it was revealed from the data, that majority of the apple growers from all the three districts were having high level of knowledge about "pest and disease management" aspect of apple cultivation, 64.35 per cent in district

Table 2: Mean and standard deviation for practice-wise Knowledge Level of apple growers.

Recommended Practices	**Shopian (n_1=101)**		**Budgam (n_2=86)**		**Baramulla (n_3=113)**		**Overall (N=300)**	
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Preparation of land and planting	7.18	2.89	6.21	5.36	9.43	5.50	7.61	4.59
Training and pruning of apple trees								
Pruning of young non-bearing trees	3.71	1.51	3.02	1.33	3.17	1.40	3.30	1.42
Pruning of bearing trees	2.95	1.46	2.68	1.42	2.40	2.22	2.68	1.70
Training and pruning of dwarf trees	2.86	1.83	3.10	2.14	3.09	2.05	3.02	2.01
Orchard Management								
Cultivation and Mulching	5.56	1.87	3.36	2.26	3.28	1.60	4.07	1.91
Thinning & rejuvenation of unproductive orchards	3.32	0.96	3.20	1.03	3.14	1.00	3.22	01.00
Irrigation and drainage	2.05	0.99	2.21	1.03	2.63	1.00	2.30	1.01
Pollination and pre-harvest fruit drop	6.15	1.98	5.56	2.22	6.21	1.42	5.98	1.88
Nutrient Management								
Organic manure (Fully decomposed FYM)	4.72	1.89	3.96	2.57	3.81	1.86	4.17	2.11
Inorganic fertilizers	9.99	2.53	7.56	2.36	8.41	1.81	8.66	2.24
Methods of fertilizer application	3.08	1.60	3.96	1.47	3.87	1.48	3.64	1.52
Methods to overcome nutritional deficiencies	2.90	1.92	3.17	2.12	2.96	1.95	3.01	02.00
Harvesting and picking	7.38	1.94	5.82	2.52	7.38	2.14	6.86	2.20
Packaging and storage	4.10	1.84	2.48	1.83	3.30	1.54	3.30	1.74
Pests and disease management	14.43	3.20	11.09	3.04	12.46	2.92	12.66	3.06

Shopian, followed by 55.75 per cent in district Baramulla and 48.84 per cent in district Budgam. However, it was also observed from the data, that majority (56.66%) of the apple growers from all the three districts (Overall knowledge level) were having high level of knowledge about pest and disease management of apple orchards.

The possible reason for the medium level of knowledge in preparation of land and planting, training and pruning of apple trees, orchard management, some practices of nutrient management, harvesting and picking, packaging and storage components of apple cultivation were complex and difficult to remember and were moderately known to apple growers. On the other hand, the practices which were simple and traditionally practiced were known to majority of the apple growers. The possible reason for low level of knowledge in methods to overcome nutritional deficiency component of apple cultivation by the apple growers in all the three districts could be found due to the fact, that this practice needs more scientific and technological intervention, of which the majority of the apple growers were lacking. Most of the apple growers were either illiterates or have low educational status, besides lacking information about the recommended technology.

In case of pest and disease management aspect of apple cultivation, the possible reason for high level of knowledge of majority of the apple growers in all the three districts was due to the fact, that much of the focus of apple growers as well as the extension agencies lies towards management of pests and disease, so that, most of the information is being delivered among the apple growers. Moreover, awareness camps, trainings, farmer's tours and Kisan mela's are being conducted mostly for the management of the pests and diseases of apple plants.

CONCLUSION

It was found, that majority of the apple growers from all the three districts were having medium level of knowledge in almost all the practice. Lack of technical knowledge was found to be the prime reason for non-adoption of recommended apple cultivation practices, as expressed by majority of the apple growers. Apple growers mainly rely on traditional practices and most of them follow private unauthorised dealers located in their vicinity. This posse's the real challenge to the extension functionaries to increase the technical knowledge of apple growers through effective capacity building programmes.

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Factors Influencing Migration from North Bihar: An Application of Logistic Regression Model#

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ABSTRACT

There are numerous economic and non-economic factors behind migration. Migrants are pushed out from their native place due to socio-economic condition. Adversely migrants are pulled into the destinations that offer comparatively high wages and employment opportunities and better living standard, health and educational facilities. Bihar stands next to Uttar Pradesh in out-migration at national level. The purpose of the present paper is to investigate factors influencing out-migration from north Bihar as this region is victim of reoccurring flood causing losses of crops and their household assets. Major socio-economic factors causing migration are analyzed using information collected from 180 migrant and 180 non-migrants from three districts namely; Samastipur, Darbhanga and Madhubani because large scale migration has been observed from these districts. Logistic regression model was applied to assess the factors responsible for migration from the study area. The results revealed that youngster belonging to lower income households and having poor housing condition are found more prone to migrate. On the other hand coefficients of education levels, land holding size, marital status were found positive and statistically significant indicating educated people were more prone to migrate as they had poor access to employment in the area under investigation. The coefficient of land holding size was positive and statistically significant pointed out that an increase in size of landholding of household increases the probability to migrate which contradicts the general assumption that poor households are more prone to migrate, does not hold true, particularly for the area under study. It is worth to mention here that migration from landowning households increased during last few decades, on account of stagnant agricultural production, crop losses due to frequent flood and poor infrastructure for agricultural production and un-availability of non-farm activities pushing youngster of even large farm households to outside of Bihar.

Keywords: Agricultural production, Flood, Logistic regression model, Migration

INTRODUCTION

The middle Ganga plain has been the hub of out-migration in the country. On account of wide spread of poverty, unemployment and underdeveloped livelihood, migration is still in vogue from this region and is mainly directed towards the comparatively developed states of western India like Delhi, Punjab, Haryana, Maharashtra, Gujarat etc. Migration from this region is dominated by males, who leave their families behind in the villages. Inter-state migration of wage earners is still continued and intensified in recent years. As per Census of India 2011, the largest number of

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out-migration (20.9 million) is reported from Uttar Pradesh and Bihar. After Uttar Pradesh, Bihar has the second largest number of persons migrating out of state. However, the inter-states migrants constitute the largest proportions of migrants from Bihar. About 14% of male and only 1% of female migrated for work/employment from Bihar as per census 2011.

Among states of eastern Indian, Bihar has been characterized as low and stagnant economic growth, high levels of poverty, and the lowest levels of per capita income (Rs.43822 per capita/annum) among the states in the country still up to 2021. The Human Development Index (HDI) for the state has increased from 0.436 in 2000 to 0.574 in 2019, however, after two decades Bihar is placed at the lowest among the states in India. Bihar is also placed at the lowest in the Gender Equality Index. The literacy rate in the state was 61.80 per cent, the female literacy rate, at 51.5 per cent, and male literacy rate at 71.20 per cent (Census of India, 2011).

The rate of migration from the Bihar to both rural and urban destinations is very high and has increased over the last decade (Kumar and Banerji, 2010; Deshingkar *et al.,* 2009). Remittances from migration have significantly contributed to increase incomes in the migrants native places (Bhaskaran and Mehta, 2009; Rodgers and Rodgers, 2001). Apart from, contributing to growth processes in other parts of the country, the migrants from Bihar have also been key drivers of social change in rural Bihar. However, in recent times, they have been facing a backlash rooted in ethnocentric movements in the host locations such as Maharashtra and Assam (Kumar, 2009).

North Bihar plain has rich natural resources like fertile alluvial soil endowed with surface and sub-surface water resources. The people in the region depend mostly on agriculture. The region is, however; also have low productivity, low crop diversification, less scope for non-agricultural activities, high incidence of rural poverty, marginalisation, feudal exploitation and persistent poor governance. North Bihar is vulnerable to flood as this region is drained by two rivers Gandak and Kosi and their tributaries- the Bagmati, Burhigandak and Kaml-Balan. In recent few decades flood has been the recurring phenomenon of north Bihar only intensity of flood varies from year to year. The flood plains are generally submerged and affect human and animal lives, physical assets and livelihood of people.

Agriculture and its allied sectors are the prime source of livelihood of rural Bihar. However, the dependence on agriculture and allied sector declined from around 75 per cent to 50 per cent during 2004-05 to 2018-19 but still the economy of the state depends on agriculture and allied sectors (NSSO employment and unemployment rounds, Periodic Labour Force Survey).

One of the most important reasons behind reduction in employment in agriculture and allied sector was vast damage to crops from weather aberration during the cropping season. Agricultural production becomes uncertain due to continuous flooding in this region. Agricultural labours works on other land get insufficient wage to feed a family of 4-5 members.

The flood, however, was not the only reason for a declining dependency on agricultural activities. The agricultural scenario changed over the time. Now it becomes commercialized and due to price hike of inputs it is not profitable and employment opportunity in agriculture started to shrink both for men and women on account of advancement in mechanization and increasing population in the state. When the economy of any region faces distress, out migration becomes an option for survival of rural households. Urbanization drew the labour away from the farm in the open market economy.

Keeping in mind, the out-migration from Bihar, the present study is conducted to find out the influencing factors of migration.

MATERIALS AND METHODS

Present study is based on primary data obtained from 180 migrant and 180 non-migrants of households of twelve villages of Samastipur, Darbhanga and Madhubani districts of north Bihar. These districts were three most migration prone districts of North Bihar (64th round NSSO report No.470, 2007-08, Census of India, 2011). Migrants and non-migrant households were selected from matching socio-economic status of the household. The survey was conducted with the help of pre-structured schedule in the year 2019 and detailed information on various socio-economic aspects were collected.

The descriptive analysis of migrant and non-migrants involving gender, age, education, occupation, land holding and income were carried out to analyse their socio-economic characteristics of both the categories of respondents which may influence them to migrate or not to migrate.

To assess the factors influencing migration, logistic binary regression model was used as the independent variable in logistic regression which is generally dichotomous i.e. the dependent variable take the value 1 with probability of success θ, or the value 0 with the probability 1-θ. This type of variable is known as Bernoulli or binary variable. In the present study θ represents the probability of an event that depends on 'n' covariates or independent variables (Tabachnick and Fidell, 1996; Sricharoen, 2013).

RESULTS AND DISCUSSION

An attempt has been made to undertake comparative analysis of socio-economic status of migrant and non-migrant households. Socio-economic profile and descriptive data of the respondents both migrants and non-migrants are presented in Table 1 and 2.

Perusal of the Tables indicated that majority of migrants (59.00%) belonged to the age group of 20-34 and about 52.0 per cent of them were from nuclear family category. The majority of migrants (88%) were literate and some of them were educated above the standard indicating that educated young persons are more prone to migrate from the study area. Majority of migrant households (62%) had less than 1 ha of land but 90 per cent migrants reported farming as their main occupation and 58 reported daily wage earning as their secondary occupation.

It was also observed that average age of migrant workers was about 33 years and average year of education was about 8 years and had average land holding 0.70 ha. The proportion of earners to total family labour was found to be 0.48 (Table 2). The annual income of migrants and non-migrant were about Rs. 1.28 lakh/year and Rs. 2.97 lakh/year respectively. It was observed from Table 2 that though education level of non-migrant was low but they had

Table 1: Socio-economic profile of the respondents

Particulars	Migrants' Household		Non-migrants' Household	
	Frequ-ency	Percen-tage	Frequ-ency	Percen-tage
Family type				
Nuclear	94	52	73	41
Joint	86	48	107	59
Total	180	100	180	100
Gender of Migrant				
Male	180	100	128	71
Female	0	0	52	29
Total	180	100	180	100
Age				
15-19	3	2	0	0
20-34	107	59	51	28
35-50	69	38	109	61
>50	1	1	20	11
Total	180	100	180	100
Literacy of migrant				
Literate	159	88	122	68
Illiterate	21	12	58	32
total	180	100	180	100
Land holding				
0 ha	19	11	10	6
<1 ha	112	62	105	58
1-2 ha	43	24	56	31
2-4 ha	6	3	9	5
>4 ha	0	0	0	0
Total	180	100	180	100
Primary Occupation of migrant at native				
Farm	161	90	169	94
Non-farm	19	10	11	6
Total	180	100	180	100
Secondary occupation of Migrant				
Agriculture and allied	15	8	12	7
Business	12	7	78	43
Service	9	5	5	3
Private work	3	2	8	4
Daily wage earner	105	58	57	32
Others	0		20	11
Total	180	100	180	100

Table 2: Household data of respondents

Particulars	Migrants (N=180)		Non-migrants (N=180)	
	Mean	SD	Mean	SD
Age (years)	32.87	6.45	38.07	7.18
Education	7.73	4.30	5.99	4.55
Land holding size(ha)	0.70	0.63	0.81	0.75
Worker	0.48	0.07	0.42	0.08
Income (Rs in lakh per annum)	1.28	0.28	2.97	1.32

more land and had less proportion of earners in the family and their income was more as compared to migrant workers in the study area. It was only due to their engagement in business activities (Table 1).

Logistic regression was worked out to assess the factors influencing migration. The result of the analysis is presented in Table 3. All the variables except worker i.e. proportion of earning members to total family members) included in the model were found significant at probability level of less than 0.5. The coefficients such as age, income and housing condition are found negative, indicating that with increase in age, income and having good living condition the pace of migration retarded. Other variables like education, land holding size, marital status have positive and significant coefficients indicated that educated people are more prone to migrate as there is paucity of gainful employment in the area under investigation. Another reason could be preference of non-agricultural work by educated people. Similar finding are reported by Sardadvar and Vakulenko (2017); Mkrtchyan and Florinskaya (2018).

The estimate of size of land holding is positive and statistically significant meaning thereby that an increase in size of landholding of household may increase the probability to migrate. The general assumption is that the comparatively poor households are more prone to migrate, does not hold true, particularly for the area under study. However it was observed that migration from landowning households increased during last few decades, on account of stagnant agricultural production, recurring losses due to flood and poor infrastructure for agricultural production and non-farm activities are also pushing youngster of even large size household to outside of Bihar. The finding is in conformity with the findings of Singh *et al.* (2002).

It is generally assumed that married people are less prone to migrate. But the estimate of logistic regression indicated that marital status increased the pace of migration. The reason may be that after marriage liabilities increased and to meet the expanses, married people have to migrate to seek better employment to enhance income. It is considered that the higher proportion of working members in the family, the lower chances of migration. But, the estimate is positive but non-significant. The reason could be that the study area has poor infrastructure and frequent floods might compelled people to migrate to augment their income to meet their household expenses.

CONCLUSION

Hence, it may be said that youngster pertaining to lower income households and having poor housing condition are found more prone to migrate. On the other hand married educated persons with land holding are more prone to migrate as they have poor access to gainful

Table 3: Factor influencing labour migration

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Age	-0.13	0.04	10.37	1	.001	0.87	0.81	0.95
Education	0.31	0.07	18.63	1	0.00	1.36	1.19	1.58
Land holding size (ha)	2.75	0.70	15.52	1	0.00	15.61	3.98	61.28
Income (Rs. Lakh/annum)	-6.69	0.91	53.88	1	0.00	0.001	.000	0.007
Marital status	1.79	.753	5.630	1	0.02	5.98	1.37	26.16
Worker	1.72	3.137	.299	1	0.58	5.56	0.01	2603.62
Housing condition	-1.466	0.62	5.65	1	0.02	0.23	0.07	0.77
Constant	10.527	2.46	18.30	1	0.00	37314.84	-	-

employment in the study area. Educated youths generally prefer non-agricultural employment. An increase in size of landholding of household increases the probability to migrate, hence the general assumption is that poor households are more prone to migrate, does not hold true, particularly for the area under study. However it was observed that migration from landowning households increased during last few decades, on account of stagnant agricultural production, crop losses on account of frequent flood and poor infrastructure for agricultural production and un availability of non-farm activities are also pushing youngster of even large size household to outside of Bihar (Singh *et al.,* 2002). The study revealed that the factors which impelled people to migrate were dignified employment in rural area, possibilities of enhancing income in destination place. All the migrants indicated that they knew their migration was temporary, but it helped them in raising their living condition and made them able to lead dignified lives. Migration provided them an opportunity to dissolve income related problems in the villages.

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Non Linear Optimization Model for Water Allocation under Deficit Irrigation System

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ABSTRACT

A non linear optimization model is formulated in the present study to optimize the deficit levels for different crop growth stages to maximize the net economic return within the available resource constraints. The model determines decade (10 days) optimal withdrawals from canal and ground water, optimal area under different crops and optimal deficit levels for different crop growth stages. The model is applied to Dadu canal command of Lower Indus basin. The result showed an overall increase of 61.7 per cent in the cropped area under deficit irrigation as compared to the full irrigation by using the proposed model. The optimal economic return under deficit irrigation is found to be 18.3 per cent higher than the optimal economic return from the full irrigation. The optimal economic return further increased by 20.3 per cent with an increase of 150 per cent in the tube well capacity under deficit irrigation as the slackness was found in the annual ground water balance constraint at the existing tube well capacity. The model is general and can be used to find out the optimal cropping pattern under deficit irrigation.

Keywords Deficit irrigation, Optimization model, Deficit level, NLP

INTRODUCTION

Water is one of the most important natural resources for all life on earth. Many uses of water include agricultural, industrial, household, recreational and ecological activities. Agriculture has been the major user of the world's water resources. Water demand is increasing as world population is growing rapidly and it would mean that more water would be needed in the agricultural sector to feed growing population. Therefore, sustainability of agriculture would demand either the development of additional water resources or efficient management of the available water resources under the existing constraints.

There are various techniques for optimal allocation of available water recourses based on optimization models. The water is allocated to different crops according to their water requirements for producing maximum yield per unit area along with the optimal allocation of the land, water and other resources (Afshar and Marino, 1989; Mayya and Prasad, 1989; Paudyal and Gupta, 1990; Thandaveswara, 1992; Shyam *et al.,* 1994; Onta *et al.,* 1995; Garg and Ali, 1998). But the continuing increase in the production is now exerting more pressure on the water resources to increase the crop production per unit of water. Therefore, deficit irrigation is also becoming a viable option i.e. deliberately under irrigating crops to reduce water consumption while minimizing adverse affect of extreme water stress on yield (Dag'delen *et al.,* 2006). The resulting yield reduction may be small as compared with the benefits gained through diverting the water to irrigate the other crops. English (1990); Reca *et al.* (2001); Singh *et al.* (2001) and Pereira *et al.* (2002) showed that deficit irrigation may also provide more production, increase in irrigated area and net economic returns from the command area. Gorantiwar and Smout (2003) developed a three-stage simulation optimization model based on deficit irrigation approach for assigning optimal water from a reservoir. Ghahraman and

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Sepaskhah (2004) formulated a non linear programming (NLP) model with an integrated soil water balance algorithm. Vedula *et al.* (2004) introduced a mathematical model (Linear Programming) for optimal conjunctive use planning to irrigate multicrop in a canal command area and maximized the annual relative yields of the crops. Gorantiwar and Smout (2006) further developed the simulation optimization model allowing for alternative schedules based on full or deficit irrigations for irrigation schemes of central and south India. Khare *et al.* (2007) developed a simple economic optimization model to explore the possibilities of conjunctive use of surface water and groundwater by using linear programming model (LPM) with various hydrologic and management constraints. Wang *et al.* (2007) developed a dynamic model for equitable distribution of water in water deficiency areas and optimized the water requirements at a given limited water supplies, and maximized the total economic benefit of the entire area. Montazar *et al.* (2010) developed an optimization model using NLP with an integrated soil water balance algorithm and carried out water allocation planning in complex deficit agricultural water resources systems, based on an economic efficiency criterion. Optimal cropping pattern were evaluated at fixed deficit levels and the model was applied to a command area in Iran. Raul *et al.* (2012) developed an Irrigation scheduling model (ISM) and a LPM for optimal conjunctive use planning of surface water and groundwater under uncertainty of hydrologic events like rainfall and canal water availability.

The existing literature showed that the optimization models are used with irrigation scheduling models (ISM) to carry out land and water resources planning under deficit irrigation. The actual yield is obtained by the ISM under different irrigation management strategies for various fixed deficit levels. Further the actual crop yield, obtained by the ISM, is used in the optimization model for optimum resource allocation. Although these models may optimize for a particular deficit level but may not give an overall optimal solution as the deficit levels are fixed. There may be possibility of increasing the net economic returns in the deficit irrigation if the deficit levels are not fixed and are also taken as variables in the optimization model.

Therefore, the present study aims to develop a NLP model to work out optimal deficit levels for optimal allocation of land and water resources to get net economic returns. The model is applied to the Dadu canal command in Lower Indus Basin to work out optimal cropping pattern under deficit irrigation.

MATERIALS AND METHODS

Study area: Dadu canal command area lies between latitude 29^o North and longitude 67^o East and it is the part of lower Indus basin which comprises in the province of Sindh, Pakistan. It covers an area of approximately 210,000 ha. The area is located in a hot arid zone and high potential evapotranspiration. The average annual rainfall of the region is around 91 mm, falling mainly in July and August. The soil type of the region is primarily fine sandy loam soil (Garg and Ali, 1998). The mean monthly maximum temperature and mean monthly minimum temperature varied between 15.9^{o}C to 42.8^{o}C and 7.7^{o}C to 15^{o}C, respectively (Garg and Ali, 1998). The wind velocity and relative humidity varied between 65 to 126 km/day and 39 per cent to 61 per cent, respectively. Further, the average daily sunshine hours over the study area varied from minimum about 8.5 hours in December to February to a maximum of about 10 hours in May and June.

The major sources of water include canal water, groundwater and hill torrents. However, generally very little flow reaches the study area from hill torrents and possibilities of its exploring are restricted considering the higher expected cost of development. Most of the area is underlain by a large alluvial sand aquifer. The canal water is supplied through Dadu canal having capacity of 89.0 m^3/s and designed for perennial cropping.

Rice is the main crop in *kharif* (May to October), while the other main crops are cotton, sorghum and oilseed. In *rabi* (November to April), wheat is the main crop along with mainly gram, and mustard. Sugarcane is an annual crop in Dadu command area. The existing cropping intensities are 30 per cent for *kharif* (summer season) and 48 per cent for *rabi* (winter season).

Model development: A NLP model is developed to obtain the optimal cropping pattern and management of available water resources from surface water and ground water for the Dadu canal command area under deficit irrigation planning. The coupling of ground water hydraulics with surface water is not considered in the optimization model because the tube well water for an average lift was around nine times costlier than the canal water. Therefore the optimization model will use the groundwater only when the surface e water is exhausted. However a ground water balance constraint on the ground water withdrawals on annual basis is imposed to consider the interaction between surface and ground water.

The existing cropping pattern in the study area includes eight major crops – Rice, cotton, sorghum and oilseed in *kharif* and wheat, gram, and mustard in *rabi* along with the perennial sugarcane. The same crops have been considered for the optimal production under deficit irrigation. The objective function comprises of returns from crops, cost of operation and maintenance of canal and tube well. The non water related cost are considered in the crop production cost while calculating return from the crops and no change in the existing farm practices i e. use of fertilizers etc. has been assumed. The model is applied on decade (10 days) basis and the variables in the model include: Decade withdrawals from the canal and tube well water for irrigation, areas under different crops and deficit levels are to maximize the net economic return from the crops.

Model application: The NLP model, formulated in previous section, has been applied to the Dadu canal command area of the Lower Indus Basin. The Dadu canal offtake from Sukkur barrage and it is a perennial canal. The existing cropping pattern, sowing dates of various crops and crop periods are shown in Table 1. The other data for the command area can be obtained from Garg and Ali (1998). Decade potential evapotranspiration for the study area has been calculated using the CROPWAT 8 model (Smith, 1992).

Table 1: Existing cropping pattern, sowing dates and duration of growth of different crops

Crops	Existing cropping pattern (ha)	Planting dates	Durations (days)
Cotton	6300.00	May 1	184
Sugarcane	12600.00	March 1	335
Wheat	52500.00	Nov. 15	120
Sorghum	2100.00	July 1	110
Gram	25869.00	Nov. 1	135
Oilseed	14700.00	Aug. 2	90
Mustard	18900.00	Nov. 1	135
Rice	21000.00	June 1	120

RESULTS AND DISCUSSION

The NLP model determined the optimal deficit levels for different growth stages to give the optimal cropping pattern in order to maximize the net economic return under deficit irrigation. It also gave the optimal allocation of surface and ground water resources for the optimum cropping pattern. The model was also applied to find out the optimal cropping pattern under full irrigation by assuming the deficit level as 1.00. The results corresponding to deficit and full irrigation are compared to ascertain the advantage of deficit irrigation in maximizing the crop production with the limited water. Further, results corresponding to varying deficit and fixed deficit are compared to find out the most suitable method under deficit irrigation.

Optimal economic return: The optimal economic return for full irrigation was found to be 1560 million rupees as compared to 1846 million rupees under deficit irrigation as shown in Figure 1. There is an increase of 18.31 per cent in economic returns under deficit irrigation. It may be attributed to increase in individual and overall crop production under deficit irrigation as compared to full irrigation, leading to increased water productivity.

Optimum cropping pattern and decade water releases: The optimal cropping patterns for eight major crops in the canal command area under full irrigation and deficit irrigation are shown in Figure 2. The deficit

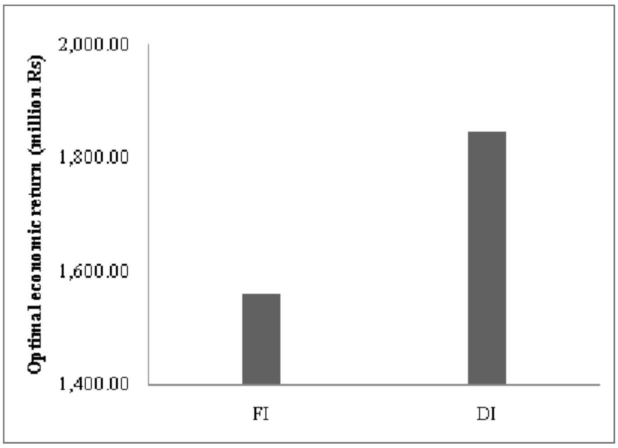


Figure 1: Comparison of net economic return between full and deficit irrigation

level for a particular crop is kept as 1.00 in full irrigation, while it is varied in deficit irrigation to find out the optimal cropping pattern and water releases. The results show a considerable increase in the cropped area under all the crops when deficit irrigation is applied as compared to full irrigation as shown in Figure 2.

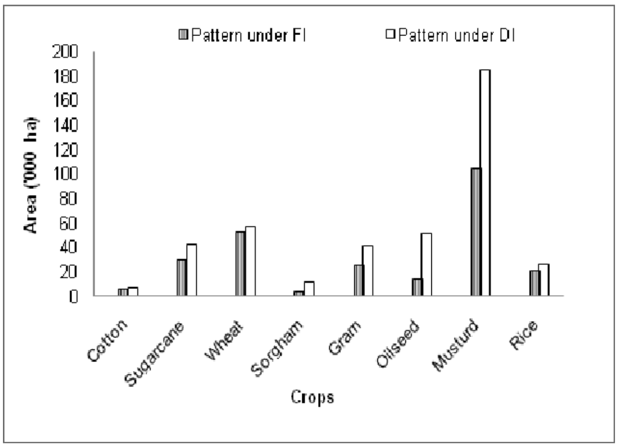


Figure 2: Optimal cropping pattern under full and deficit irrigation

Optimal cropping pattern under full and deficit irrigations are compared with the existing cropping pattern as shown in Figure 3. The results show a significant rise in the cropped area for deficit irrigation over the existing cropping pattern. Cropping area increased by 142.5 per cent in *kharif* and 195.0 per cent in *rabi* season under deficit irrigation as compared to the existing cropping pattern. Similarly, there is an increase of 79.1 per cent and 52.0 per cent in cropping area for *kharif* and *rabi* seasons respectively under deficit irrigation as compared to full irrigation for *kharif* and *rabi* seasons as shown in Figure 3. Further, the total cropped area in deficit irrigation is increased by 172.8 per cent as compared to the existing cropped area and 61.7 per cent as compared to full irrigation as shown in Figure 3.

Optimal surface and ground water releases under full and deficit irrigations are shown in Figure 4 and Figure 5 respectively. Optimal decade surface water

Figure 3: Comparison among existing cropping pattern, optimal cropping patterns under full and deficit irrigations

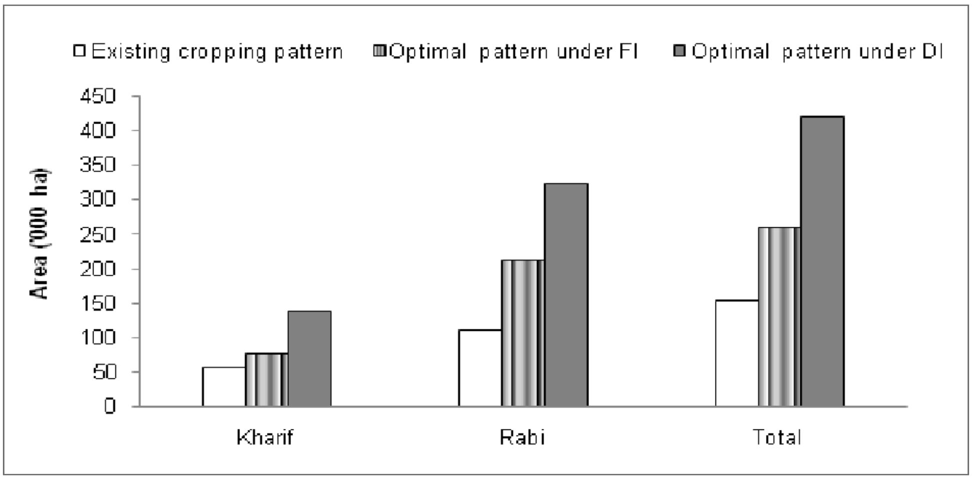
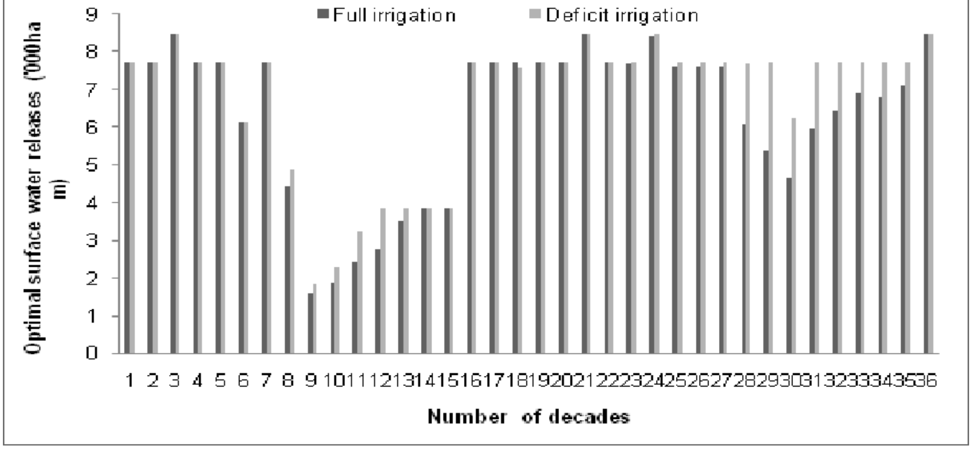


Figure 4: Optimal surface water releases under full and deficit irrigations



releases are raised for deficit irrigation as compared with optimal decade surface water releases for full irrigation. There is 6.3 per cent increase in surface water under deficit irrigation as compared to full irrigation. The optimal decade ground water releases are increased for almost all decades under deficit irrigation as compared to optimal decade ground water releases for full irrigation as shown in Figure 5. There is an overall increase of optimal ground water releases by 24.5 per cent under deficit irrigation as compared to full irrigation. The overall water utilization is increased by 8.9 per cent in deficit irrigation as there is a significant increase in cropped area under deficit irrigation as compared to full irrigation.

Comparison of water requirements under full irrigation and deficit irrigation: Water requirements for the considered crops under full and deficit irrigations are shown in Figure 6. The overall water requirement is raised by 10.8 per cent for deficit irrigation over full irrigation as optimal cropped area is increased under deficit irrigation as discussed in the previous section. It is evident from Figure 5 that there are no ground water withdrawals for the decades 8, 9, 10, 11, 28 and 30 whereas Figure 6 shows water requirements for these decades. However, the water requirements for these decades, either under deficit or full irrigation, are met by surface water releases as is evident from Figure 4. It is because of the fact that the tube well water is around 9.0 times costlier than the surface water in the command area and therefore ground water would only be used when the water requirements of the crops cannot be met by the surface water.

Optimal deficit levels and crop productions: The deficit levels for the growth stages are taken as variables in the model formulation and optimal deficit levels for the considered crops are shown in Table 2. The optimal deficit levels are found to be different for different crops and varied with the crop growth stages depending upon the optimal combinations of water

Figure 5: Optimal ground water releases under full and deficit irrigations

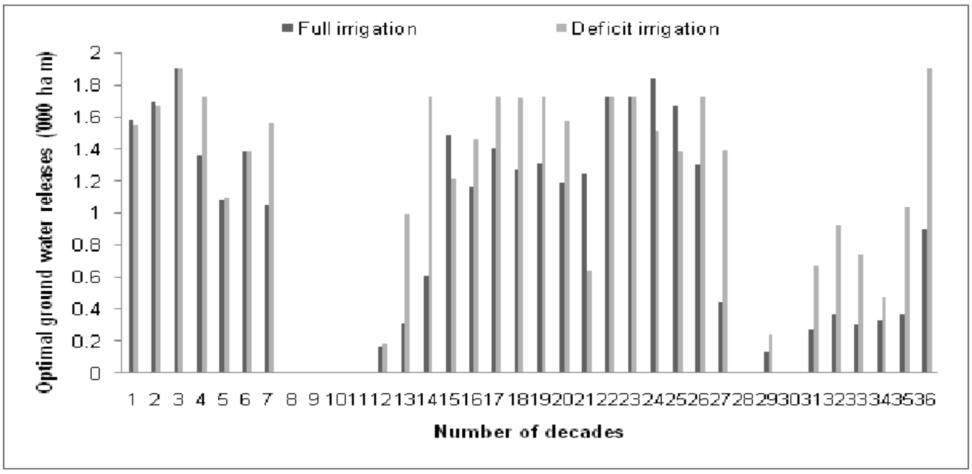


Figure 6: Decade water requirement for crops under full and deficit irrigations

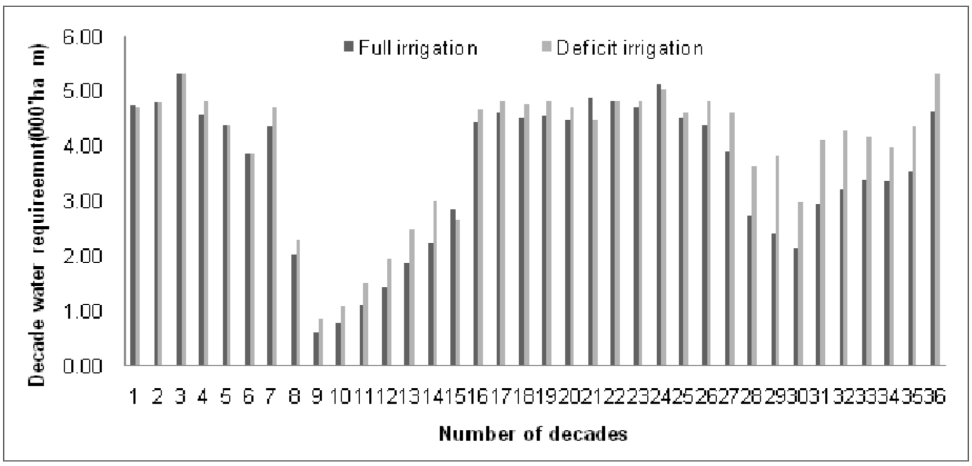


Table 2: Optimal deficit levels (Eta/ETm) under various crop growth stages for additive approach

Crop growth stages	Crops							
	Cotton	Sugarcane	Wheat	Sorghum	Gram	Oilseed	Mustard	Rice
I	0.70	1.00	1.00	0.50	1.00	0.50	1.00	0.99
II	1.00	1.00	1.00	0.61	1.00	0.50	0.84	1.00
III	0.93	0.67	0.82	0.50	0.50	0.66	0.69	0.65
IV	0.51	0.50	1.00	1.00	0.50	1.00	0.62	0.50

requirements, water availabilities and corresponding reduction in yields. It can further be seen from Table 2 that deficit levels are maximum for sorghum, oilseed and mustard while it is least for wheat crop in the command area.

The optimal crop productions under full and deficit irrigation are given in Table 3. There is a significant improvement in crop production for sugarcane, sorghum, oilseed and mustard crops under deficit irrigation as compared to full irrigation. The overall crop production is also increased under deficit irrigation as compared to overall crop production under full irrigation. The increase in crop production gave an increase of 18.3 per cent in economic returns as discussed.

Table 3: Optimal crop production under full and deficit irrigation for additive approach

Crops	Production (100 kg)	
	FI	DI
Cotton	94500.00	94500.00
Sugarcane	23055289.20	24044554.09
Wheat	1575000.00	1575000.00
Sorghum	66528.52	108211.22
Gram	310428.00	310428.00
Oilseed	147000.00	376638.64
Mustard	1045481.59	1420736.52
Rice	1365000.00	1365000.00
Total	27659227.30	29295068.48

Effect of increasing tube well capacities: No slackness was found in tube well capacities constraints during peak demand periods and therefore it indicated the full utilization of the tube well capacities during the peak demand periods. However the slackness was found in the annual ground water balance constraint, indicating that the annual ground water recharge was more than the annual ground water withdrawals in the study area. Therefore the existing tube well capacities were increased for till annual ground water recharge became equal to the annual ground water withdrawals and the corresponding optimal cropping patterns along with increase in the optimal economic returns were obtained. The effect of increasing the tube well capacities on the benefits is shown in Figure 7. The result show a maximum increase of 20.3 per cent in benefits corresponding to a maximum increase in the tube well capacity by 150 per cent under deficit irrigation.

The new optimal deficit levels for different crops under increased tube well capacity are shown in the Table 4. A comparison of Table 2 and Table 4 indicate that the deficit levels are approaching towards full irrigation as the water availability is enlarged due to increased tube well capacities. The optimal cropping patterns under existing and increased tube well

Table 4: Optimal deficit levels (Eta/ETm) under various crop growth stages for additive approach under maximum increased tube well capacity

Crop growth stages	Crops							
	Cotton	Sugarcane	Wheat	Sorghum	Gram	Oilseed	Mustard	Rice
I	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00
II	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00
III	0.50	0.51	1.00	0.50	1.00	0.79	0.93	1.00
IV	0.50	0.50	1.00	0.50	0.50	1.00	1.00	0.50

capacities are shown in Figure 8. The optimal cropping pattern under increased tube well capacity changes to give a new combination of different crops to yield more economic return within the constraints of the systems.

Optimal surface and ground water releases under existing and maximum increased tube well capacities are compared in Figure 9 and Figure 10 respectively. There is 12.4 per cent increase in surface water releases

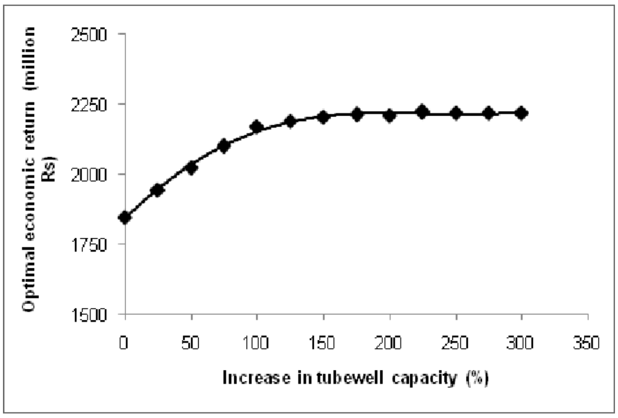


Figure 7: The effect of increase in tube well capacities on optimal benefits under deficit irrigation

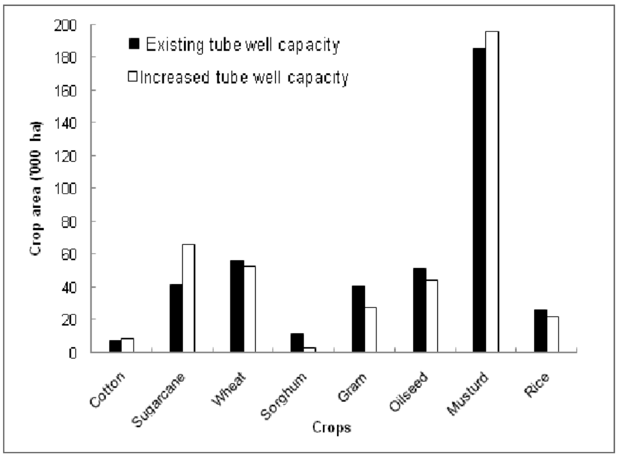


Figure 8: Comparison of optimal cropping pattern under existing and increased tube well

Figure 9: Comparison of optimal surface water releases under existing and maximum increased tube well capacities for deficit irrigation

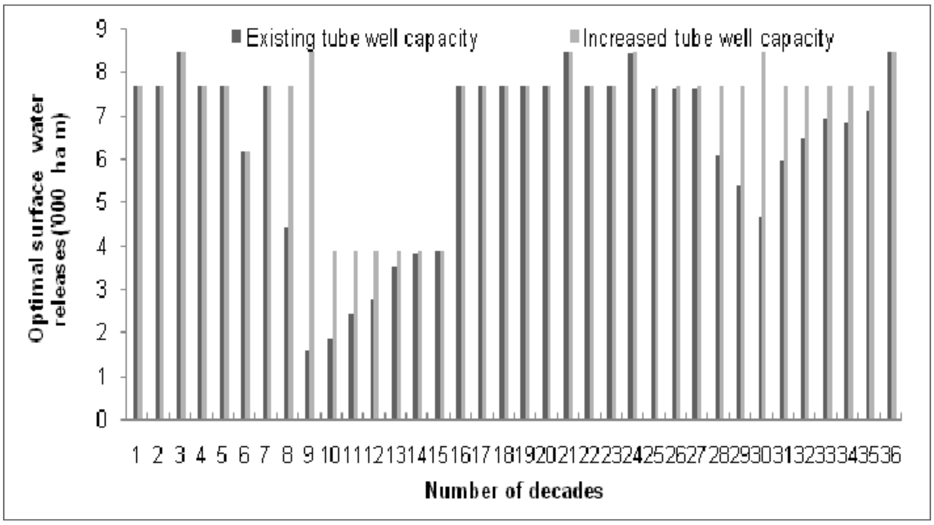


Figure 10: Comparison of optimal ground water releases under existing and maximum increased tube well capacities for deficit irrigation

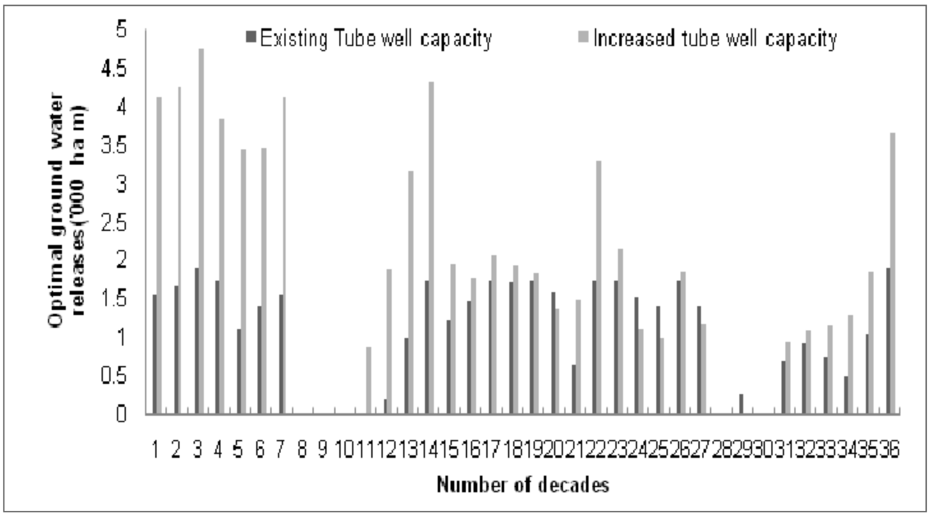
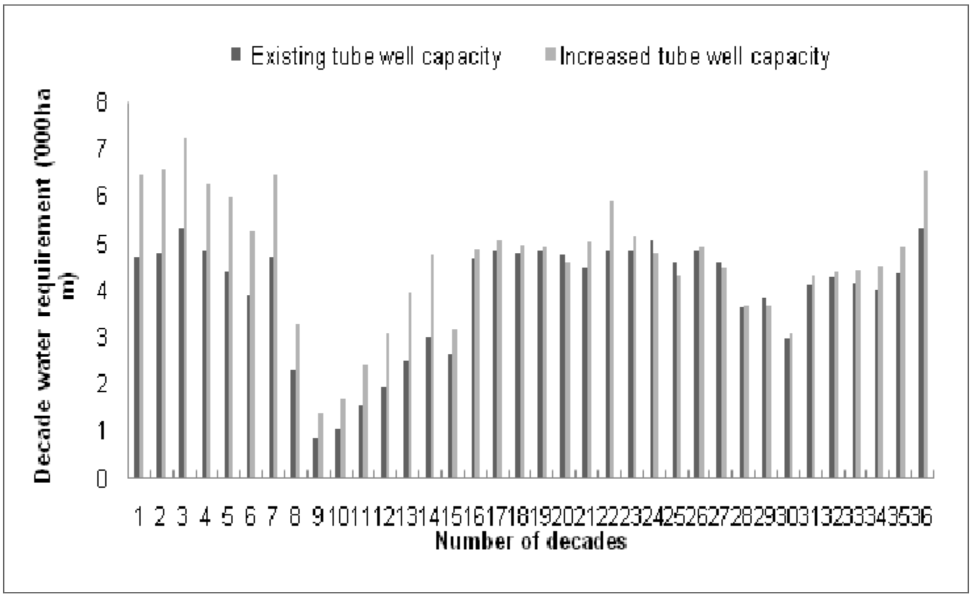


Figure 11: Comparison of optimal water requirement under existing and increased tube well capacities for deficit irrigation



under maximum increased tube well capacity as compared to existing tube well capacity. Figure 10 shows a significant rise in optimal ground water withdrawals in almost all decades under maximum increased tube well capacity as compared to existing tube well capacity because of the increase in water requirement for the new optimal cropping pattern.

Decade crop water requirements in the command area, under existing and maximum increased tube well capacities, are compared in Figure 11. The overall water requirement is increased by 16.9 per cent for maximum increased tube well capacity as compared to existing tube well capacity. It is because of the crops are gradually shifting to full irrigation as water availability is augmented due to increased tube well capacity.

CONCLUSION

A NLP model is formulated in this study and is applied to Dadu canal command of the Lower Indus Basin. It is used to determine optimal deficit levels for different crop growth stages under deficit irrigation. It also gave the optimal water releases (canal water and ground water) and cropping pattern with maximization of net economic return under deficit irrigation for the command area. The net economic return is improved by 18.3 per cent for deficit irrigation as compared to optimal net economic return for full irrigation. The total cropped area in deficit irrigation is increased by 177.2 per cent and 61.7 per cent as compared to the existing cropping pattern and optimal cropping pattern under full irrigation respectively. A further increase of 20.3 per cent in the net economic return can be obtained by increasing the tube well capacities by 150 per cent as there existed slackness in the annual ground water balance constraint at the existing tube well capacity. It can be concluded that deficit irrigation show a significant improvement on optimal cropping pattern, water recourses allocation and overall economic return for the command area. The NLP model is quite general and can also be applied to other irrigation management systems.

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Crop Growth Trend Analysis of Uttar Pradesh: An Overview

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ABSTRACT

The twenty-first century began with a new promise for the future of agriculture in the new millennia. Beginning from the year 2000, agricultural scenario of the state of Uttar Pradesh was poised to make a major growth trend. An analysis of the growth in area, production and yield of common crops of Uttar Pradesh was therefore taken up covering a period of seventeen years. Based on the exponential growth rate function, it was found that cereal production has registered a positive trend, while pulses had a negative trend in all three aspects, area, production and productivity. The growth rate for the major food grains has receded in area, but production and productivity improved. Coefficient of variability was computed to establish the magnitude of variation, which allowed comparing the production trend with crop performance. Modelling the production trend with respect to the contribution of area and productivity showed that overall contribution towards growth in production was favourable. Significant growth together with increased variability indicated lesser risks associated with production. Effect of yield towards production was prominent in crops like small millets, jowar, bajra, barley, potato and wheat. Contribution of area was predominant in maize, bajra, wheat and rice while defining the production trend.

Keywords: Analysis, Agriculture, Crop growth trend

INTRODUCTION

The end of the twentieth century has witnessed dramatic agricultural development in India, especially in poor and marginal agrarian states such as Uttar Pradesh, thanks to the green revolution that hit second part of the century (Kalamkar *et al.,* 2002). The dawn of the new millennia by the year 2000 had brought in new promises to the agricultural development in the country, because of newer technologies and new crop varieties. It was emphasised that crop production in the new millennia will shift towards high value agriculture which require augmentation of irrigation facilities, expanding extension infrastructure and providing newer genetically improved varieties (Rao, 2005). During the period of on-going green revolution, the production trend in the agricultural sector showed leaps and bounds, by the introduction of high yielding input responsive varieties, which initially contributed largely to the production boost, followed by steady increase in area under cultivation. Development of irrigation projects in the post independent India has augmented this growth to a great extent. Later in the century, the production growth showed a plateauing trend in several crops, especially among the principal crops. However, in states like Uttar Pradesh, the impact of green revolution was confined to few pockets of the state such as North-West, due to severe socio-economic instability of the region, pushing it lower in order from the food-grain production in the country (Ahmad, 2013).

In an agrarian country like India, where agricultural development is the back bone of sustenance, production growth should keep abreast to the growing population and their food needs. Therefore, in populous states like Uttar Pradesh agricultural production trend needs close monitoring for making future policy interventions

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(Reddy and Mishra, 2009; Vaidyanathan, 2010). It is reported that the agricultural growth in last decade can largely be attributed to the increasing prominence of high value agriculture (Dalwai, 2012).

The development of crop production in India for the second half of the twentieth century registered a compound growth rate of 2.72 for the food grains in the country. While the yield improvement contributed greatly to the production in cereal food staples like rice, wheat and maize, increased area was the major contributor for production in pulses and oil seeds (Kalamkar *et al.*, 2002). This study followed the behavioural analysis of agricultural production introduced by (Sharma, 1977) by analysing compounded growth rate and statistical variation, while decomposing the production as a product of area and productivity. Several previous works has analysed similar growth patterns in different crops in different parts of the country (Minhas, 1964; Bastine and Palanisani, 1994; Mundinamani *et al.*, 1995; Kalamkar *et al.,* 2002).

The northern state of Uttar Pradesh is flourished with abundance of natural resources, such as vivid soil types, agro-climatic variations and agro-geographic zones that can support a large number of crops and cropping systems (Basu, 2008). The degree of agro-diversification was slowly gaining momentum by the end of the twentieth century, with slowly changing cropping preference and patterns (Jorge and Valdes, 1995; Chand, 1999; Joshi *et al.,* 2004; Jana, 2006). However, in Uttar Pradesh, which is highly populated, fragmentation of land holding is a rampant problem due enormous population growth, adversely affecting the growth of agriculture (Kumar, 2010). To realise the promises of the new century, we have attempted to analyse the initial crop production trends of Uttar Pradesh in this paper considering a period of seventeen years beginning from the year 2000. We also endeavour to analyse the trend shifts with respect to crop instability and introduction of newer crops, focussing on the future prospects of agricultural development in the state of Uttar Pradesh.

MATERIALS AND METHODS

The data for the study was sourced from the Department of Agriculture, Government of Uttar Pradesh which mainly included temporal data on area, production and productivity of common crops viz. rice, wheat, maize, jowar, bajra, maize, barley, pulses, sugarcane, cotton and oilseed for the period from 2000-01 to 2016-17 (17 years). The data was in annual intervals and included cumulating production figures and area under production. The data pertaining to different seasons such as *rabi*, *kharif* and *zaid* per year were pooled to obtain the annual cumulative figure to account for the overall production growth. The compounded growth rate of the three production components such as area, production and productivity were calculated based on the logarithmic regression function as given in (1).

$$Y = A\,B^{t} \qquad \text{...(1)}$$

Where Y is the area/ production/ productivity of the crop, A is the intercept, B is the regression coefficient and t is the time variable. The compounded annual growth rate (CAGR) was calculated from the regression equation as,

$$\text{CAGR} = (\text{Antilog}\ (\log B)-1) \times 100 \qquad \text{...(2)}$$

The compound growth rate was tested for their significance by the students' t-test.

The crop instability for each of the components were estimated individually by estimating the coefficient of variation (CV) and expressed in percentage as,

$$\text{CV}\ (\%) = \frac{\text{SD}}{\text{Mean}} \times 100 \qquad \text{...(3)}$$

Fragmenting the contribution of area and productivity and their interaction towards the production of various crops, the linear model suggested by (Sharma, 1977) and (Narula and Vidyasagar, 1973) was used.

$$\Delta P = \Delta A + \Delta Y + \Delta A \Delta Y \qquad \text{...(4)}$$

Where, ΔP is the deviation in production from the average production level in the first decade (2000-2010, base) and the average production in the second half of the study interval spanning between 2011-2017 (test). ΔA is the deviation in area from the base to the test interval and ΔAΔY is the interaction effect. The contribution was calculated for the components area, productivity and interaction as,

$$\text{Contribution}\ (\%) = \frac{\Delta X}{\Delta P} \times 100 \qquad \text{...(5)}$$

Where, ΔX is either the deviation in respect of area (ΔA) or productivity (ΔA = Y) or interaction (ΔA ΔY), individually and contextually.

RESULTS AND DISCUSSION

CAGR of common agricultural crops of Uttar Pradesh for the period from 2000-01 to 2016-17 indicated marginal fall in rice area, while area under wheat showed increase (Table 1). Significant growth in area (24.92) was seen for barley. Among the remaining cereals, bajra showed positive growth, while jowar, maize and small millets area showed decline, along with pulses. Oilseeds, cotton, sugarcane, potato and onion showed positive growth in area. In contrast to the area decline in rice, its production and productivity showed significant improvement registering CAGR of 1.53 and 1.35 per cent respectively. Similar trend was seen in maize also. However, all the other crops showed similar growth response in case of area and production. It is pertinent to highlight that among all the crops, productivity has registered positive growth, except for oilseeds. This has indicated that introduction of new varieties and technologies could have driven the improved productivity in most of the crops in Uttar Pradesh. Similar conspicuous shift in cropping pattern was reported earlier in Indian agriculture during the overlapping period with the present analysis, indicating that shift towards oilseeds during 1980s has tilted towards cotton and other non-food crops during the subsequent decades (Dalwai, 2012).

Crop instability occurs when the crop production components show high level of variation between subsequent years and seasons. There can several reasons for this, such as vagaries of weather, biological and socioeconomic factors that causes production to decline while factors that boosts production can elevate it. Unstable cropping pattern, however, makes it difficult to judge the cropping pattern and make policy decisions on the future of agriculture. The crop instability in Uttar Pradesh for the preceding seventeen years showed that CV was highest for barley followed by small millets. Looking at the growth trend, this can be assumed to be caused by contrasting reasons. While new crops like barley gained growth momentum, perhaps due wider adoption owing to higher economic returns, small millets were pushed back with significant reduction in area and production. In case of wheat, the instability was the lowest with a CV of 2.57 per cent, which indicated a stable production scenario in the new

Table 1: Compound growth rate, coefficient of variability and growth contribution of area, production and productivity of common crops in Uttar Pradesh for the period 2000-01 to 2016-17

Crop	Compound growth rate (%)			Coefficient of variability (CV)			Growth contribution		
	Area	Production	Yield	Area	Production	Yield	ΔA	ΔY	ΔAΔY
Rice	-0.22	1.53	1.35	12.96	11.18	9.62	-19.38	89.44	29.95
Wheat	0.46	1.21	0.83	2.57	13.84	12.29	29.44	74.11	-3.55
Jowar	-4.39	-4.32	0.07	25.13	25.17	14.42	122.33	-27.50	5.17
Bajra	0.55	3.58	3.01	4.06	18.43	16.07	13.22	83.67	3.12
Maize	-1.68	0.75	3.91	9.87	13.68	24.02	-144.49	259.28	-14.79
Small Millets	-8.24	-7.16	1.26	53.15	53.86	20.69	122.84	-59.19	36.35
Pulses	-1.37	-2.40	0.65	9.42	21.00	12.95	81.15	28.09	-9.23
Oilseeds	2.89	1.99	-0.02	16.29	15.59	9.15	138.82	15.48	-54.30
Sugarcane	0.50	1.73	1.23	4.26	10.94	8.39	23.83	72.62	3.55
Cotton	0.39	4.36	5.02	22.76	45.52	29.14	7.29	77.10	15.61
Barley	24.92	27.93	2.45	66.48	67.61	52.78	69.21	40.81	-10.01
Potato	2.67	2.94	0.26	13.40	15.35	5.91	86.45	11.03	2.52
Onion	0.06	2.59	1.95	9.26	18.33	13.60	6.51	67.44	26.05

*Significant at 5% level; ** Significant at 1% level; ΔY, the change in productivity; ΔA, the change in area; ΔAΔY, the interaction effect of ΔY and ΔA

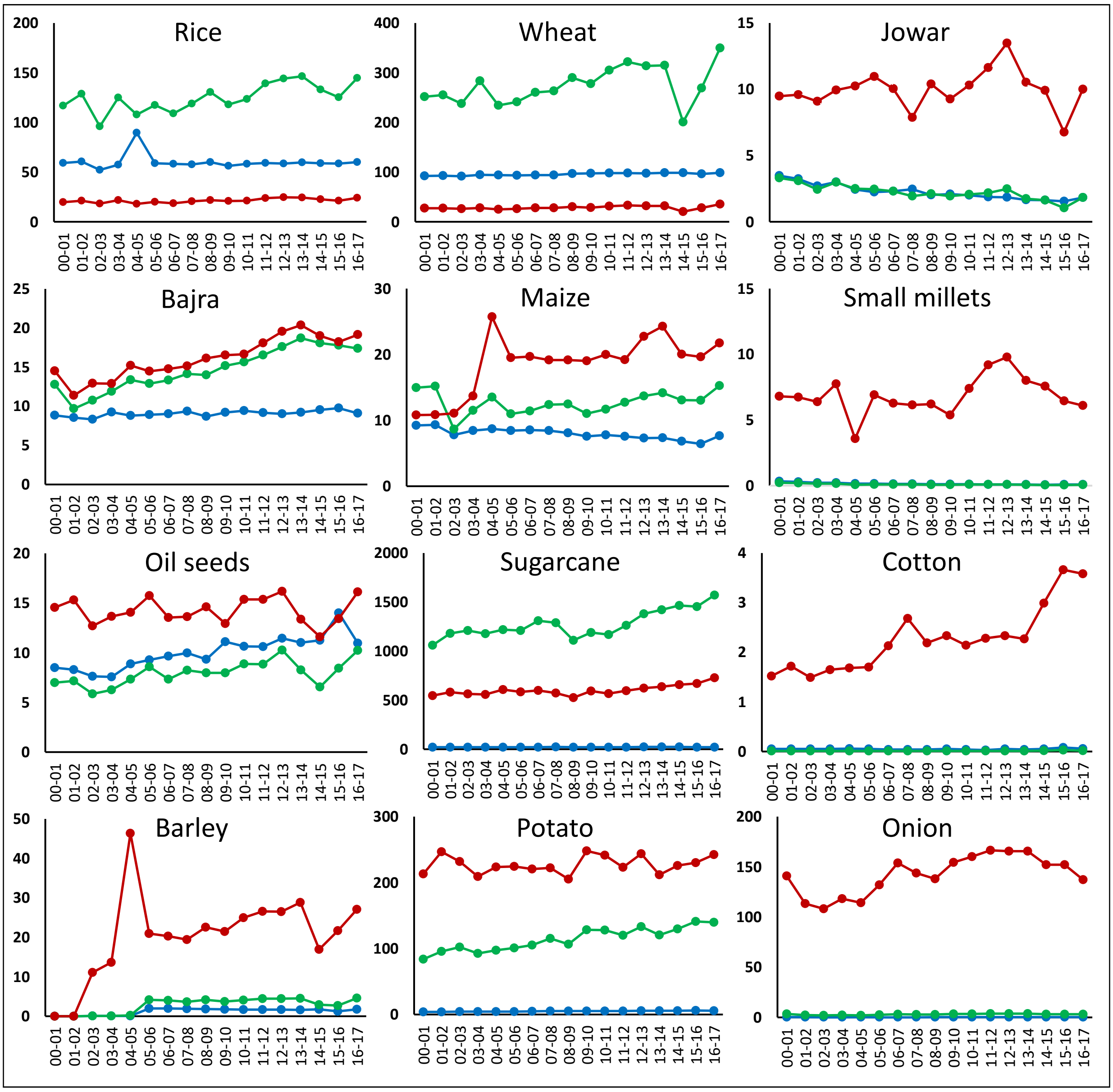

Figure 1: Area (Lakh ha), production (Lakh tonnes) and productivity trends of major crops of Uttar Pradesh for the period between 2000 and 2017

century. The crop instability of rice and cotton could be attributed to increased production, while in jowar decline has caused the variability to widen. For the remaining crops, the CV remained below 10 except for potato and oilseeds, implying a steady growth trend for these crops. In contrast, the CV of pulses could have been registered from the fall in area and production.

The production growth in crops of Uttar Pradesh, when partitioned into components of area, productivity and their interactions revealed critical pattern of growth occurred in the first one and half decade (Table 1). While yield contribution was maximum in oilseeds, followed by jowar and small millets, staple cereals such as rice and maize recorded negative contribution of yield to the production. All the other crops registered positive contribution of yield, with varying magnitudes. On the contrary, the area effect was maximum (259.3%) in maize which was almost 2.80 times higher than rice, the next highest contributor to the production among all the crops. Negative effect of area was recorded in two crops, jowar and small millets, which could probably due to less farmer preference for these crops. Positive interaction was identified for crops such as rice, small millets and onion, whereas significant negative contribution of interaction effect was found in oilseeds. Similarly, negative interactions were observed for barley and wheat, indicating fluctuation in realised productivity of crops over different periods, such as the first decade and the second decade.

CONCLUSION

The changing scenario of crop production pattern in Uttar Pradesh, indicates a marginal decline in rice and maize areas, but with an increase in production, attributable to newer agro-technologies. Further, increasing water scarcity in crop production could also be contributing factor. Nevertheless, wheat area had shown an increase, marginal enough to support similar growth in production and productivity. Area and production decline was apparent in only few crops, such as jowar, small millets and pulses. Fall in pulses production needs further in-depth analysis, because of its primary importance in nutritional security of the country. In general, production variability was in tandem with area and productivity changes implying the role of newer technologies and crop adoption behaviour of the farming community of the state. For instance, barley cultivation is showing a fast-growing trend in the state which could be attributable to current nutritional awareness, and also in tune with the market demands for such crops (Dalwai, 2012). Comparing the contribution of different components, it is obvious that the yield increase was the major contributing factor towards production increase than the area.

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Participation of Women in Farm Operations of *rabi* Crops in Sub Mountainous Region of Punjab

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ABSTRACT

Women in India are the backbone of the society and important resource in agriculture and rural economy. They make essential contributions to the agricultural development, allied activities and pursue many livelihood strategies. In Punjab state participation of women in agriculture varies from one region to another. Present paper is planned with specific objective to study the participation of women in farm operations of *rabi* crops in sub mountainous region of Roopnagar and Hoshiarpur districts of Punjab state. From two blocks three villages were selected randomly in each district. Then ten women respondents, five marginal and small farmers and five farm labourers families were interviewed, for making the sample of 120 respondents. Full participation of farm women was found in weeding, cleaning of seeds and grain drying operations for different crops, whereas farm labourers were more involved in weeding, cleaning of seeds and harvesting operations. Plant protection measures and grain drying were the most time consuming operations. Cultural values of the region could be made more inclusive to overcome gender discriminatory practices by sensitizing rural masses regarding the pertinent role of women in agriculture.

Keywords: Agriculture, Farm women, Farm labourers, Sub mountainous region

INTRODUCTION

Women of India are the pillar of community who play a vital role in Indian economy. Rural women have great experience about agriculture and its related activities. They have great capacity of promoting agriculture in real sense, if opportunities are given to them. According to 2011 census in Punjab, out of 173 lakh rural population, 82.5 lakh were rural women who plays a great role in agriculture. Women produced 60 to 80 percent of food including basic foods such as rice and maize in developing countries. Their involvement in agriculture force in developing countries was about 43 per cent (FAO, 2011).

A report by Government of India, 2010, highlighted that a farm women spent an average time of 7-8 hours in different operations of agriculture activities. Farm women were having 10 to 15 years of experience of farm activities and were working in farm for 6-10 am in morning and 2-4 pm in the afternoon on daily basis which might be increased at the peak time of season (Kumari *et al.,* 2020 and Singh *et al.,* 2018).

The results of a study conducted by Women and Population Division of FAO (2013) stated that in developing countries women provided 60-80 per cent labour for household production, 70 per cent for agriculture labour and 100 per cent for processing the food items. The participation of women in agriculture found different in different ecological zones of Punjab. From five different agro -climatic zones the active participation of women is found in sub-mountainous zone of Punjab. The active participation is found in post- harvesting activities as compared to others (Saikia *et al.,* 2021 and Mishra, 2014). The present paper is an attempt to study the participation of women in farm operations of *rabi* crops in sub mountainous region of Roopnagar and Hoshiarpur districts of Punjab state.

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MATERIALS AND METHODS

The study was conducted in sub mountainous region of Punjab. Multistage random sampling technique was used. Two districts viz. Roopnagar and Hoshiarpur were randomly selected. Then two blocks were randomly selected from each district and from each block three villages were selected. Ten women respondents, five marginal and small farmers and five farm women labourers families were interviewed with the help of a structured interview schedule, making the sample of 120 respondents. Participation of respondents in agricultural activities was analyzed on the basis of mean scores of type of participation they had, whether they were participating fully, partially or not participating in a particular operation of particular crop. Here, full participation means they performed a particular operation without any kind of help from others, partial participation means the type of participation in which other member(s) of family helped them. These members could be the husband, son/ daughter or any other member from family, nil denotes no participation of respondent. The extent of participation was analyzed on the basis of average time they took for doing any operation as per cropping season.

RESULTS AND DISCUSSION

Women in India are the backbone of the society and important resource in agriculture and rural economy. They make essential contributions to the agricultural development and allied and household activities and pursue multiple livelihood strategies. Traditionally, women have always played an important role in agriculture - as farmers, co-farmers, wage labours and managers of farms. The multiple role of women leads to a significant contribution in real terms to be productive system. Women with middle age group and belonged to low castes participated more in different agricultural activities as compared to upper castes. Most of the women in the study area had partial participation in agricultural activities along with other family members. For supporting their husband's economically women participated along with them in different agricultural activities. Women with low economic status families participated more than high economic status families. On the other hand farm labourers women

Table 1: Distribution of respondents according to their socio- economic profile

	Farm women (n=60)	Farm labourer (n=60)	Overall (n=120)	Z-value
Age				
Up-to 25	12(20.00)	8(13.33)	20 (16.66)	0.9797^{ns}
26- 50	29(48.33)	30(50.00)	59(49.16)	0.1826^{ns}
51-75	19(31.67)	22(36.67)	41(34.16)	0.5774^{ns}
Average Age	39	42		Overall -41
Caste				
General Castes	30(50.00)	4(6.67)	34(28.33)	5.27**
Scheduled Castes (SCs)	9(15.00)	29(48.33)	38(31.66)	3.92**
Backward Castes (BCs)	21(35.00)	27(45.00)	48(40.00)	1.12^{ns}
Annual family income				
50,000 -1,00,000	7(11.67)	55(91.67)	62(51.66)	8.76**
1,00,000- 1,50,000	18(30.00)	5(8.33)	23(19.16)	3.01**
1,50,000- 2,00,000	10(16.67)	-	10(16.67)	3.30**
2,00,000- 2,50,000	11(18.33)	-	11(18.33)	3.47**
2,50,000- 3,00,000	8(13.33)	-	8(13.33)	2.92*
3,00,000 and above	6(10.00)	-	6(10.00)	2.51^{ns}
Average Annual family income (Rupees)	Rs. 95,000	Rs. 66,422	Rs. 69,243	

Note: Figures in the parentheses indicate percentage
**Significant at 1% level; *Significant at 5% level; *ns - non significance

were fully participated in different agricultural activities, however due to mechanization their participation had decreased in agriculture.

Data given in Table 1 reveal that half of the respondents (48.33% farm women and 50% farm labourer) belonged to 26-50 years age group. Average age for farm women was 39 years and for farm labourers, it was 42 years. Overall average age was 41 years for both the categories. No significant difference found between the age of respondents for the both categories. Half of the farm women belonged to general castes and 48.33 per cent farm labourer belonged to scheduled castes indicating the fact that a significant majority of the farm women belonged to general castes whereas farm labourers were mostly either SCs or BCs. Regarding annual family income it was found that farm women earned fifty thousand to three lakh rupees whereas, labour class families earned just in thousand and very few earned up to Rs. 1.5 lakh. A significant difference was found between income of farm women and farm labourers.

Regarding farm women's participation in wheat cultivation, it was found that one third of farm women (33.33 %) participated fully and more than half (55.00%) participated partially in weeding operation (Ranked Ist). Average time they spent for this operation was thirteen hours. Same results had been found by Sidhu 2007and Mishra 2014. Grain drying was the second highest ranked operation in which 66.67 per cent farm women were engaged partially. Only 11.67 per cent of them did this operation independently. Average time taken for this operation was six hours followed by winnowing (IIIrd) and storage (IVth). In the operations of plant protection and grain drying maximum time had been given by farm women. Selection of variety was the pre- decided operation. Farm labourers women did all the activities independently, worked for eight hours in field under strict supervision of farmer. Weeding, harvesting and winnowing were the highest ranked operations in which all the farm labourers participated. Due to mechanization and male dominance no participation of women was found in operations of land preparation, fertilizer application, and selection of variety, cleaning of seeds, sowing and marketing. Godara (2011) and Kaur and Mavi (2015) also substantiated the same kind of results.

In maize cultivation, it was divulged that 40 per cent farm women participated fully and less than half of them (46.67%) participated partially in weeding operation (Ranked Ist). Average time they spent for this operation was fourteen hours. Shelling of grains was the second highest ranked operation in which one third of farm women (30.00%) participated individually and 31.67 per cent of them did this operation with the help of others. Average time they took for this operation was twenty nine hours. Shelling of grains found a prolonged process in which maximum time of farm women was spent though they had access to maize sheller. Grain drying was third highest ranked operation in which 40 per cent of farm women engaged partially and 21.66 per cent of them engaged independently. Manuring was another operation (IVth) followed by harvesting (Vth), storage (VIth) and plant protection measures (VIIth) operations in which most of the women participated partially. Farm women spent maximum time in plant protection measures and harvesting. Plant protection measures was a long process in which 28.33 per cent of farm women participated. They used many methods of plant protection such as, hand picking of pests, sprinkling cow dung and clay mixture, beating drums and using domestic dogs for combating the threat of birds and monkeys etc. After ripening of crop the more time consuming operation was harvesting. Manuring, weeding, harvesting and cleaning of grains were the highest ranked operations in which all the farm labourers participated. Due to mechanization it was found that there was no participation of women in many operations such as land preparation, fertilizer application etc. Same results had been found by Singh (2018) and Vepa (2009).

In the study area less than half of respondents' families (46.67%) cultivated potato crop. Majority of farm women were engaged in different operations of potato cultivation. The operation of cleaning of potatoes got highest rank in which 67.85 per cent of farm women participated partially and 32.14 per cent participated fully. Average time they spent on this was 27 hours per crop and emerged as the most time consuming operation. Grading and bagging of potatoes ranked second in which 78.58 per cent of farm women participated partially and 21.42 per cent of them did it independently. They spent 16 hours on

Table 2: Nature and extent of participation of respondents in different operations of wheat cultivation

Operations	Farm women (n=60)						Farm labour (n=60)				
	Nature of participation					Extent	Nature of participation				
	Full	Partial	Nil	Mean Score	Rank	Average time (hours)@	Full	Partial	Nil	Mean Score	Rank
Land preparation	-	-	60(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	VI
Selection of variety	3(5.00)	16(26.67)	41(68.33)	1.37	VI	-	-	-	60(100.00)	1.00	VI
Cleaning of seeds	7(11.67)	23(38.33)	30(50.00)	1.67	V	±6	-	-	60(100.00)	1.00	VI
Sowing	-	17(28.33)	43(71.67)	1.28	VII	±3	-	-	60(100.00)	1.00	VI
Fertilizer application	-	-	60(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	VI
Irrigation	-	-	60(100.00)	1.00	VIII	-	37(61.67)	-	23(38.33)	2.23	III
Weeding	20(33.33)	33(55.00)	7(11.67)	2.21	I	±13	60(100.00)	-	-	3	I
Plant protection measures*	-	17(28.33)	43(71.67)	1.28	VII	30	-	-	60(100.00)	1.00	VI
Harvesting	-	-	60(100)	1.00	VIII	-	-	-	60(100)	3	I
Threshing	-	-	60	1.00	VIII	-	30	-	30	2.00	V
Winnowing	3(5.00)	44(73.33)	13(21.67)	1.83	III	±6	60(100.00)	-	-	3.00	I
Grain drying	7(11.67)	40(66.67)	13(21.67)	1.90	II	±16	53(83.33)	-	7(11.67)	2.77	II
Storage	-	42(70.00)	18(30)	1.70	IV	±6	35(58.33)	-	25(41.67)	2.17	IV
Marketing	-	-	60(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	VI

Note: Figures in the parentheses indicate percentage; @ Average time was calculated as per cropping season

Plant protection measures* includes hand picking of pests, cow dung and clay mixture, beating drums & using domestic dogs for combating the threat of birds and monkeys etc.

Table 3: Nature and extent of participation of respondents in different operations of maize cultivation

Operations	Farm women (n=60)						Farm labour (n=60)				
	Nature of participation					Extent	Nature of participation				
	Full	Partial	Nil	Mean Score	Rank	Average time (hours)	Full	Partial	Nil	Mean Score	Rank
Land preparation	-	-	60(100.00)	1.00	IX	-	-	-	60(100.00)	1.00	VI
Selection of variety	3(5.00)	11(18.33)	46(76.67)	1.28	VII	-	-	-	60(100.00)	1.00	VI
Cleaningof seeds	-	12(20.00)	48(80.00)	1.20	VIII	±8	30(50.00)	-	30(50.00)	2.00	IV
Manuring	4(6.66)	38(63.33)	18(30.00)	1.77	IV	±4.26	60(100.00)	-	-	3.00	I
Sowing	-	-	60(100.00)	1.00	IX	-	-	-	60(100.00)	1.00	VI
Weeding	24(40.00)	28(46.67)	8(13.33)	2.27	I	±14	60(100.00)	-		3.00	I
Fertilizer application	-	-	60(100.00)	1.00	IX	-	-	-	60(100.00)	1.00	VI
Irrigation	-	-	60(100)	1.00	IX	-	-	-	60(100.00)	1.00	VI
Plant protection measures	-	17(28.33)	43(71.66)	1.28	VII	30	-	-	60(100.00)	1.00	VI
Harvesting	-	44(73.33)	16(26.67)	1.73	V	±22	60(100.00)	-	-	3.00	I
Cleaning of grains	-	27(45.00)	33(55.00)	1.45	VIII	±7	60(100.00)	-	-	3.00	I
Shelling of grains	18(30.00)	19(31.67)	23(38.33)	1.92	II	±29	21(35.00)	-	39(65.00)	1.70	V
Grain drying	13(21.66)	24(40.00)	23(38.33)	1.83	III	±5	53(88.33)	-	7(11.66)	2.77	II
Storage	-	42(70.00)	18(30.00)	1.70	VI	±8	44(73.33)	-	16(26.67)	2.47	III
Marketing	-	-	60(100.00)	1.00	IX	-	-	-	60(100.00)	1.00	VI

Note: Figures in the parentheses indicate percentage

Table 4: Nature and extent of participation of respondents in different operations of potato cultivation

Operations	Farm women (n=28)						Farm labour (n=60)				
	Nature of participation					Extent	Nature of participation				
	Full	Partial	Nil	Mean Score	Rank	Average time (hours)	Full	Partial	Nil	Mean Score	Rank
Land preparation	-	-	28(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	V
Using compost before sowing	-	14(50.00)	14(50.00)	1.5	V	±5	28(46.67)	-	32(53.33)	1.93	III
Pre-sowing irrigation	-	14(50.00)	14(50.00)	1.5	V	±5	60(100.00)	-		3.00	1
Selection of variety	-	4(14.29)	24(85.71)	1.14	VII	-	-	-	60(100.00)	1.00	V
Seed treatment	-	-	28(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	V
Methods of sowing-											
i.By potato planter	-	28(100.00)	-	2.00	III	-	-	-	60(100.00)	1.00	V
ii. Flatbed method	-	-	-	-	VIII	-	-	-	60(100.00)	1.00	V
iii Ridges	-	-	-	-	-	-	60(100.00)	-	-	3.00	1
Irrigation	-	-	28(100.00)	1.00		-	25(41.67)	-	35(58.33)	1.83	IV
Fertilizer application	-	4(14.28)	24(85.71)	1.14	VI	±6		-	60(100.00)	1.00	V
Plant protection measures	-	2175.00)	7(25.00)	1.75	IV	30		-	60(100.00)	1.00	V
Digging	-	28(100.00)	-	2.00	III	±27	60(100.00)	-	-	3.00	1
Cleaningof potatoes	9(32.14)	19(67.85)	-	2.32	I	±27	60(100.00)	-	-	3.00	1
Grading	6(21.42)	22(78.58)	-	2.21	II	±16	60(100.00)	-	-	3.00	1
Bagging	6(21.42)	22(78.58)	-	2.21	II	±12	60(100.00)	-	-	3.00	1
Storage	-	28(100.00)	-	2.00	III	±8	53(88.33)	-	7(11.67)	2.65	II
Marketing	-	-	28(100.00)	1.00	VIII	-	-	-	-	1.00	V

Note: Figures in the parentheses indicate percentage

Table 5: Nature and extent of participation of respondents in different operations of vegetable cultivation

Operations	Farm women (n=60)						Farm labour (n=60)				
	Nature of participation					Extent	Nature of participation				
	Full	Partial	Nil	Mean Score	Rank	Average time (hours)	Full	Partial	Nil	Mean Score	Rank
Landpreparation	-	-	60(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	VIII
Seed treatment	5(8.33)	29(48.33)	25(41.67)	1.63	V	±3	-	-	60(100.00)	1.00	VIII
Sowing	5(8.33)	29(48.33)	25(41.67)	1.63	V	±4	30(50.00)	-	30(50.00)	2.00	V
Raising vegetablenursery	5(8.33)	29(48.33)	25(41.67)	1.63	V	±15	60(100.00)	-	-	3.00	I
Care of nursery	5(8.33)	29(48.33)	25(41.67)	1.63	V	20	52(86.67)	-	8(13.33)	2.73	III
Transplanting ofvegetable nursery	5(8.33)	29(48.33)	25(41.67)	1.63	V	±15	55(91.67)	-	5(8.33)	2.83	II
Irrigation	5(8.33)	29(48.33)	25(41.67)	1.63	V	±15	60(100.00)	-	-	3.00	I
Hoeing & weeding	24(40.00)	28(46.67)	8(13.33)	2.27	I	±5	60(100.00)	-	-	3.00	I
Fertilizer application	-	11(18.33)	49(81.67)	1.18	IX	±2	34(56.67)	-	26(43.33)	2.13	IV
Plant protectionmeasures	-	17(28.33)	43(71.67)	1.28	VII	30	21(35.00)	-	39(65.00)	1.7	VI
Harvesting	-	44(73.33)	16(26.67)	1.73	IV	±3	60(100.00)	-	-	3.00	I
Picking of vegetables	-	44(73.33)	16(26.67)	1.47	VI	3	60(100)	-	-	3.00	I
Storage	10(16.67)	28(46.67)	22(36.67)	1.80	III	±2	60(100.00)	-	-	3.00	I
Marketing	-	-	60(100.00)	1.00	VIII	-	-	-	60(100.00)	1.00	VIII
Vegetable processing	26(43.33)	-	33(55.00)	1.85	II	1	11(18.33)	-	49(81.67)	1.37	VII

Note: Figures in the parentheses indicate percentage

grading and 12 hours on bagging per crop. Storage (IIIrd), plant protection measures (IVth), using compost before sowing and pre- sowing irrigation (Vth) were other operations in which farm women participated. They spent maximum time on plant protection measures, digging and cleaning of potatoes. On the other side farm labourers were more active in potato cultivation as compared to farm women. They were fully participated in many operations, such as pre-sowing irrigation, ridges on flat bed, digging, cleaning of potatoes, grading and bagging (Ist). Eighty eight per cent of farm labourers were fully participating in storage process (IInd) followed by using compost before sowing (IIIrd) and irrigation (IVth).

In this region most of the farming families cultivated vegetables such as, peas, green chilies, cauliflower, cabbage, radish, carrots etc. Large farmers cultivated vegetables on commercial level, whereas marginal and small farming families cultivated for domestic purpose only. Operation of hoeing and weeding ranked first in which forty percent of farm women were fully involved and 46.67 per cent of them participated partially. Average time they spent for this operation was 5 hours per crop. Vegetable processing found solely women oriented process with second rank. Storage (IIIrd), harvesting (IVth), seed treatment, sowing, raising vegetable nursery, care of nursery, transplanting of vegetable nursery and irrigation (Vth) were other operations in which farm women's participation was found. They spent most of the time on plant protection, raising and care of nursery. On the other hand, farm labourers were engaged in the operations of raising vegetable nursery, irrigation, hoeing & weeding, harvesting, picking of vegetables and storage with full participation. No participation of women was found in land preparation due to mechanization. Marketing operations was found to be male bastion in the study area. Same results had been found by Kumar and Mishra (2018); Kumari and Laxmikant (2015).

CONCLUSION

Women's participation in agriculture had been always under weighted. Due to lack of information women have remained as invisible hands and their participation was always ignored. Their positions are always under estimated. Her major participation is found from agricultural activities to animal husbandry, from domestic chores to family maintenance and care of each and every member of family. Despite such a huge contribution, her role has yet not been recognized. They are not familiar with agriculture technology and needs training for the use of farm technology to improve their work participation and reduce drudgery. Cultural practices were selective discriminatory when the handling of finances and marketing of the agricultural produce comes to the force. Peculiar cultural values of the region could be made more inclusive to overcome gender discriminatory practices by sensitizing rural masses regarding the pertinent role of women in agriculture.

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Women Entrepreneurship in India vis-à-vis Punjab - Status, Motivation and Challenges

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ABSTRACT

The economic development of a nation is largely sparked by its enterprising spirit. In India, women constitute around 48 percent of the population but their participation in the economic activities is only 34 per cent. Women entrepreneurship has been recognized as an important untapped source of economic growth. In this backdrop, the present study was carried out with the objectives to study the status of establishments owned by women entrepreneurs in Punjab vis-a-vis India along with motivating factors and challenges faced by them. The study revealed that at national level, the women owned establishments formed 13.76 per cent of the total enterprises while for Punjab, it was only 7.33 per cent at the state level and about merely 1.38 per cent of total women establishments at the national level. The district Sangrur had the highest number of rural women establishments (11.3%) while Jalandhar had the highest (18.9%) urban enterprises. More than three-fourth establishments were operated without hired workers. Number of women establishments involved in agricultural activities constituted about one-fourth of the total number of establishments owned by women in Punjab as compared to about 34 per cent in India. About 54 per cent of the establishments were rural in Punjab and 65 per cent in India. Maximum of the women establishments were working throughout the year. Self-finance emerged out to be the major source of finance in both Punjab (85%) and India (79%). Women faced different socio-cultural, production related challenges amongst which finance from institutional sources and marketing competitiveness emerged out to the major ones. Renaissance of entrepreneurship is the need of the hour and this is possible only by taking effective steps to provide institutional financial support, entrepreneurial awareness, orientation and skill development programmes along with creation of nurturing environment with family support that motivates and supports women entrepreneurs.

Keywords: Challenges, Entrepreneur, Motivation, Status, Women

INTRODUCTION

The economic development of a nation is largely sparked by its enterprising spirit. In India, women constitute around 48 percent of the population but their participation in the economic activities is only 34 per cent. During the last decade, women entrepreneurship has been recognized as an important untapped source of economic growth. A two hour increase in the amount of unpaid labour undertaken by women leads to decrease in women's labour force participation rate (LFPR) from 60 to 50 per cent (Ferrant *et al.*, 2014). Increasing women's labour force participation by 10 percentage points could add $700 billion to India's gross domestic product by 2025 i.e. a 1.4 per cent increase in GDP (Woetzel *et al.*, 2015). A 10 per cent increase in the female-to male ratio of workers would increase per capita net domestic product in India by eight percent (Estevevolart, 2004). By 2030, enabling women entrepreneurs to start up and scale could increase direct employment by around 50 million to 60 million people and increase indirect and induced employment of another 100 million to 110 million people in India (Bain, 2019). Thus, ambitious yet realistic push can enable India to achieve

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a significant contribution from women through direct, indirect and induced employment alone.

Women participation in the rural sector is always found to be higher than the male members of the society, but more women are participating in the low paying menial works in the rural areas (Borkar, 2016). The reproductive work and domestic roles on the supply side along with religious and social restrictions prove to be significant variables in influencing female LFP (ibid). To make matters worse, the lack of awareness about the rights of working women creates further grounds of exploitation of women. Punjab, even after being a birthplace of the Green Revolution in the country and India's most prosperous state in1970s and 1980s, has the lowest female WPR (13.9%) in 2011.

MATERIALS AND METHODS

This paper is based on secondary data collected from different published sources viz. Global Entrepreneurship Monitor (GEM) Report on Women's Entrepreneurship 2016-17; Economic Survey, published by Ministry of Finance, Government of India (GoI). Besides, the study also used the NSO (2019) study on Time Use in India by Ministry of Statistics and Programme Implementation, GoI; All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India; Punjab Sixth Economic Census (2013) Government of Punjab, published research papers and thesis. The data were analysed using statistical tools like percentages, averages, graphs and ranks.

RESULTS AND DISCUSSION

A woman entrepreneur is a confident, creative and innovative woman desiring economic independence individually and simultaneously creating employment opportunities for others.

A. Status of women entrepreneurship: At national level, the total number of establishments owned by women entrepreneurs was 8.05 million which formed about 13.76 per cent of the total enterprises. At state level, this figure is only 1.11 lakh for Punjab forming about 7.33 per cent of total enterprises at the state level and about only 1.38 per cent of total women establishments at the national level (Figure 1).

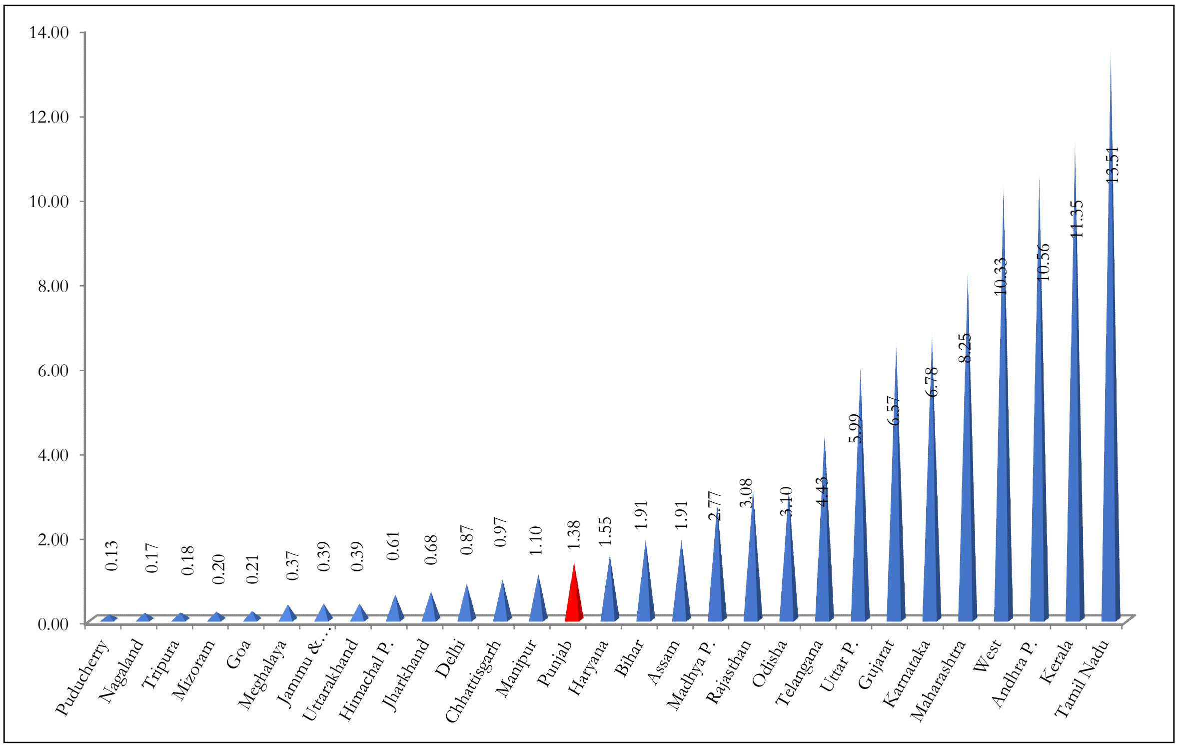

Figure 1: Distribution of total number of Establishments under women entrepreneurship in India (% share in total)

Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India

Note: % share <0.1 % for Daman & Diu, Lakshadweep, Dadra & Nagar Haveli, A&N islands, Chandigarh, Sikkim and Arunachal Pradesh

Further it was observed that number of women establishments involved in agricultural activities constituted about one-fourth of the total number of establishments owned by women in Punjab as compared to about 34 per cent in India. About 54 per cent of the establishments were located in rural Punjab as compared to about 65 per cent in rural India (Figure 2 & 3).

About 76 per cent establishments in Punjab were operated without hired workers (Figure 4) i.e. they were own account establishments operated by household members only and this figure was about 83 per cent at the national level (Figure 5). Women-owned enterprises which are largely single-person enterprises translates to lower returns and employment.

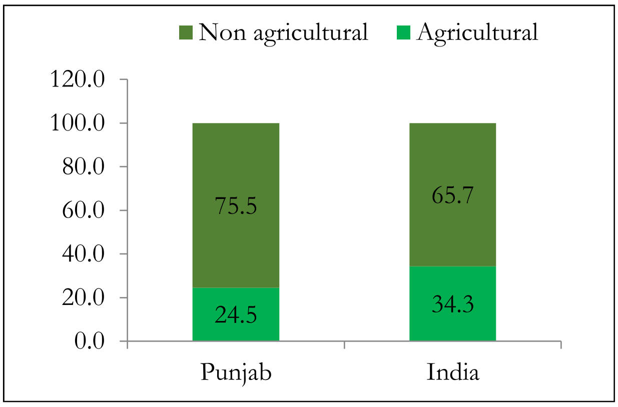

Figure 2: No. of establishments under women entrepreneurs by activity (% to respective totals of women entrepreneurs)
Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India and Punjab Sixth Economic Census (2013), Government of Punjab

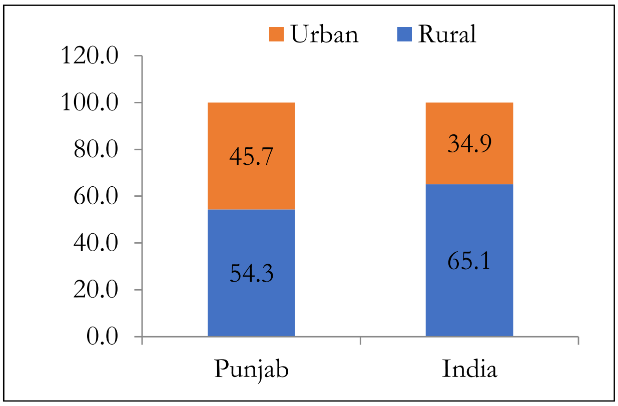

Figure 3: Number of establishments under women entrepreneurs by sector (% to respective totals of women entrepreneurs)
Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India and Punjab Sixth Economic Census (2013), Government of Punjab

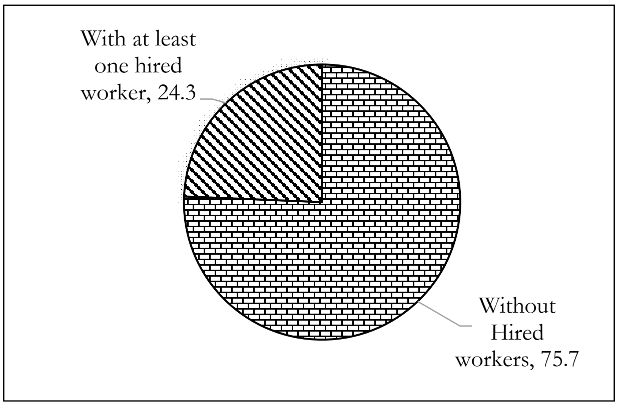

Figure 4: No. of establishments under women entrepreneurship by type of establishments in Punjab (% share)
Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India and Punjab Sixth Economic Census (2013), Government of Punjab

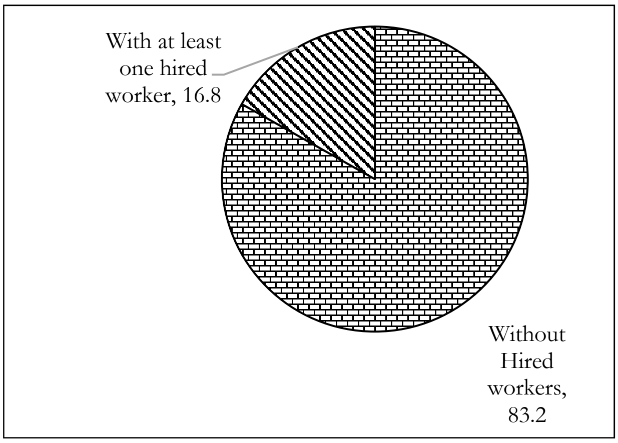

Figure 5: Number of establishments under women entrepreneurship by type of establishments in India (% share)
Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India and Punjab Sixth Economic Census (2013), Government of Punjab

According to the nature of operation, about 92 per cent of the women establishments were working throughout the year more or less regularly i.e. were perennial while about 6 per cent were confined to a particular season and rest 2.14 per cent were casual at the state level (Table 3). Similar kind of pattern existed

Table 1: Total number of establishments under women entrepreneurship by nature of operation

State	Perennial	Seasonal	Casual	Total
Punjab	101598	6944	2379	110921
	91.59	6.26	2.14	100.00
India	7166019	726435	158365	8050819
	89.01	9.02	1.97	100.00

Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India and Punjab Sixth Economic Census (2013), Government of Punjab

at the national level, as about 89 per cent, 9.02 per cent and 1.97 per cent of the establishments were perennial, seasonal and casual in nature respectively.

Data relating to source of finance for the women owned enterprises indicated that self-finance emerged out to be the major source of finance in both Punjab and India. Almost 85 per cent of the women establishments were self-financed in Punjab whereas at national level it was 79 per cent (Figure 6).

The second important source i.e. donation or transfer from other agencies contributed 12.5 per cent at the state and 14.65 per cent at the national level. Other sources included assistance from the state Government and Borrowing from financial institutions with contributions of 1.6 per cent and 0.5 per cent and the respective figures were 3.4 per cent and 1.1 per cent at the national level.

In Punjab, the district wise total number of establishments under women entrepreneurship is depicted in Figure 7 and Table 2. Total number of agricultural establishments in Punjab was 1.11 lakh, of which 60188 were rural and 50733 were urban. The district Sangrur had the highest number of rural establishments i.e.11.3 per cent while for all other districts, the number of rural establishments formed below 10 per cent share. In case of urban enterprises, Jalandhar had the highest share of about 18.9 per cent followed by Ludhiana (16%), Amritsar (12.6%) while for all other districts the share was below 7 per cent. It was also observed that 83916 establishments (75.7%) were working without any hired worker and the share of such enterprises was as high as 90.5 per cent in Mansa while it was below 86 per cent for all the districts. In terms of establishments with at least one worker, Rupnagar and Tarn taran had the highest share of about 35 per cent with rest district being below 31 per cent.

B. Motivational factors behind successful women entrepreneurs: The hidden entrepreneurial potential of women has extended their kitchen activities, mainly 3P's, Pickle, Powder and Pappad and they started entering into fields related to modern 3E's i.e., Energy, Electronics and Engineering. Skill, knowledge and adaptability in business are the main reasons that have encouraged women to emerge into business ventures.

In a study on factors motivating women entrepreneurs of operational businesses after categorizing them in six segments based on varying demographics, motivations, ambitions and constraint, it was found that they were influenced by differing factors as motivators to start entreprenurship (Table 3).

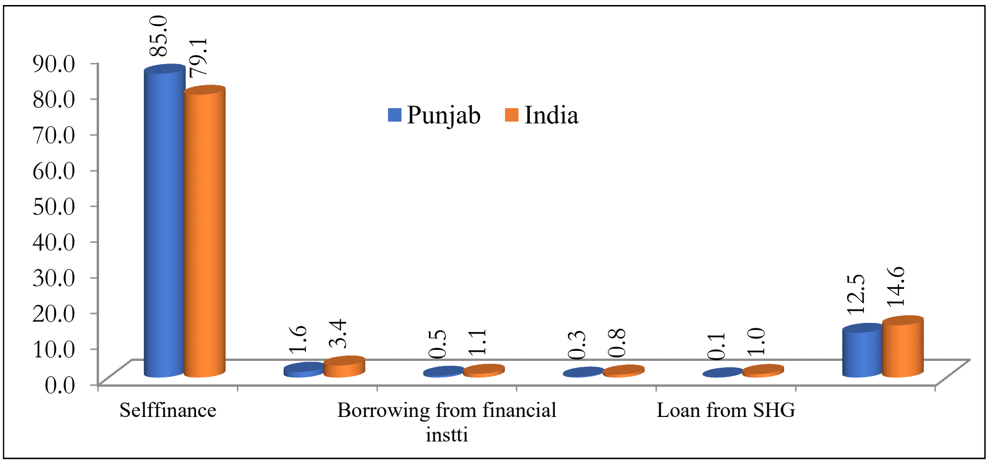

Figure 6: Total number of Establishments under women entrepreneur by Major Source of Finance
Source: All India Report of Sixth Economic Census (2016), Ministry of Statistics and Programme Implementation, Government of India

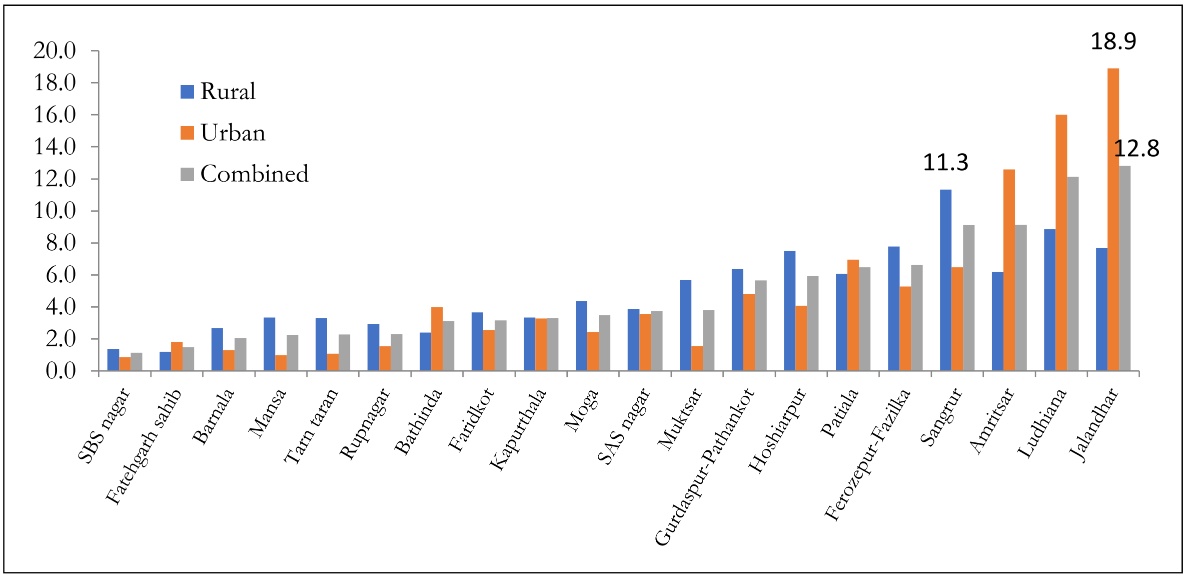

Figure 7: Districtwide total number of establishments under women entrepreneurs in Punjab (% share)

Table 2: District wise Total Number of Establishments under Women Entrepreneurs in Punjab

District/particulars	Sector						Combined		
	Rural			Urban					
	Type of establishment			Type of establishment			Type of establishment		
	Without hired worker	With at least one hired worker	Total	Without hired worker	With at least one hired worker	Total	Without hired worker	With at least one hired worker	Total
Gurdaspur-Pathankot	3192	647	3839	1715	724	2439	4907	1371	6278
Kapurthala	1507	500	2007	1200	460	1660	2707	960	3667
Jalandhar	3748	876	4624	6966	2625	9591	10714	3501	14215
Hoshiarpur	3377	1139	4516	1058	1006	2064	4435	2145	6580
SBS	654	181	835	297	135	432	951	316	1267
Fatehgarh	637	86	723	709	212	921	1346	298	1644
Ludhiana	4156	1172	5328	5235	2884	8119	9391	4056	13447
Moga	2146	476	2622	904	330	1234	3050	806	3856
Ferozepur-Fazilka	3654	1024	4678	1925	752	2677	5579	1776	7355
Muktsar	2853	580	3433	561	226	787	3414	806	4220
Faridkot	1897	308	2205	964	331	1295	2861	639	3500
Bathinda	1241	201	1442	1596	424	2020	2837	625	3462
Mansa	1882	129	2011	397	105	502	2279	234	2513
Patiala	3128	532	3660	2688	837	3525	5816	1369	7185
Amritsar	2695	1033	3728	4254	2138	6392	6949	3171	10120
Tarn	1294	694	1988	346	197	543	1640	891	2531
Rupnagar	1145	628	1773	506	271	777	1651	899	2550
SAS	1904	431	2335	1156	652	1808	3060	1083	4143
Sangrur	5807	1018	6825	2561	727	3288	8368	1745	10113
Barnala	1430	186	1616	531	128	659	1961	314	2275
Total	48347	11841	60188	35569	15164	50733	83916	27005	110921

Source: Punjab Sixth Economic Census (2013), Government of Punjab

Table 3: Motivations to start enterprise by women entrepreneurs (% respondents)

<table>
<tr><th>Motivators to start (n=991)</th><th>Scaler</th><th>Urban small business owner</th><th>Rural small business owner</th><th>Urban solopreneur</th><th>Rural solopreneur</th><th>Rural agripreneur</th></tr>
<tr><td>Interest/ familiarity with sector</td><td rowspan="2">>45</td><td rowspan="2">>45</td><td>26-45</td><td rowspan="2">>45</td><td>>45</td><td>>45</td></tr>
<tr><td>Fulfill unmet need</td><td rowspan="2">< 25</td><td rowspan="3"><25</td><td rowspan="2"><25</td></tr>
<tr><td>Greater control & flexibility</td><td rowspan="3">26-45</td><td rowspan="3">26-45</td><td rowspan="3">26-45</td></tr>
<tr><td>Recognition</td><td rowspan="2">>45</td><td>26-45</td></tr>
<tr><td>Financial need</td><td>>45</td><td>>45</td></tr>
<tr><td>Employment creation</td><td rowspan="2"><25</td><td rowspan="2"><25</td><td rowspan="2">26-45</td><td rowspan="2"><25</td><td rowspan="2"><25</td><td rowspan="2"><25</td></tr>
<tr><td>No access to suitable job</td></tr>
</table>

Source: Bain (2019) Women and Entrepreneurship Survey (n=1128), operational businesses only considered (n=991) extracted from Powering the economy with her: Women Entrepreneurship in India by Bain & company and Google (Pub.)

Financial need, interest in product or sector and recognition were the most commonly occurring motivators. Most rural entrepreneurs are driven by financial need i.e. necessity entrepreneurship while urban entrepreneurs were motivated by opportunity, especially recognising unfulfilled needs and interest in specific sectors. Many other studies also stated the responsibility of home as well as work and time management skills, educational levels, satisfaction from enterprise, achievement of success, attitude towards employees, expectations from venture, to become independent, sense of competiveness etc. as the major motivational factors behind the success of women entrepreneurs (Carter, 2005; Boden and Nuci,2000; Kovalainen,1993; Moore and Buttner, 1997).

Women entrepreneurship in India is still emerging and factor driven i.e. it is recognized as early stages of economic development, usually marked by a largely rural population working primarily in sectors of agriculture and the extraction of natural resources. The nation needs a lot of improvement as far as women entrepreneurial activity is concerned. The representation of women in the area of entrepreneurship is very limited as female entrepreneurial activity is only 7.6 per cent though it has shown an increase over the year 2014 (Table 4).

Among different factors affecting women entrepreneurship, the percent share of opportunity driven women entrepreneurs was the highest i.e. 61.6 per cent followed by necessity driven entrepreneurs (33.1%) and women with entrepreneurial intentions (16.7%). Among the factors responsible for discontinuation of business by female entrepreneurs, non profitability was observed for about 18 per cent women and lack of finance by about 5 per cent women entrepreneurs.

Table 4: Women entrepreneurship in India

S. No.	Parameter	Per cent of TEA
1	Development level	Factor driven
2	Female Total Entrepreneurial Activity	7.6
3	Ratio of female to male TEA	0.60
4	Factor affecting women entrepreneurship	
	Necessity driven	33.1
	Opportunity driven	61.6
	Entrepreneurial intentions	16.7
5	Female business discontinuation	
	Unprofitability	17.9
	Lack of finance	5.4
6	change in TEA 2016 over 2014	0.66

Source: Global Entrepreneurship Monitor Report on Women's Entrepreneurship Report, 2016-17

C. Challenges faced by the women entrepreneurs: Studies highlight that the women has imposed roles and responsibilities in society based in biology (O'leary, 1997). Women faces the most is the 'time poverty' while dealing with both outside and domestic work, leading to greater stress and difficulty (Brush, 2004). A study by Gilani (2004) finds that the two greatest problems in starting a business for women entrepreneur is the difficulty of balancing entrepreneur and family responsibilities.

Unpaid activities: Women bear an unfair burden of unpaid activities in the household, which puts a constraint on their ability to look out for opportunities of paid work. Of the approximately 432 million working age women in India, about 343 million are not in paid formal work. An estimated 324 million of these women are not in the labor force; and another 19 million are in the labor force but not employed (Bain, 2019). According to NSO, only about 18 per cent of rural women and about 16 per cent urban women participate in paid works at the national level as compared to men (53.4% and 58.1%) as shown in Table 5.

Table 5: Percentage of persons participating in a day in unpaid activities and paid activities (considering only the major activity of the time slots for age 6 years and above)

Activity/category	Rural		Urban	
	Male	Female	Male	Female
India				
Unpaid work	47.8	85.0	35.1	81.7
Paid work	53.4	17.7	58.1	15.5
Punjab				
Unpaid work	30.7	82.3	33.1	80.6
Paid work	58.8	12.5	60.3	13.1

Source: NSO, 2019

In Punjab, the situation is worse as only about 13 per cent of rural and urban women each are doing paid work as compared to about 59 rural and 60 per cent urban men. If included, unpaid care work would constitute be equivalent to 63 per cent of Indian GDP (Budlender, 2008).

Socio-cultural problems: Jahanshahi *et al.* (2010) in a study on personal issues of women entrepreneurs in global scenario with special reference to India observed that being a women is the greatest hindrance for them as well as the patriarchy was one of the major issue for blocking their ways. The cultural constraints such as social stigmas about strength, skill and adaptability etc. for women has been highlighted for women entrepreneurship by many studies (Bush, 1997; Kollan and Parikh, 2005; Gilani, 2004).

Production related problems: The available literature shows that finance is particularly and widely regarded as the major obstacle faced by women entrepreneurs (Anna *et al.*, 2000; Crampton and Mishra, 1999; OECD 1997). Taherdoost (2017) finds that the primary source of funds for women entrepreneurs is their personal savings, but low income women seldom have any personal savings. According to a recent study on women engaged in micro-enterprises in Punjab (Singh, 2020), the main obstacle faced by women entrepreneurs was the high cost for production (Table 6 followed by other problems like ignorance about loan procedures for finance, management problems, inadequate infrastructure, unavailability of skilled members etc.

Table 6: Distribution of women entrepreneurs according to their production related problems (N=120)

Production related problems	Weighted average	Rank
Power and water shortage	1.71	VIII
Lack of skilled members	1.84	VI
Management problems	1.94	III
Inadequate infrastructure	1.89	IV
Non availability of raw materials	1.78	VII
Non availability of machines and equipments	1.88	V
High cost of production	2.30	I
Low productivity in enterprises	1.84	VI
Loaning procedure of financial institutes	2.13	II

Source: Singh (2020)

Among different market related problems, market competitiveness appeared to the major obstacle followed by changing demand pattern, high transport costs, lack of improved technology and infrastructure.

Cheeroli and Kumar (2018) in a study on the women micro-enterprises revealed that the major problems faced were lack of managerial expertise along with other problems and Vejju (2018) highlighted that main challenges faced by rural women included mainly finance and marketing. Various authors have also highlighted that the problems faced by women entrepreneurs are mainly lack of marketing strategy and process and networking (George and Thomas, 1998; Gilani, 2004; Sinha, 2005) while Awasthi and Mukherjee (2009) reveal that women-operated micro-businesses do not grow because of inadequate investment capital which forces them to buy raw material in smaller quantities making it costlier coupled with low level of skills which compel them to adopt low technology based production process. Thus all these market related problems affect the cost of production adversely and limit the ability to experiment or introduce new products and designs.

CONCLUSION AND SUGGESTION

Out of the total establishments, share of women owned is only about 7 per cent at national level and merely 1.38 per cent of the women establishments in Punjab. The nation needs a lot of improvement as far as women entrepreneurial activity is concerned.

Entrepreneurship by Choice: Most of these women have become entrepreneurs out of sheer necessity and have not been driven toward entrepreneurship by choice or opportunity. There is, therefore, a huge opportunity to empower women to choose entrepreneurship as a career choice and move from a mindset of being job seekers to job creators. Renaissance of entrepreneurship is the need of the hour and this is possible only by educating women strata of population, spreading awareness and consciousness amongst women to outshine in the enterprise field. They should be made to realize their strengths, and important position in the society and the great contribution they can make for the entire economy.

Structural and cultural support: There is need for appreciation and encouragement from family and friends which builds tremendous confidence among women. Our society needs to bring about an attitudinal change in regard to the role of women entrepreneurs. This will lead to the development of a desirable environment in which women will come forth and will show their talents. To motivate women entrepreneurship all that is needed is orientation in the right direction and removal of all obstacles in the way of success.

A strong support framework: Financial institutions and nationalized banks may setup special cells to assist women entrepreneurs by providing small-scale financial support and low-financing cost credits to visionaries hailing from a low financial background.

We need to create a nurturing ecosystem that motivates and supports women entrepreneurs while providing them with the much-needed training in literacy for an entrepreneur, understanding competence and competitiveness, mentoring and other necessary resources, to make a quantum leap while marketing. Women entrepreneurs must be moulded properly with entrepreneurial traits and skills to meet the changes in trends, challenges in global markets. They should be competent enough to sustain and strive for excellence in the entrepreneurial arena.

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Impact Assessment of Cluster Front Line Demonstration on Greengram Crop

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ABSTRACT

The present study was conducted by KVK, Maulasar, Nagaur-II during 2018 to 2020 in the *Kharif* season with seventy five cluster frontline demonstrations at Nagaur district of Rajasthan. The results of demonstrations showed that farmers could increase the green gram productivity notably by adoption of improved production technology. From the present study, it was observed that the improved green gram variety GAM-5/GM-6 recorded the higher yield (6.17 q/ha) compared to the farmers' practices variety (5.03 q/ha). The increase in the demonstration yield over farmer's practices was 21.49 per cent. Technology gap, extension gap and the technology index values were 3.02 q/ha, 1.20 q/ha and 32.27 per cent, respectively. The increment in yield of green gram crop under demonstrated plot was due to spreading of improved and latest technology viz. improved variety, seed treatment with bio-fertilizers, optimum seed rate, right dose & method of fertilizers, weed management and plant protection measures.

Keywords: Cluster frontline demonstration, Extension gap, Green gram, Productivity, Technology gap, Technology index

INTRODUCTION

India is the largest producer, consumer and importer of pulses. Pulses are a good and chief source of protein. Contribution of pulses to Indian agriculture has been tremendous besides being one of the important constituents of our diet which rich in protein. Among the grain legumes, green gram [*Vigna radiata* (L.) Wilczek], commonly known as Moong; is an excellent source of high quality protein (25%). In India Rajasthan, Maharashtra, AP, Bihar, Karnataka, Gujarat are the major growing states of greengram. In Rajasthan, green gram was cultivated in an area of 6.52 lakh ha with production 4.08 lakh tonne and productivity 626 kg/ha during the year 2018-19 (Commissionerate of agriculture, Rajasthan-Jaipur, 2018-19). Even though pulse production increased significantly during the last decade but continuing the rapid growth is a challenge for researchers, extension agencies and policy makers to fulfill the domestic demand. Yield potential of green gram is also very low because of the fact that the crop is mainly grown in rainfed conditions and marginal lands with poor management practices (Use of local variety, poor INM, IWM & IPM practices) as well as inherent factors associated with the crop.

Keeping the above point in view, cluster frontline demonstrations on greengram using improved practices was conducted with the objective to demonstrate newly released crop production technologies and its management practices in the farmers' field under different farming situations and at different agroclimatic regions under the supervision of agricultural scientists. The newly and innovative technology having higher production potential under the specific cropping system can be popularized through cluster front line demonstration programme.

MATERIALS AND METHODS

The present study was carried out in the Nagaur district is located on the North-western part of Rajasthan state

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and lies at 27°20'N latitude and 73°74' E longitude with an altitude of 302 m above the mean sea level. Cluster frontline demonstrations (CFLDs) were conducted during *kharif*, 2018, 2019 and 2020 with evaluation the performance of GAM-5/GM-6, variety of greengram in Maulasar & Didwana block of the district. Variety GAM-5/GM-6 of greengram was demonstrated which potential yield is higher in medium to higher rainfall areas with loamy soils than low rainfall areas of Rajasthan. In this study, 100 farmers were selected from aforesaid blocks during consecutive years. Soils in the demonstrated area were sandy loam texture with pH ranges between 7.4 to 8.8 and EC 0.27 to 0.78. Before conducting the CFLD programme, farmers were identified in group meeting and specific production technology. All the technological intervention was taken as per prescribed package and practices for improved variety of greengram crop (Table 1). The grain yield, gap analysis, cost of cultivation, net return and additional returns parameters were recorded (Table 2 and 3). Assessment of gap in adoption of recommended technology before laying out the CFLD's through personal discussion with selected farmers. The training was organized about detailed technological intervention with improved package and practice for successful greengram cultivation. Scientists visited regularly demonstrated and farmer's fields. The feedback information from the farmer's was also recorded for further improvement in research and extension programmes. The extension activities i.e. training, scientist's visits and field days were organized at the demonstrated sites. The basic information were recorded from the farmer's field and analyzed to comparative performance of cluster frontline demonstrations and farmer's practice. Different parameters were calculated to find out technology gaps (Yadav *et al.,* 2004).

Extension gap = Demonstrated yield- Farmer's practice yield

Technology gap= Potential yield- Demonstration yield

Additional return= Demonstration return- Farmer's practice return

$$\text{Technology index} = \frac{\text{Potential yield-Demonstration yield}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

The result of the study indicated that gap existed in the potential yield and demonstration yield is due to soil fertility and weather conditions. By conducting cluster frontline demonstration of proven technologies, yield potential of greengram can be increased up-to great extent. The improved package and practices are more important with technological intervention for enhancing productivity and profitability of pulses (Table 1).

Grain yield: The results (Table 2) revealed that average grain yield of greengram under cluster frontline

Table 1: Detail of package and practices for greengram cultivation

Technological intervention	Farmer's practice	Recommended Practice
Variety	Heera moti, GM-4, SML-668	GM-4, MH-421, IPM 02-3, GAM-5
Seed treatment	Carbendazim 50 WP @ 2g/kg	Carbendazim 50 WP @ 2g/kg seed, Imidacloprid 70 WS @ 5g/kg seed & Rhizobium and PSB culture 5-10 ml/kg seed
Soil treatment	No Application	Quinalphos 25 kg/ha
Spacing	Un uniform plant population	30 x 10 cm
Time of Sowing	1-30 July	1July- 15 July
Nutrient management	Imbalance use of fertilizers and 50 kg DAP at sowing.	Balance fertilization:-10-15 kg N, 30-40 kg P_2O_5 & 40 kg S/ha at sowing time. Spray of 2% NPK (18:18:18) at flowering time
Weed management	Hand weeding	Imazethapyr 10SL 50g a.i./ha at 20-25 DAS
Plant protection measures	Use of Monocrotophos 1 litre/ha	Spray of Imidacloprid @ 0.5ml/litre of water at 30 days for sucking pest and one spray of Streptocyclin 1g/10 litre of water for bacterial blight control

Table 2: Yield performance, technology gap, extension gap and technology index of green gram under Farmers' Practice and Cluster Front Line Demonstration

CFLD conducted year	Crop	Variety	No. of Demons-trations	CFLD Area (ha)	Yield (q/ha)			% increased yield over local check	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
					Potential of variety	Demons-trated plot	Local Check plot				
2018	Greengram	GAM-5	50	20	10	6.22	4.8	29.58	3.78	1.42	37.80
2019	Greengram	GAM-5	25	10	10	7.25	6.15	17.89	2.75	1.10	27.50
2020	Greengram	GM-6	25	10	8	5.48	4.40	24.55	2.52	1.08	31.50
Average						6.17	5.03	21.49	3.02	1.20	32.27

Table 3: Economics of greengram under Cluster frontline demonstrations

Conducted year	Cost of cultivation (Rs/ha)		Gross return (Rs/ha)		Net Return (Rs/ha)		B:C Ratio	
	Demonstrated plot	Local Check plot	Demonstrated plot	Local Check plot	Demonstrated plot	Local Check plot	Demonstrated plot	Local Check plot
2018	23117	21800	46709	35955	23592	14155	2.02	1.65
2019	24200	23500	52571	44318	28371	20818	2.17	1.89
2020	24460	22500	52484	44637	28024	22137	1.82	2.33
Average	23926	22600	50588	41637	26662	19037	2.01	1.96

demonstrations were 6.22, 7.25 and 5.48 q/ha as compare to 4.82, 6.15 and 4.40 q/ha recorded in farmer's practice and average yield increase of 29.58, 17.89 and 24.55 per cent during 2018, 2019 and 2020, respectively. The above findings were accordance with Sumathi, (2012), Ganesh, (2010) and Laxmi *et al.,* (2017).

Extension gap, technology gap and technology index: The extension gap 1.42, 1.10 and 1.08q/ha, technology gap 3.78, 2.75 and 2.52 q/ha and technology index 37.80, 27.50 and 31.50 was recorded (Table 2) during 2018, 2019 and 2020, respectively. The extension gap should be assigned to adoption of improved dissemination process in recommended practices which outcome in higher grain yield than the farmer's practice. The similarly observations were also obtained in greengram crop by Patil *et al.,* (2015) and in blackgram by Sahare *et al.*, (2018). The higher grain yield was attributed to higher potential with improved variety, seed & soil treatment, timely sowing, nutrient management, weed management, insect-pest and disease management in accordance of scientific package and practices.

Economics analysis: The economic analysis results revealed that the greengram recorded higher net returns and B:C ratio from demonstrated plot were 23592, 28371 & 28024 Rs/ha and 2.02, 2.17 & 1.82 during 2018, 2019 and 2020, respectively. The higher net returns and B:C ratio in green gram demonstration might be due to the higher grain yield and better pricing of the produce in the market. These results are in accordance with the findings of Patil *et al.*, (2015). Recommended practice proved beneficial in respect of yield and economics of greengram in consecutive blocks of Didwana & Maulasar in Nagaur District.

CONCLUSION

The findings of the study revealed that wide gap exist in demonstrated and farmer's practices in green gram due to technology and extension gap in Nagaur District of Rajasthan. It can be concluded (Table 2) that higher yield in demonstration was due to adoption of improved varieties and technologies. The per cent increment in yield of green gram in demonstrated plots over the farmers practice created greater awareness and motivated the other farmers to adopt the improved package of practices of green gram. These demonstration trails also enhance the relationship and confidence between farmers and KVK scientists. The participant farmers also play an important role as source of information and quality seeds for wider dissemination of the improved varieties of green gram for other nearby farmers. So FLD programme is a successful tool in enhancing the production and productivity of green gram crop through changing the knowledge, attitude and skill of farmers. The programme of cluster frontline demonstration could be popularized for other pulse crops also in order to increase farmer's income and attain self-sufficiency in pulse production.

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Farmers' Perception and Factors Influencing Adoption of Organic Farming

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ABSTRACT

Organic farming in India has gained attention due to degradation of production resource base in the wake of increasing use of agro-chemicals and rising consciousness about safe food and health among the consumers. The present study was undertaken to delve into farmers' perception about organic farming and to identify the factors determining the adoption of organic farming. The study was conducted in the states of Bihar and Kerala. Factor analysis was used to study the perception, while logistic regression was used to identify the factors determining the adoption of organic farming. Five factors having Eigen values greater than one were extracted with varimax rotation and Kaiser Normalization while using 15 statements related to organic farming. These five factors accounted for 63.65 per cent of total variance. The rotated factor loadings for each of the five factors ranged from 0.404 to 0.818. The findings revealed that the major themes of perception about organic farming among the farmers were related to economic, health, ecology, technology, and institutional support systems perspectives. Logistic regression revealed that the variables s age, access to training, environmental attitude, and risk orientation had positively significant influence on adoption decision for organic farming. The study indicated that opportunities for capacity building for organic farming technologies as well as sensitization towards environmental orientation should be promoted.

Keywords: Environmental attitude, Institutional support systems, Organic farming, Risk orientation

INTRODUCTION

The conventional agriculture has led to the problems of greenhouse gases emissions, loss of biodiversity, pollution due to injudicious use of agrochemicals, and land degradation (Crowdera and Raganold, 2015; Atoma *et al.,* 2020), and consequently, organic farming (John, 2014) has gained popularity (Dangour, 2010; Das *et al.*, 2020). The growing use of agrochemicals like fertilizers and pesticides had led to initiation for organic movement in 1940s. Organic agriculture aims at sustainable system with enhancement of soil fertility and biological diversity (Treadwell *et al.*, 2016). According to The International Federation of Organic Agriculture Movements (IFOAM, 2008), organic farming sustains soil health, ecosystem and people. The growing preferences to organic food products have emerged as a profitable opportunity for the farmers. However, the growth of organic agriculture is often limited by inexperience with production methods, inadequate marketing and technical infrastructure, low consumer spending power, and government policies (Halberg *et al.*, 2007; Reganold *et al.*, 2011). Several initiatives are being made at individual as well as organizational levels to promote organic farming; however, the scale of operation is limited. To bring about a shift in cultivation methods, there is a need of implementing extension interventions so that the farmers are educated about new technologies of organic cultivation of crops as well as market opportunities for organic produce. The present study was undertaken with the objectives of understanding of farmers' perception and identifying the factors determining the adoption of organic farming, which would facilitate in devising effective extension strategies and measures for promotion of organic farming.

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MATERIALS AND METHODS

The study was conducted with 140 randomly selected farmers comprising 70 farmers each from Kerala and Bihar. Organic farming has been initiated in Kerala while, *SRI* method of cultivation with organic inputs are being promoted in the Gaya district of Bihar. To map the perception of farmers about organic farming, factor analysis of their responses to a battery of statements was deployed. A set of 15 statements with response pattern of strongly agree, agree, uncertain, disagree, and strongly disagree, with corresponding weightage of 5,4,3,2 and 1 was administered to the farmers. The scores obtained on each of the statements were subjected to factor analysis to identify a reduced set of variables, which could help in delineation of dimensions of their perception. The set of 15 statements had reliability coefficient of 0.68, which is under the acceptable range of 0.6-0.7 (Hulin *et al.,* 2001). The logistic regression was deployed to identify the factors influencing adoption of organic practices technique. The dependent variable in logistic regression is usually dichotomous, that is, the dependent variable can take the value 1 with a probability of success (θ), or the value 0 with probability of failure ($1 - \theta$). Here in this study, farmers were grouped as adopters and non-adopters of organic practices based upon its use by them on their farm. A value of 1 was given to adopter and value 0 was given to non-adopter. The logistic regression makes no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance within each group. The relationship between the predictor and response variables is not a linear function in logistic regression, instead, the logistic regression function is used, which is the logit transformation of θ:

$$\theta = \frac{{}_{e}\,(a + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i)}{{}_{1+e}\,(a + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i)}$$

Where a = the constant of the equation and, b = the coefficient of the predictor variables.

RESULTS AND DISCUSSION

Perception about organic farming: Factor analysis of the responses of the farmers to set of statements related to organic farming showed a significant value ($P<0.01$) of Bartlett's test of sphericity and Kaiser-Meyer-Olkin measure of sampling adequacy value greater than 0.6 (Table 1). These values suggested the appropriateness of using factor analysis. Five factors having Eigen values greater than one were extracted with varimax rotation and Kaiser Normalization. These five factors accounted for 63.65 per cent of total variance (Table 2).

Table 1: Kaiser-Meyer-Olkin and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.661
Bartlett's Test of Sphericity	Approx. Chi-square	553.39
	df	105
	Sig.	.000

Table 2: Initial Eigen values and total variance explained

Component	Initial eigenvalues		
	Total	Percent of variance	Cumulative (%)
1	3.798	25.321	25.321
2	1.763	11.752	37.073
3	1.574	10.492	47.565
4	1.326	8.839	56.404
5	1.087	7.248	63.652
6	.927	6.177	69.829
7	.824	5.491	75.320
8	.737	4.915	80.235
9	.637	4.248	84.483
10	.530	3.531	88.015
11	.517	3.450	91.465
12	.460	3.066	94.531
13	.321	2.139	96.670
14	.265	1.764	98.434
15	.235	1.566	100.000

Having performed the varimax rotation and Kaiser Normalization, the rotated factor loadings for each of the five factors (Table 3) were examined. The variables with factor loading value greater than 0.4 were chosen as suggested by Portney and Watkins (2000). The first factor comprised of 4 items with factor loadings in range of 0.667 to 0.818. The four items related to the cost of cultivation, sale price, incentives, and labeling cost loaded for the first factor and so it was labelled as economic consideration. Relative

Table 3: Rotated component matrix

S.N.	Components	Factors				
		Economic	Ecological	Health	Technology	Institutional support
1.	The cost of cultivation is higher.	.714				
2.	The price of produce is not remunerative	.667				
3.	Labelling of products incurs additional cost.	.818				
4.	Incentives are less for organic products.	.734				
5.	Organic farming is good for improving the soil fertility.		.622			
6.	Organic farming will enhance beneficial insects and pollination of crops		.797			
7.	Organic farming will promote traditional varieties and biodiversity.		.691			
8.	Organic farming will provide pesticide free safe food to consumers.			.568		
9.	Nutritional security will be better with organic farming.			.771		
10.	The health hazards due to use of fertilizers and pesticides will reduce due to organic means.			.566		
11.	Preparation of inputs is a cumbersome process.				.404	
12.	Lack of availability of technology is major concern.				.601	
13.	There is risk of decline in production due to lesser effectiveness of technology				-.711	
14.	Certification is major constraint.					.727
15.	Access to training and advisory is very less.					.737

*The rotated factor loadings below 0.4 have been omitted in the table

advantage (Rogers, 1983) is one of the salient attributes of any innovation and farmers keep into consideration the cost-benefit trade off while choosing for adoption decision. At present, there is no stability in market demand and price so often the organic products are sold at the same rate as conventionally grown products. There is need for mechanism of segmentation in market pricing as well as incentivization in pricing of organic produce as well as input availability. The second factor comprised of three items with factor loadings in range of 0.622 to 0.797. These three items loading for factor 2 were related to sustainability of soil and biodiversity of flora and fauna. Therefore, the factor was labelled as ecological considerations. A lot of deliberations have been made through various fora and there is growing acceptance of the need to promote organic farming for ecological redressal. Organic farming is regenerative in nature and helps in boosting the soil fertility and enhances the co-existence of various cultivars both traditional as well as modern, insect species particularly the beneficial insects which could improve the pollination. Injudicious use of chemicals has led to deterioration of soil. The third factor comprised of three items with factor loadings in range of 0.566 to 0.771. The factor 3 was labelled as health considerations as it comprised the items related to safe food, nutrition, and health hazards during application or spray of chemicals. Persistence of pesticide residues in farm produce as well as harmful impact on farmers and labourers while making sprays have raised concern about the health issues. The fourth factor comprised of three items with factor loadings in range of 0.0.601 to 0.711. The factor 4 was labelled as technological considerations as it comprised of items related to input, availability and effectiveness of technologies for organic cultivation. Often the organic inputs are either not readily available or the process of their preparation is complex, cumbersome and time consuming. Also there is a need of acquiring know-how and do-how of the technologies related to organic cultivation. Access to training and advisories on organic cultivation is also limited. The other major issue endorsed by the farmers was about the certification of organic produce. Unless the produce is certified as organic, its marketing will be difficult. Certification process needs to be facilitative and access to agencies should be easy. The provisioning of facilities for capacity building and certification need institutional arrangements. Therefore, the two items related to training and certification under the fifth factor having loadings of 0.727 and 0.737, respectively were labeled as institutional support. The findings revealed that the major themes of perception about organic farming among the farmers were related to economic, health, ecology, technology, and institutional support systems perspectives. t is deduced that the economic perspective is the predominant factor for the farmers' perception about organic farming.

Factors influencing adoption of organic farming: The socio-economic variables like age, access to training, environmental attitude, risk orientation, experience in farming, access to credit, access to information and access to market were considered as the explanatory variable for the farmers' decision to adopt organic farming. The measurement process and the descriptive statistics are presented in Table 4.

Table 5 provides the results of logistic regression. Logistic regression measures model estimation fit with the value of -2 log likelihood. The minimum value of -2 log likelihood is 0, which corresponds to a perfect fit, hence; lower its value the better fitting the model. Chi-square test of significance and Nagelkerke R^2 value provides the basis to represent the overall model fit. The significant chi-square value, about 98 per cent of accuracy of prediction of classes and Nagerkerke R^2 value (0.95) show the overall fit of the model was better. Nagerkerke R^2 value signifies that the model could explain 95 per cent in the outcome. Wald statistics provides the statistical significance for each estimated coefficient (β). The estimated coefficients (β_o β_i …. β_n) tell about the probability of happening or not happening of the one of the possibility of the dependent variable (here in this study it is adoption or non-adoption of organic practices). For better interpretation the coefficients are transformed into Odds' ratio. Hence they are expressed in terms of logarithms. Therefore, the analysis provides transformed (antilog) value as exponentiated logistic coefficient of respective original coefficient. If β_i (the original coefficient) is positive, its transformation (the exponentiated coefficient) will be greater than 1, meaning that the odds of an event happening will increase for any positive change in the independent variable (Hair *et al.*, 2007). However, a coefficient just

Table 4: Definition and descriptive statistics of variables used in the empirical model

Variable	Definition and measurement	Minimum	Maximum	Mean value	Standard error
Age (X_1)	Age of the farmer, measured in years	22.00	75.00	47.5500	11.59653
Education (X_2)	Farmer's education level measured in number of years of schooling and college	.00	18.00	10.9214	5.02951
Experience in farming (X_3)	Number of years for which a farmer is engaged in farming	2.00	50.00	19.7107	11.97465
Access to credit (X_4)	Score on rating scale: No access=1; Access to somewhat extent=2, Access to a great extent =3	1.00	3.00	1.7500	.72096
Access to training (X_5)	Score on rating scale: No access=1; Access to somewhat extent=2, Access to a great extent =3	1.00	3.00	1.8786	.75358
Environmental attitude (X_6)	Index worked out on scale 1- 5	1.00	5.00	3.5615	.58676
Risk orientation	Index worked out on scale 1- 5	1.00	5.00	3.3443	.92389
Access to market	Score on rating scale: No access=1; Access to somewhat extent=2, Access to a great extent =3	1.00	3.00	2.1714	.68848
Access Information	Score on rating scale: No access=1; Access to somewhat extent=2, Access to a great extent =3	1.00	3.00	1.8143	.74511

Table 5: Result of Logistic regression

Variable	β	SE (B)	Wald	P	Exp (β)
Age	.167*	.088	3.597	.058	1.181
Education	.215	.161	1.776	.183	1.240
Experience in farming	-.064	.094	.469	.494	.938
Access to credit	-.698	1.301	.287	.592	.498
Access to training	5.338**	2.367	5.085	.024	208.001
Environmental attitude	8.377**	3.518	5.668	.017	4345.554
Risk orientation	4.274***	1.635	6.831	.009	71.823
Access to market	.517	1.396	.137	.711	1.677
Access Information	-1.095	1.259	.757	.384	.334
Constant	-62.025***	21.803	8.093	.004	.000

Model summary: Chi square = 174.35(P< .0001); -2 loglikelihood = 19.728; Cox & Snell R square = 0.712; Nagelkerke R^2 = 0.95; Accuracy of prediction of classes = 97.9 %; Level of significance: ***(P< 0.01); **(P< 0.05), ***(P< 0.10)

represents the expected change in the logit, when the independent variable increases by one unit.

The positively significant coefficients of explanatory variables indicate their positive influence on adoption decision of farmers towards organic farming (Table 6). As expected, the variables such as age, access to training, environmental attitude, and risk orientation had positively significant influence on adoption decision for organic farming. It is evident from the Exp (β) column Table 5 that the odds of adopting organic farming is 1.18 times higher with farmers of higher age. Similarly, the odds of adopting organic farming is 208 times higher with farmers having access to training. It is further deduced that the odds of adopting organic farming is 4345 times higher among the farmers having favourable environmental attitude, while it will be 72 times higher with the farmers having risk orientation. What emanates from the findings is that with age the farmers have realized the undesirable consequences of use of agro-chemicals on soil, ecosystem as well as human health. The young farmers are motivated more towards profit maximization in than to sustainable means. As newer opportunities and technologies are required for shifting to organic farming, the variable access to training has assumed significance in farmers' response pattern. Similarly, the concern for environmental considerations has emerged prominently among those farmers who are likely to adopt organic farming. Transiting to organic cultivation would require reliance on alternative organic inputs or means for management of soil fertility, pest management and weed management in place of chemical fertilizers, pesticides and weedicides. The farmers might not have the conviction in efficacy of alternative organic inputs in successful management of plant nutrition, pest and weeds. This calls for risk orientation among the farmers. Therefore, the probability of adoption of organic farming would be better among the farmers with better risk orientation. Contrary to *a priori* expectation, education, experience in farming, access to credit, access to information and access to market were not found to have a significant influence on adoption decision of farmers. Though not significant, access to credit and access to information showed negative relation. It suggests that the due to lack of access to credit they did not use much chemical and cultivation system was oriented to organic by default.

CONCLUSION

The findings revealed that the major themes of perception about organic farming among the farmers were related to economic, health, ecology, technology, and institutional support systems perspectives. It is deduced that the economic perspective is the predominant factor for the farmers' perception about organic farming. The study identified that the variables namely age, access to training, environmental attitude, and risk orientation had positively significant influence on adoption decision for organic farming. There is a need to facilitate capacity building of farmers in application of technologies related to organic farming. Institutional support system for arrangements related to certification, pricing, and marketing need to be ensured for promotion of organic farming.

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Online Education in India During the Corona Pandemic: Aptitude and Attitude of Students

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ABSTRACT

Emergence of Coronavirus from Wuhan, China has brought in a very unique experience in the history of modern era, impacting people in all walks of life. Educational sector saw a quantum leap into digital teaching-learning. The situation was unique and there emerged an unfamiliar order in the midst of pandemic chaos. Despite many adversities faced by the teaching fraternity and the student community, the learning never stopped. The study aimed to find out the attitude and aptitude of students in India during the lockdown. This study draws out the following conclusions – Zoom and Cisco Webex were the top two platforms that the students had knowledge of for remote learning; students ranked their computer skills as good (47%), fair (33.80%) and poor (19.20%); 49.60 per cent of the students ranked their app skills as good, 34.10 per cent fair and 16.40 per cent poor; a significant difference in the computer skills, app skills and overall skills (both computer and app) of the students was observed. Students opined that online mode of teaching was not suitable for practical content, more self dependency consequently stressful and provided an opportunity to choose their learning style. There was a significant difference between the knowledge, skill, and attitude of the students. The top two problems cited by the students in online classes were network connectivity issues and a pressing need for more storage space to avail the data related to course content.

Keywords: Coronavirus, Covid-19, Digital learning, e-learning, Higher education sector, Online teaching, Pandemic, Student

INTRODUCTION

Educational institutions across the world are reeling over from the after effects of the Coronavirus in the form of complete shutdown of the campuses. To contain the spread of the virus, it has become essential for all schools and colleges to operate in a distance mode. This led to a global shift to online education, with many struggles and triumphs on the part of the students, teachers and the management. The global education system has thus changed and adapted itself to the demands of new normal. Consequently, the educators have now adopted a new form of remote education using various digital tools like mobiles, laptops, digital video streaming apps and a myriad of online educational resources to enhance student's engagement and understanding. In India, most educational institutions shifted to online teaching after the nation went into complete lockdown since March 2020.

The strange routine for students during lockdown comprised of answering to their roll calls over internet, listening to just the voices of their teachers explain complex theories on the white board. Information and communication technology (ICT) helped the teachers and students to sync over various networks, make judicious use of the time to fulfill the various curriculum requirements, lest the students lose their academic year. Software replaced the sacred space between the teacher and the student, while internet replaced the physical infrastructure (Shankar, 2020). Although arduous,

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students managed to wade through new and unusual standards that the academic institutions put them through to complete their formal requirements to pass the course.

With this background, the study proposed to understand the impact lockdown has had on students by measuring their knowledge of online applications used for digital learning; aptitude of students – specifically in terms of computer, app skills; attitude of student's towards online education; problems faced during digital learning. Several research questions that were analyzed in the study include: Was there a significant difference among the computer skills of the students? Did the app skills of the students show a significant difference? Was there a significant difference in both the computer and app skills? Was there any significant difference in knowledge, skills, and attitude?

MATERIALS AND METHODS

Data was collected through an online-based survey in May 2020 using a pre-structured questionnaire. Students who are actively involved in online education during the pandemic were chosen for the study based on purposive random sampling. A total of 315 students belonging to the government, aided colleges, and state agriculture universities participated in the study. This exploratory study assessed the knowledge, skill, and attitude of the students towards online education. The student's knowledge of ten online apps was assessed and reported using frequency and percentages. Skills and attitude were measured on a three-point continuum of good, poor, and fair with a scoring of 3, 2, and 1 respectively. Likewise, attitude towards online education was also measured on a three-point continuum of agree, neutral, and disagree with 3, 2, and 1 score respectively. To find out the significant difference among student's skills, t-test was computed and a one-way ANOVA analysis was done to find out the significant difference between knowledge, skill, and attitude of the students about online education. Finally, data on problems faced by the students while attending the online classes were collected with yes and no options, for which frequencies and percentages were calculated.

RESULTS AND DISCUSSION

Table 1 shows that 63.30 per cent of the students possessed average knowledge of various apps, which is an indication of active participation in the online classes. The greatest (89.50%) per cent of the students knew about the Zoom app followed by Cisco Webex (84.10%), individual e-learning platforms (66.30%), Microsoft Teams (64.40%), and face time (63.20%). A considerable percent of the students were aware of Skype (61%), Go to meeting (60.30%), Google Hangouts & Google classroom (48.90% & 48.30%), and dropbox (47%). Zoom and Cisco Webex appear to be the most widely used cloud computing video conferencing apps for online education as they are free, user friendly, and simple to use. The findings of this study are in accordance with a study conducted by

Table 1: Percentage of students with knowledge on apps Vs No knowledge during Covid-19

Apps	Knowledge		No Knowledge	
	Frequency	Percentage	Frequency	Percentage
Zoom	282	89.50	33	10.50
Cisco Webex	265	84.10	50	15.90
Individual e-learning platforms developed by your University	209	66.30	106	33.70
Microsoft Teams	203	64.40	112	35.60
Face time	199	63.20	116	36.80
Skype	192	61.00	123	39.00
Go to meeting	190	60.30	125	39.70
Google hangouts	154	48.90	161	51.10
Google classroom	152	48.30	163	51.70
Drop box	148	47.00	167	53.00
Average	199.40	63.30	115.60	36.70

Radha *et al.* (2020) where the students (38.29%) indicated the use of zoom app for e-learning. Another study conducted in Hong Kong by Qiuhan *et al.* (2020) reveal that only 30% of the students showed strong willingness to study via online apps such as Zoom and Canvas. The students in the present study seem to have pre-existing knowledge of individual e-learning platforms such as Mana TV, e-courses of the universities even before lockdown since they were developed by their parent universities and were accessing the lessons from these platforms. Low knowledge about dropbox and Google classroom could be because they were not used before lockdown as the classes were going on in the traditional mode of classroom teaching. Bhati, Vatta and Tiwari (2020) reported that only 38% of the students were aware of e-library and 36% MOOCs, both of which have been widely popularized by UGC the last couple of years. A study conducted by Devi and Sornapudi (2020) reveals that 49% of the students did not use any e-learning platform for knowledge up-gradation, while 21% have used Swayam e-learning portal and 12% used UGC MOOCs.

The results from Table 2 reveal that a highly significant proportion of the students are well versed with emailing skills (mean score 2.60) followed by internet and web browsing (mean score 2.50), and typing and MS office (mean score 2.40). The students also have fair skills in file management, printing and print screen, hyperlinks (mean score – 2.30, 1.90, & 1.80) respectively. From these results, it is evident that the students possess basic computer and email skills as possessing an email is necessary for activities like biometric attendance, scholarships, etc. Further, internet browsing skills are essential to submit various co-curricular activities like assignments, seminars, and project work. Skills like printing, print screen, and hyperlink were poor as most of them do not possess printers and never required them much before lockdown for their studies. Moreover, they relied on external sources, like college libraries or internet centers for printing documents.

It is indicated in Table 3 that, a remarkable percentage of the students have good skills in submitting assignments, attempting quizzes or any online exams, and social networking skills with a mean score of 2.70, 2.60 & 2.60 respectively. The reason for good skills in these areas may be due to familiarity with certain apps like Google classroom and WhatsApp, where assignments were posted, online exams were attempted regularly, notes and important messages were shared, before lockdown. Radha *et al.* (2020) reported that 73 per cent students were comfortable in taking online mock tests, which clearly is an indication of their skills in that area. The students of the present study have fair skills in attending video conference (mean score 2.40) followed by time management skills (mean score 2.30) and creating and sharing audio files (mean score 2.20). A considerable percent of the students possess poor skills in digital music and webinar (mean score 2.00 & 1.90) respectively due to lack of previous exposure.

The results of the t-test indicate there exists a significant difference among the computer skills of the

Table 2: Computer skills of the students

Computer Skills	Good		Fair		Poor		Total	Mean
	F	%	F	%	F	%	Score	Score
Email	198	62.90	96	30.50	21	6.70	807	2.60
Internet and web browsing	188	59.70	103	32.70	24	7.60	794	2.50
Typing Skills	174	55.20	107	34.00	34	10.80	770	2.40
MS office – Word, excel and power point	157	49.80	120	38.10	38	12.10	749	2.40
File management or file types converting ppt to pdf	148	47.00	113	35.90	54	17.10	724	2.30
Printing	91	28.90	99	31.40	125	39.70	596	1.90
Print screen, hyper links	80	25.40	107	34.00	128	40.60	582	1.80
Average	148.00	47.00	106.40	33.80	60.60	19.20	717.40	2.30

Table 3: App skills of the students

Computer Skills	Good		Fair		Poor		Total	Mean
	F	%	F	%	F	%	Score	Score
Assignment	229	72.70	73	23.20	13	4.10	846	2.70
Quiz or multiple choice questions or blanks Online exam	199	63.20	101	32.10	15	4.80	814	2.60
Social networking – Whatsapp, Instagram, Facebook etc	199	63.20	101	32.10	15	4.80	814	2.60
Attended Video conferencing / web meeting	166	52.70	107	34.00	42	13.30	754	2.40
Time management skills	143	45.40	133	42.20	39	12.40	734	2.30
Creating and sharing audio files	135	42.90	108	34.30	72	22.90	693	2.20
Digital Music	104	33.00	110	34.90	101	32.10	633	2.00
Webinar	74	23.50	125	39.70	116	36.80	588	1.90
Average	156.10	49.60	107.30	34.10	51.60	16.40	734.50	2.30

Table 4: Computer skills t-test

Classification	Frequency	Mean	SD	Calculated value	P-Value	Remark
Poor	39	1.11	5.44			
Fair	134	5.96	1.13	4.94	0.039	Significant
Good	142	8.57	5.11			

students (Table 4). So, therefore we reject the null hypothesis. This means there is a variation among the skills of the students wherein some may possess good skills, some may have fair or poor skills. This might be due to various reasons like their awareness levels, accessibility, and affordability status.

There exists a significant difference in the app skills of the students. Hence the null hypothesis is rejected (Table 5). The difference in the app skills among the students may be contributed to their academic performance, usage, and interest in exploring the various apps.

There exists a significant difference in overall skills since p-value < 0.05 (Table 6). The results of the t-test show that there exists a significant difference in overall skills among students (good, fair, and poor). It might be due to individual variations in terms of exposure, experience, interest, and variations in the skills of students. Some students may be good at higher-order skills like learning independently, analyzing, and using

Table 5: App skills t-test

Classification	Frequency	Mean	SD	Calculated Value	P-Value	Remark
Poor	22	0.73	4.68			
Fair	156	8.17	2.38	4.58	0.044	Significant
Good	137	9.79	6.31			

Table 6: Overall skills (t-test)

Classification	Frequency	Mean	SD	Calculated value	P-Value	Remark
Poor	35	2.33	21.31			
Fair	175	17.77	4.51	4.94	0.038	Significant
Good	108	14.74	22.77			

for various purposes, whereas, some other students may have lower-order skills where they can only understand the basics of the computer. Hence, there appears to be significant variation in the overall skills of the students.

Concerning the attitude of the students towards online education, a maximum percentage of students agree that online mode of teaching is not suitable for practical (mean score 2.70), as most of the practical content is skill-based which is better learnt with a direct face to face teaching and is helpful to clarify the doubts readily (Table 7). A recent study conducted in April 2020 also reported that 80 per cent of the students felt that traditional teaching is better for practical classes (Radha *et al.,* 2020). A significant proportion (mean score 2.50) of the students perceived that self-dependency tends to be more in online classes due to lack of peer group interaction or support, which may create stress among the students. Other researchers have reported that online learning requires more self discipline and self-motivation on part of the students (Smart and Cappel, 2006). Further, more alertness is needed in e-classes. Contrary to this, the same percentage (mean score 2.50) of the students felt that online teaching provides an opportunity for choosing their learning style due to the availability of different multimedia content. A considerable portion of the students felt that theory classes are easy to participate in than practical classes (mean score 2.40).

An average percentage (mean score 2.30) of the students opined that it is difficult to maintain decorum while attending online classes from their homes where disturbances may be quite common from multiples sources; hence they even felt difficult to accept online learning. A sizeable segment of the students expressed that they are comfortable with *e*-classes as there is no

Table 7: Attitude of the students towards online education

Statements	**Agree**		**Neutral**		**Disagree**		**Total**	**Mean**
	F	**%**	**F**	**%**	**F**	**%**	**Score**	**Score**
Not suitable for all types of practical content	230	73.00	63	20.00	22	6.98	838	2.70
Self dependency is more in online classes and is stressful due to lack of peer group interaction / support	194	61.60	85	27.00	36	11.43	788	2.50
Online teaching provides me an opportunity for choosing my learning style due to the availability of different multimedia contents	182	57.80	98	31.10	35	11.11	777	2.50
More alertness is needed in *e*-classes than traditional classroom teaching	196	62.20	72	22.90	47	14.92	779	2.50
Theory classes are easy to participate than practical classes	184	58.40	81	25.70	50	15.87	764	2.40
It is difficult to maintain academic decorum	142	45.10	140	44.40	33	10.48	739	2.30
Found online learning difficult to accept	143	45.40	111	35.20	61	19.37	712	2.30
Comfortable with *e*-classes as there is no constant supervision	125	39.70	130	41.30	60	19.05	695	2.20
Formal presentation of the teacher makes the topic less understandable	137	43.50	113	35.90	65	20.63	702	2.20
Escaped from notes taking as teaching material is readily accessible	136	43.20	104	33.00	75	23.81	691	2.20
Dress of the students should be causal	124	39.40	105	33.30	86	27.3	668	2.10
No difficulty in transition from traditional to digital teaching	95	30.20	105	33.30	115	36.51	610	1.90
Would like to continue the digital form of learning in the next semester	92	29.20	70	22.20	153	48.57	569	1.80
Average	152.30	39.50	98.20	31.20	64.50	20.50	717.80	2.20

constant supervision due to the teacher's high priority on the content delivery mechanism (mean score 2.20). Formal presentation of the teacher makes the topic less understandable (mean score 2.20) as it is difficult to get clear visual cues like in the traditional classroom. Further, the students believed that as most of the teachers deliver PowerPoint presentations the reading material was readily accessible without writing notes (mean score 2.20). Postgraduate medical students were of the opinion that online teaching was relevant to their learning needs and clinical practice. They also reported that the online sessions were interesting, enjoyable and material given was easy to access (Bhati *et al.,* 2020).

With respect to the dress code, the students opined that (mean score 2.10) it should be causal but, it might hamper the academic environment. The students responded negatively as they felt the difficulty in transition from traditional to digital teaching and a considerable percentage of them are not yet ready to continue their learning through a digital platform (mean score 1.90 & 1.80) respectively. Indian students preferred traditional classroom learning over e-learning as reported in a study conducted by Radha *et al.* (2020). Similar response was given by Hong Kong students where 32 per cent disagreed and 22 per cent strongly disagreed to the statement 'online education is better than face to face interaction' (Qiuhan *et al.*, 2020). The dislike towards online education seems to be universal. This might be due to many reasons like lack of infrastructure facilities like ergonomic study table and chair, money to recharge, mobile phone, power cut, and network issues due to the remoteness of their native places, all of which need to be critically considered for continuing digital teaching-learning.

Table 8 is the base table for ANOVA which indicates that out of 315 student's 306 students have overall knowledge and 9 respondents have no knowledge.

Based on ANOVA analysis it can be inferred that there is a significant difference between the knowledge, skill, and attitude of the students (Table 9). This might

Table 8: Overall App knowledge VS No Knowledge

Overall app Knowledge	No app Knowledge	Total
306	09	315

Table 9: One way ANOVA analysis of Knowledge, Skills, and Attitude

Attitude	Skills	Know-ledge	Calculated value	P-value	Remark
15	35	86	5.044	0.020	Significant
223	175	75			
77	108	58			
		39			
		8			
		12			
		12			
		7			
		1			
		3			
		4			
		1			
		0			
Total		306			

be due to individual variations among student's in terms of digital literacy, interest for new knowledge, self-learning abilities, sustained interest to pursue the unknown, dedication, and time management all of which might have contributed to the variation in knowledge, skills, and attitude.

It can be seen from Table 10 that a majority (88.90%) of the students indicated that lack of regular network connectivity is the foremost problem faced by them during online classes. The findings in the study conducted by Bhati, Vatta and Tiwari are in concurrence with the present study, wherein 69.30 per cent of the students faced network issues while attending online classes (Bhati *et al.,* 2020). The plausible reason for network connectivity may be that most of the students are residing in remote areas, even though the data package has increased after lockdown, it might be insufficient for continuous streaming of video lessons. Another prominent problem faced by the students of the present study was the requirement of more storage space to retrieve course-related content (86.70%). Non-availability of suitable hardware-software combination for online classes was reported as a barrier to the success of online learning (Mseleku, 2020). Lack of humour on the part of teachers (82.50%) was another problem felt by the current study population, which could be

Table 10: Problems faced during online education by the students

Problems	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Network connectivity issues/ Regular internet connection	280	88.90	35	11.10
Need more storage space to avail the data related to course content	273	86.70	42	13.30
Lack of humor	260	82.50	55	17.50
No clear and consistent communication by the teacher	236	74.90	79	25.10
No proper ergonomically suitable space/table for oneself at home	236	74.90	79	25.10
Posture problems due to long use	230	73.00	85	27.00
Difficulty in concentration	228	72.40	87	27.60
Monotonous sessions	222	70.50	93	29.50
Bored with continuous sessions	208	66.00	107	34.00
Financial constraints to accessing online classes	200	63.50	115	36.50
Compulsory/forced participation	144	45.70	171	54.30
Lack of confidence & skills in using technology	144	45.70	171	54.30
Feedback is not taken from the students	90	28.60	225	71.40
No announcements regarding classes, quiz, assignments in social media/ WhatsApp group	71	22.50	244	77.50

attributed to the novelty of online platform for the teaching community and a greater focus on content delivery.

A significant percentage (74.90%) of the students expressed lack of clarity in the communication of teachers during online classes due to technical issues like bandwidth, sudden power cuts, all of which may lead to missing the continuity of the lesson. More than three fourth (74.90%) of the students were facing the problem of lack of ergonomic table and chair to attend online classes without which posture problems could arise (73%). Unconducive physical spaces at the homes of the students and inappropriate study ambience were some of the problems listed by several researchers (Mseleku, 2020). Nanigopal *et al.* (2020) reported the absence of a separate reading room for study at student's homes (44.4%).

Slightly more than seventy per cent of the students felt difficulty in concentration due to lack of ambience at home like a separate study room, proper seating facilities etc. Further, seventy per cent of the students experienced monotony in sessions as this might be new to both the teachers and students. The teachers might have paid utmost concentration on technicalities of conducting and attending the sessions which could have impacted the lecture delivery and style. More than fifty per cent (66%) of the students expressed boredom due to continuous sessions and financial constraints to access online classes was articulated by 63.50% of students, as it needs more data and money.

Nearly fifty per cent of the students felt the online teaching-learning process is forced upon them (45.70%) and they lack confidence & skills in using technology (45.70%) as it is sudden and new for them. A very small per cent (28.60%) of the students indicated that feedback is not taken from them and no intimation is given regarding classes, quiz, and assignments in social media/WhatsApp group (22.50%). This might be attributable to network issues and lack of alertness on behalf of the students.

CONCLUSION

The COVID-19 pandemic has made a lasting impact on the landscape of India's education system with a sudden and unprepared shift to online teaching-learning continuum. Online teaching-learning has many advantages such as being feasible, affordable, ubiquitous, confirming to the Covid–19 norms and hence can be made a part of all school/university curricula post the pandemic (Agarwal and Kaushik, 2020). Students participating in online study have given a positive perception of knowledge gain and efficacy.

It was also pointed out that participation in online classes was easy and, there was more of self reflection on learning (Matsunaga, 2016).

The findings of the study point out that Zoom and Cisco Webex were the two popular platforms through which the students were engaged in online learning during the pandemic. Almost fifty percent of the students ranked their app skills as good and 47 per cent of the students opined that their computer skills were good. There was a significant difference between the knowledge, skill, and attitude of the students as well as computer skills, app skills and overall skills (both computer and app). Even though the students faced hiccups in remote learning in the initial days, they did use the lockdown time fruitfully for their studies.

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Construction and Validation of Knowledge Test regarding Plant Toxicity in Dairy Animals: A Methodological Approach

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ABSTRACT

The toxic plants are affecting the health of dairy animals and income of dairy farmers. Many of the plants which adversely affect the animal health are found in vicinity of the farmers. Sometimes, the farmers lack information regarding those toxic plants and it comes to feed of animal whereas sometime due to accidental ingestion the animals are affected. Thus, an attempt was made to develop the knowledge test regarding plant toxicity in dairy animals. The knowledge test consists of 21 statements. Reliability of the test was measured by using Spearman Brown formula (0.851) as well as Cronbach's alpha (0.817). The overall test content validity index was 0.928. Thus reliability and validity of the test indicates its consistency and precision of the results. The developed test will held in assessing the knowledge level of farmers regarding plant toxicity and accordingly the awareness and training programmes can be planned.

Keywords: Dairy farmers, Knowledge test, Plant toxicity, Reliability, Validity

INTRODUCTION

Plant toxicity in dairy animals always a part of major concerned for veterinarians. In urban and peri-urban areas of India, it is often observed, the animal roaming freely in the streets often comes in contact with roadside poisonous plants like *Cannabis sativa, Nerium indica*, parthenium etc. Even in rural areas there is limited land for grazing mainly due to encroachment of the human population upon traditional grazing lands. Although, the grazing helps livestock to express their natural behaviour but it increases the chance of plant poisoning which can even lead to devastating effect i.e. death of animal. Another reason for plant toxicity in dairy animals is new importations are unfamiliar with the strange ingestion of their fresh surrounding. Recently, introduced stocks and travelling stocks are in danger of plant toxicity. Sometime it may happen due to accidental ingestion of toxic plant eaten along with grass. During farmers' field visit, it was observed that due to lack of awareness among dairy farmers regarding poisonous plant they are feeding those plants. Also, it has been noticed that due to high cost of feed and straw farmers are compel to feed their animals in those palatable plants which is having less adverse effect on animal health.

Based on literature, the livestock were mainly poisoned through contact and/or ingestion of leaves (51.1%) and other parts of the poisonous plants (stem, seed and fruit) which account for 34.5 per cent (Gurmesa and Abdeta, 2019). The livestock's were predisposed to these toxic plants due to agricultural expansion (29.5%), drought (22.3%), soil erosion (8.6%) and overgrazing (3.6%). Report of USDA ARS 2011 explained clearly about livestock losses can be heavy if animals: i) graze ranges infested with poisonous plants when plants are most toxic, ii) are driven, trailed through, or unloaded from trucks onto range or pasture areas infested with poisonous plants. Animals are less selective in their grazing at these times of stress, iii) are not watered regularly, iv) are allowed to become hungry. Such animals are more likely to eat lethal quantities of poisonous plants, v) are grazed on rangelands early in spring when there is no other green vegetation except poisonous plants, vi) are stressed, such as when they are trucked, penned, or handled (branding, vaccination, etc.) and vii) are not limited on how much and how

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fast they consume the plants. Therefore, pastures and ranges management is important otherwise these toxic plants can proliferate to the point that non-toxic forage is scarce, compelling livestock to eat the toxic plants (Panter *et al.*, 2011).

Plant poisoning in livestock is a serious issue which can result into death in severe case. Many reported that the livestock owners and animal health professionals informed that plant poisoning is posing significant livestock health problems. The first and foremost thing to prevent the plant poisoning in dairy animals is creating awareness and enhancing knowledge of dairy farmers regarding plant toxicity. Many people were not familiar with plants found in and around, that may be potentially harmful if ingested, injected, contact through the skin and most plants cause poisoning in animals only when they were accidentally eaten. The knowledge of these poisonous plants passed on from one generation to another through local and elderly people which plays an important role for providing general awareness and toxicological research (Huai and Xu, 2000) but the recent trend of nuclear centred family is breaking the information flow. Therefore, it is important to measure the knowledge level of farmers regarding plant toxicity in dairy animals and formulate the strategy to bridge this knowledge gap in order to prevent the dairy animals from plant toxicity. Till date no instrument is available to measure the knowledge of farmer regarding plant toxicity in livestock. Therefore, the knowledge test has been developed regarding plant toxicity in dairy animals. This developed tool will help in assessing the knowledge level of farmers regarding plant toxicity in dairy animals. Also, this test will be helpful to researcher, veterinarians, extension agent, progressive farmers etc.

MATERIALS AND METHODS

Development and validation of the Plant Toxicity Knowledge Test (PTKT) for dairy animals

The entire process of developing and validating the test is described under three phases viz.

Phase I–Item writing following Edward 14 informal criteria and relevancy testing,

Phase II–Item analysis through difficulty index and discrimination index

Phase III–Standardisation of the test

Phase I–Item writing following Edwards' 14 informal criteria and relevancy testing

Construct definition and operationalization: For the present study, the construct was knowledge about plant toxicity in dairy animals for farmers in order to prevent the animal from plant toxicity. A thorough review of literature was carried out to identify the items responsible for plant poisoning in dairy animals. Articles related to possibility of grazing animals' plant toxicity, fodder management, different poisonous plants responsible for poisoning in bovines, symptoms of affected cattle by plant toxicity, awareness and knowledge level of farmers, economic losses occurring to farmers and what precaution farmers are undertaking to prevent plant toxicity were reviewed deeply. Apart from research papers, discussion was carried out with the scientists and experts of pharmacology and toxicology, medicine and animal nutrition on the essential, desirable and value added knowledge domain for the plant toxicity. The total 30 items were compiled and edited following 14 informal criteria as suggested by Edwards (1957).

Relevancy test of items: Finally the 25 statements on a five point continuum viz., Most relevant, Somewhat relevant, Relevant, Least relevant and Not relevant with the score of 5,4,3, 2 and 1, respectively and reverse for the negative statements were mainly sent by Google form survey and some were handed over personally to the total of 45 judges. The experts were from ICAR-IVRI, Extension Education Division, and few in-service Ph.D. scholars. The judges were requested to make necessary modifications and addition or deletion of items if required. A total of 25 responses were obtained in time out of 45. The Relevancy Weightage (RW) and Mean Relevancy Score (MRS) were worked out for all the selected indicators individually by using the following formula:

$$\text{Relevancy weightage} = \frac{(\text{Most relevant} \times 5) + (\text{Somewhat relevant} \times 4) + (\text{Relevant} \times 3) + (\text{Least relevant} \times 2) + (\text{Not relevant} \times 1)}{\text{Maximum possible score}}$$

$$\text{Mean relevancy score} = \frac{(\text{Most relevant} \times 5) + (\text{Somewhat relevant} \times 4) + (\text{Relevant} \times 3) + (\text{Least relevant} \times 2) + (\text{Not relevant} \times 1)}{\text{Number of judges}}$$

Finally the statements having relevancy weightage of more than 0.80 and mean relevancy score of 4.00 or more were selected for item analysis. As a result, a total of 24 statements selected for the item analysis. The similar method was used for relevancy testing by Singh *et al.* (2018).

RESULTS AND DISCUSSION

Phase II–Item analysis through difficulty index and discrimination index

Item analysis was carried out in order to evaluate the item characteristics of each item of the Plant Toxicity Knowledge Test in dairy animals. For item analysis, researcher interacted with 48 dairy farmers from *Khata* village and adjoining region. The responses were tabulated and then the item difficulty index and item discrimination value were calculated.

Difficulty index: The difficulty index was calculated with the objective to drop the items that are extremely easy or extremely difficult. The item difficulty index was calculated as a percentage of the total number of correct responses to the test items. It is calculated using the formula $p = R/T$,

where p - item difficulty index,

R - number of correct responses, and

T - total number of responses (which includes both correct and incorrect responses).

The value of p (proportion) ranges from 0 to 1 (Hotiu, 2006). When multiplied by 100, p-value converts to a percentage, which is the percentage of dairy farmers who got the item correct. Those items with a p-value between 20 and 90 per cent are considered as good and acceptable. Among these, items with p-value between 40 and 60 per cent are considered excellent, because DI is maximum at this range. The higher the p-value, the easier the items. Whereas, items with p-value (difficulty index) less than 20 per cent (too difficult) and more than 90 per cent (too easy) are not acceptable and need modification.

In the present study from Table 1 it can be inferred that 21 items were falling in good (20-90%) category out of which 4 items belongs to excellent (40-80%) category. However, 2 items were very difficult (<20%) and 1 item was too easy (>90%) to answer. Therefore, 3 items were eliminated and 21 items were retained based on difficulty index. Among the selected items (24) after relevancy test, the item no. 11 i.e. "Do you have an idea that cotton seed cake contains gossypol should not be fed to dairy animal continuously (>2 months) but with the gap of 3-4 weeks can be provided?" was eliminated due to difficulty (0.187) in answering. As the farmers from *Khata* village were having poor knowledge regarding cotton seed cake. The item no. 20 i.e. "Do you know that Bracken fern is poisonous to cattle and can result in red coloured urine?" was eliminated due to difficulty (.041) in answering. The reason behind this the farmers were unaware about Bracken fern toxicity in dairy animals. Another item no. 5 i.e. "It is advised not to use pesticide spray on fodder crops" was eliminated due to too easy difficulty index (0.958) as almost every farmers' were aware to avoid spray in fodder crop. Thus, 87.5 per cent of items were falling in good category whereas 8.3 per cent were too difficult to answer and 4.2 per cent were too easy to answer.

Table 1: Frequency and mean of difficulty index

Difficulty Index	Category	No. of items	Mean
20 to 90%	Good	21	87.5
40 to 60%	Excellent	4	16.7
<20%	Too difficult	2	8.3
>90%	Too easy	1	4.2

Discrimination index: It was calculated in order to measure the ability of each item to discriminate between those who scored high on the total test score and those who scored low. The higher the DI the better the test item discriminates between the dairy farmers with higher test scores and those with lower test scores.

The DI was calculated using the formula $DI = (UG–LG)/n$

Where, UG is the number of dairy farmers in the upper group who got an item correct and

LG is the number of dairy farmers in the lower group who got an item correct and

N is the total number of dairy farmers in the largest of the two groups.

The categories of discriminating indices (Ebel's, 1979)

(1) If DI $\geq$0.40, then the item is functioning satisfactorily.

(2) If $0.30 \leq DI \leq 0.39$, then little or no revision is required.

(3) If $0.20 \leq DI \leq 0.29$, then the item is marginal and needs revision.

(4) If $DI \leq 0.19$, then the item should be eliminated or completely revised.

In the present study from Table 2, 20 items were falling in good (>.40) whereas 2 statements were falling in little revision category (.30<= to <=.39). The item no 6 was retained with little revision, as farmers were in doubt after which specific period of spray they can feed the crop to dairy animals. The another item no. 21 was retained with little revision as farmers were unaware regarding symptoms which can emerge due to contact with parthenium but they knew it is a toxic plant. However, 2 items i.e. item no. 5 and 20 were eliminated (<=.19) due to low discrimination index.

Table 2: Mean and frequency of discrimination indices

Discrimination Index	Category	Number of items	Mean
>.40	Good	20	83.33
.30<= to <=.39	Little revision	2	8.33
.20≤ to ≤.29	Marginal	0	0
<=.19	Eliminate	2	8.33

From Table 3, it can be inferred that the item number 5, 11 and 20 were eliminated whereas item 22 was eliminated during relevancy test. Thus, the final

Table 3: Developed Knowledge test regarding plant toxicity in dairy animals

S.No	Items	Difficulty Index	Discrimi-nation Index	Remarks
1	Are you aware that the travelling stock and recently introduced stock are more likely to get poisoned as they are unaccustomed to local plants?	68.7	0.75	Retained
2	Are you aware that young plants have higher concentrations of nitrate than mature plants?	27.0	0.75	Retained
3	Do you know that providing cold water for drinking as a home remedy can reduce the toxic effects in nitrate poisoning in livestock?	35.4	0.75	Retained
4	Do you know that drying or making of silage reduces the cyanogenic glycoside content in plant material?	68.7	0.75	Retained
5	It is advised not to use pesticide spray on fodder crops.	95.8	0.125	Eliminated
6	Do you agree that after pesticide spray, the crop should be fed after 1 week?	89.5	0.312	Retained
7	Application of fertilizers containing nitrates can lead to the accumulation of nitrates in plants and can lead to toxicity.	77.08	0.6875	Retained
8	Are you aware that the animals should not be allowed for grazing in a field applied with weedicides recently as it can cause toxicity?	81.2	0.5625	Retained
9	Are you aware that a sudden change in the fodder or consumption of an abnormally excessive amount of feed can result in ruminal tympany?	72.9	0.75	Retained
10	Do you know that the young shoots of Sorghum upto less than 60 cm tall should not be fed to dairy animals as it contains more amount of Cyanogenic Glycosides?	77.0	0.6875	Retained
11	Do you have an idea that cotton seed cake contains gossypol should not be fed to dairy animal continuously (> 2 months) but with the gap of 3-4 weeks can be provided?	18.7	0.5625	Eliminated
12	Accidental consumption of Parthenium can lead to toxicity in animals.	60.4	1	Retained
13	Accidental eating of Datura sp. by dairy animals is highly poisonous.	60.4	1	Retained
14	Do you have the idea that if seeds of Argemone adulterated in mustard oil; it becomes poisonous for livestock as well as human beings?	83.3	0.5	Retained
15	By chance Calotropis (Madaar) is coming in the feed of dairy animals is toxic.	50.0	0.75	Retained

Table 3 contd...

S.No	Items	Difficulty Index	Discrimi-nation Index	Remarks
16	Seeds and leaves of Ricinus Communis (Castor) is also poisonous to dairy animals	79.1	0.56	Retained
17	Do you know, Ipomea sp. is very much poisonous to dairy animals?	77.0	0.68	Retained
18	Are you aware that consumption of oxalis plants can cause oxalate poisoning in dairy animals?	45.8	0.75	Retained
19	Are you aware that Nerium (Kaner) and Thevetia (Peela Kaner) are highly toxic to the dairy animals and can cause death?	85.4	0.43	Retained
20	Do you know that Bracken fern is poisonous to cattle and can result in red coloured urine?	4.1	0.12	Eliminated
21	Do you know that parthenium can cause contact dermatitis in people handling the plant?	87.5	0.37	Retained
22	Are you aware that Strychnos nuxvomica seeds are highly toxic and are used for malicious poisoning?	Item removed during relevancy test		
23	Do you know that Lantana Camara is poisonous to dairy animals, and can lead to photosensitization	50.0	0.75	Retained
24	Do you know that frost and hail damage can cause accumulation of nitrate in stem and stalk which can cause toxicity to animals?	35.4	0.75	Retained
25	Do you know that plant poisoning can result in significant economic loss to the farmer?	52.0	0.75	Retained

knowledge test consists of 21 items for assessing the knowledge level of dairy farmers with respect to plant toxicity in dairy animals.

Phase III—Standardisation of the test

The present test is standardised through reliability and validity testing which was ascertained using split half method as well as cronbach's alpha and content validity, respectively.

i. Reliability of test: Reliability of the testing instrument is the ability to give consistent, stable and accurate measurement score in repetitive testing with same instrument. It helps in assessing the homogeneity of items in test. For testing the reliability, the items were administered to *Kheda* village of Bareilly were interacted with 40 dairy farmers.

The split half method was used to check the reliability of the present test for which after item analysis the test was divided into two halves based on even and odd number of statements. The Pearson product moment correlation between odd and even scores was 0.742. This coefficient indicates split half reliability of test. To adjust the split half reliability in to full test reliability, Spearman- Brown (1910) prophecy formula was used which is as follows:

$$R=\frac{2r}{1+r} = \frac{2\times0.742}{(1+0.742)} = 0.851$$

Where, R= Reliability coefficient of the whole test

r = Pearson correlation between two halves

The whole test reliability was found to be 0.851 and significant at 1 per cent level of significance. Since the reliability coefficient of whole test was more than 0.7, the present test was considered to be highly reliable. Although, split half method is widely held method for reliability testing because of benefit of single administration of the test and use of one sample. However, the major limitation of this method is there could be several ways of splitting a test and each method of split-half gives a different value of reliability. Rudner *et al.* (2002) observed that split-half reliability is a function of how the test was split. A solution to the problem was provided by Cronbach's alpha which is interpreted by many researchers as the average of all possible split-half correlations (Cortina, 1993). Cronbach's alpha also assumes that average covariance among non- parallel items is equal to the average covariance among all parallel items. Thus, in present study standardised Cronbach's alpha also used to get more stability and accuracy with the following formula:

$$\alpha_{standardized} = \frac{K\bar{r}}{(1+(K-1)\bar{r}}$$

Where K is number of items in test

$\bar{r}$ is mean of the K(K-1)/2 non-redundant correlation coefficients

The value of Cronbach's alpha calculated and found to be 0.817 which means test was good consistent in measurement. A commonly accepted rule for describing internal consistency using Cronbach's alpha as shown in Table 4.

Table 4: Depicting the internal consistency using Cronbach's alpha (DeVellis, 2012)

Cronbach's alpha	Internal Consistency
$0.9 \leq \alpha$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6d \leq \alpha < 0.7$	Questionable
$0.5d \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

ii. Validity of test: Validity means ability of an instrument to measure what one intended to measure. The developed test was checked for content validity. According to Kerlinger (1987) content validity of test is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. There are several methods to quantify the degree of experts' agreement towards content relevancy of a test. The paper considered the most acceptable method as suggested by Lynns' in 1986. For quantifying the content validity, the 21 selected statements ('t' value >1.75) were given to 6 experts. The 6 experts were selected as with increase in number of experts the likelihood of achieving total agreement decreases. The 4-point scale was used to avoid a neutral and ambivalent midpoint as per Davis (1992) 1= not relevant, 2 = somewhat relevant, 3= quite relevant and 4= highly relevant. Then for each selected statements

Table 5: A list of statements towards plant toxicity in dairy animals with their respective "I-CVI"

S.No.	Statements	Agreement	I-CVI*
1	Are you aware that the travelling stock and recently introduced stock are more likely to get poisoned as they are unaccustomed to local plants?	6	1
2	Are you aware that young plants have higher concentrations of nitrate than mature plants?	5	0.833
3	Do you know that providing cold water for drinking as a home remedy can reduce the toxic effects in nitrate poisoning in livestock?	6	1
4	Do you know that drying or making of silage reduces the cyanogenic glycoside content in plant material?	6	1
5	Do you agree that after pesticide spray, the crop should be fed after 1 week?	6	1
6	Application of fertilizers containing nitrates can lead to the accumulation of nitrates in plants and can lead to toxicity.	5	0.833
7	Are you aware that the animals should not be allowed for grazing in a field applied with weedicides recently as it can cause toxicity?	6	1
8	Are you aware that a sudden change in the fodder or consumption of an abnormally excessive amount of feed can result in ruminal tympany?	6	1
9	Do you know that the young shoots of Sorghum upto less than 60 cm tall should not be fed to dairy animals as it contains more amount of Cyanogenic Glycosides?	5	0.833
10	Accidental consumption of Parthenium can lead to toxicity in animals.	6	1
11	Accidental eating of Datura sp. by dairy animals is highly poisonous.	6	1
12	Do you have the idea that if seeds of Argemone adulterated in mustard oil; it becomes poisonous for livestock as well as human beings?	5	0.833
13	By chance Calotropis (Madaar) is coming in the feed of dairy animals is toxic.	5	0.833

Table 5 contd...

S.No.	Statements	Agreement	I-CVI*
14	Seeds and leaves of Ricinus Communis (Castor) is also poisonous to dairy animals	6	1
15	Do you know, Ipomea sp. is very much poisonous to dairy animals?	5	0.833
16	Are you aware that consumption of oxalis plants can cause oxalate poisoning in dairy animals?	5	0.833
17	Are you aware that Nerium (Kaner) and Thevetia (Peela Kaner) are highly toxic to the dairy animals and can cause death?	6	1
18	Do you know that parthenium can cause contact dermatitis in people handling the plant?	6	1
19	Do you know that Lantana Camara is poisonous to dairy animals, and can lead to photosensitization	6	1
20	Do you know that frost and hail damage can cause accumulation of nitrate in stem and stalk which can cause toxicity to animals?	5	0.833
21	Do you know that plant poisoning can result in significant economic loss to the farmer?	5	0.833
	S-CVI/avg		0.928

*I-CVI means content validity index for each item

Content Validity Index i.e. I-CVI calculated to check its relevance to the underlying construct (Table 5). Then for computation of Content Validity Index for overall test S-CVI worked out. The S-CVI/Ave which means the average of the I-CVIs for all the items of the test calculated to be 0.928. Thus, 92.80 per cent of items were judged content validity as per the Lynn's criteria for excellent content validity: I-CVI= 1.0 with 3 to 5 experts and a minimum I-CVI of 0.78 for 6 to 10 experts as well as SCVI/Ave $\geq$0.90. The similar methodology was used by Shruti *et al.* (2019) for calculating the content validity index.

iii. Administration of the test: The final knowledge test consisted of 21 statements which would measure the knowledge level of dairy farmers regarding plant toxicity in dairy animals. The test can be administered in dichotomous form viz., Yes or No. The overall score of the individual respondent towards knowledge level of dairy farmers regarding plant toxicity in dairy animals could range from 0-21.

CONCLUSION

During data collection and field visit under the project, it was strongly observed that dairy farmers lacks information regarding plant toxicity in dairy animals. It was also observed, the villages having higher knowledge level in this aspect were having low incidences of plant poisoning. The knowledge of locally available poisonous plants which can affect their animals' health and milk production adversely is lacking. Therefore, attempt has been made to develop the knowledge test with respect to plant poisoning in dairy animals. This developed knowledge test will help in assessing the knowledge level of dairy farmers as well as planning for awareness and training program accordingly. The provision of awareness and training program to farmers with respect to plant poisoning will enhance their knowledge level. This increased knowledge level can prevent the animals from plant toxicity which will benefit the animal health and farmers' income ultimately.

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Extent of Knowledge of College Students towards E-learning Platforms during COVID-19 Pandemic

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ABSTRACT

Many countries ordered closure of all educational institutes due to COVID-19. A sample of 300 students was selected from all the 6 constituent colleges of Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan. Students from 2nd and 3rd year were selected from which 50 students was selected randomly from each college to study the extent of knowledge of students regarding e-learning platforms during COVID-19. Data collection was done through "Google Forms" which was sent on Whatsapp and e-mail. This study reveals that the respondents had good knowledge about the Zoom (MPS 74.9) and average knowledge about Cisco Webex (52.9) in comparison to other three e-learning platforms which include Microsoft Teams, Google Meet and Google Classroom in which respondents possessed poor knowledge with MPS of 22.23, 26.76 and 11.6 respectively. The study concludes that among all the 5 e-learning platforms the students had good knowledge about Zoom platform as just after the lockdown this platform was being used by majority of the faculty for online teaching.

Keywords: Covid-19 pandemic, E-learning, Online teaching, Platforms, Student's knowledge

INTRODUCTION

COVID-19 a novel corona virus disease which spread across the globe had a great impact on education in which social distancing was the only option due to which many countries have ordered closure of all educational institutes. Educational institutions came to a functional standstill since they had to protect their students from viral exposures, which are likely in a highly socializing student community. In the beginning of February 2020, schools only in China and a few other affected countries were closed due to the proliferating contamination. However, by Mid-March, nearly 75 countries had implemented or announced closure of educational institutions. According to UNESCO, by the end of April 2020, 186 countries have implemented nationwide closures, affecting about 73.8 per cent of the total enrolled learners. Even though the lockdown and social distancing were the only ways to slow down the spread of the COVID-19 by breaking the chain of transmission, closure of educational institutions has affected large number of students. During the lockdown, teachers were instructed to teach through e-learning platforms. Raju (2020) argued that there was a need to adopt innovative teaching for continuing education and to overcome mental stress and anxieties during the lockdown. A significant positive impact of COVID-19 also reported learning efficiency and performances by adopting online learning strategies (Gonzalez *et al.,* 2020).

In a nutshell, COVID-19 has been a trigger for educational institutions worldwide to pursue creative approaches in a relatively short notice. During this time, most of the universities had shifted to online mode using Zoom, Cisco Webex, Microsoft Teams, Google Meet and Google Classroom.

MATERIALS AND METHODS

Locale of the study: The present study was conducted in Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan. All

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the constituent colleges of MPUAT were selected which included: College of Community and Applied Sciences, College of Community and Applied Sciences, College of Technology and Engineering, College of Dairy and Food Technology, College of Fisheries, Rajasthan College of Agriculture, College of Agriculture, Bhilwara

Selection of sample: The sample was selected from all the six constituent colleges of MPUAT, Udaipur. A list of enrolled students of second year and third year of Undergraduate degree program was procured from each constituent college. From the list, a sample of 50 students was selected randomly from each college. Thus the total sample of study comprised of 300 students.

Selection and development of research tool: A questionnaire was prepared using 'Google Forms' to collect data from the respondents. Questionnaire included both, closed-ended as well as open-ended questions.

Procedure of data collection: An online survey was conducted to collect the information from the students. A link was generated for the developed questionnaire and was sent to the students through Whatsapp and e-mail. The responses were received on email/whatsapp of the researcher.

Analysis of data: Frequency, percentage and mean per cent score were used for analysing the data statistically.

RESULTS AND DISCUSSION

The prime objective of the investigation was to study the extent of knowledge of college students towards e-learning platforms during Covid-19 pandemic. Keeping in view the specific objective of the investigation, the data was collected and analysed. The results are presented as under:

Zoom: Table 1 clearly indicates that all the respondents (100%) knew that only 100 participants are allowed in the free version, 65 per cent of the respondents had knowledge that host have right to deny entry and remove the users during a session. More than half of the respondents knew that screen sharing is possible, recording support is available for host i.e. 65 and 66 per cent respectively. More than half of the respondents (57.66%) knew that participants can mute or unmute their microphone on permission by host, 62.33 per cent respondents were aware about participants can start and stop their video, 64 per cent of the respondents knew that they had access to features like chat, raise hand, dial-in and one can leave the meeting in between (62%). Half of the respondents (50%) knew that they can add private comments to the host or other participants, 61.66% were aware about there is a time limit for single session and majority of the respondents (93.33) knew that Zoom platform can be accessed on Desktop, PC, Android and Apple devices.

Cisco Webex: It can be seen from the Table 2 that from 11 features more than half of the respondents had knowledge about 7 features of Webex i.e. (51%) screen sharing is possible, (50.33%) recording support is available for host, (54%) participants can mute or unmute their microphone on permission by host and

Table 1: Knowledge of respondents regarding Zoom platform (n=300)

Particular	Frequency	Percentage
Only 100 participants are allowed in the free version	300	100.00
Host have right to deny entry and remove the users during a session	195	65.00
Screen sharing is possible	198	66.00
Recording support is available for host	152	50.66
Participants can mute or unmute their microphone on permission by host	173	57.66
Participants can start and stop their video	187	62.33
Access to features like chat, raise hand, dial-in is available	192	64.00
One can leave the meeting in between	186	62.00
Participants can add private comments to the host or other participants	150	50.00
There is a time limit for a single session in free version i.e. 40 min.	185	61.66
It can be accessed on Desktop, PC, Android and Apple devices	280	93.33

Table 2: Knowledge of respondents regarding Cisco Webex platform (n=300)

Particular	Frequency	Percentage
Host have right to deny entry and remove the users during a session	150	50.00
Screen sharing is possible	153	51.00
Recording support is available for host	151	50.33
Participants can mute or unmute their microphone on permission by host	162	54.00
Participants can start and stop their video	169	56.33
Access to features like chat, raise hand, dial-in is available	158	52.66
One can leave the meeting in between	168	56.00
Participants can add private comments to the host or other participants	122	40.66
There is a time limit for a single session in free version	82	27.33
Allow attendees to enable breakout sessions	116	38.66
It can be accessed on Desktop, PC, Android and Apple devices	159	53.00

56.33 per cent knew that participants can start and stop their video. Data in Table 2 also reveals that half of the respondents (50%) knew that host have right to deny entry and remove the users during a session, 52.66 per cent of the respondents were aware about access to features like chat, raise hand, dial-in is available and 56 per cent knew about one can leave the meeting in between. Less than half of the respondents (40.66%) knew about participants can add private comments to the host or other participants, only one-fourth of the respondents (27.33%) knew that there is a time limit for a single session in free version, 38.66 per cent were aware about Cisco Webex allow attendees to enable breakout sessions and more than half of the respondents (53%) knew about it can be accessed on Desktop, PC, Android and Apple devices.

Microsoft teams: Data in Table 3 reveals that majority of the respondents (83.33%) knew that participants can mute or unmute their microphone on permission by host and two-third (66.66%) of the respondents knew about sharing of screen is also possible. Only 20 per cent respondents had knowledge about host have right to deny entry and remove the users during a session. Less than one-fourth of the respondents (21%) knew about participants can start and stop their video, (21.66%) had access to features like chat, raise hand and dial in, (21.33%) one can leave the meeting in

Table 3: Knowledge of respondents regarding Microsoft Teams platform (n=300)

Particular	Frequency	Percentage
Host have right to deny entry and remove the users during a session	60	20.00
Screen sharing is possible	200	66.66
Recording support is available for host	63	21.00
Participants can mute or unmute their microphone on permission by host	250	83.33
Participants can start and stop their video	63	21.00
Access to features like chat, raise hand, dial-in is available	65	21.66
One can leave the meeting in between	54	21.33
Participants can add private comments to the host or other participants	57	19.00
Upload assignment such as video, pdf file, Google docs or Google Forms survey	67	22.33
Participants can check their grades after evaluation done by the host	57	19.00
There is time limit for a single session	44	14.66
Allow attendees to enable breakout sessions	52	17.33
It can be accessed on Desktop, PC, Android and Apple devices	86	28.66

between, participants can add private comments to the host or other participants. About 22.33 per cent of the respondents knew that participants can upload assignment such as video, pdf file, Google docs or Google Forms survey and less than 20 per cent of the respondents had knowledge about that participants can check their grades after evaluation done by the host, time limit for single session (14.66%), allow attendees to enable breakout sessions (17.33%) and more than one-fourth of the respondents knew that it can be accessed on Desktop, PC, Android and Apple devices.

Google meet: Perusal of Table 4 depicts that less than one-fourth of the respondents (23.66%) knew that in Google Meet they had access to features like chat, raise hand and dial-in, they can add private comments to the host or other participants (16.33%). Two-third of the respondents (66.33%) knew that it can be accessed on Desktop, PC, Android and Apple devices. About one-third of the respondents (30%) knew about the sharing screen is also possible. Nearly one-fourth of respondents (26.66%) knew about host have right to deny entry and remove the users during a session. One-fourth of the respondents (25%) knew about participants can mute or unmute their microphone on permission by host and only 17.33 per cent knew about the time limit.

***Google cclassroom*:** It is evident from the Table 5 that more than half of the respondents (55.33%) knew that participants can add private comments to the host or other participants, they can check their grades after evaluation done by the host (66.66%) and participants can unenrolled themselves in the class. Half of the respondents had knowledge about that they can upload assignment such as video, pdf file, Google documents or Google form survey. More than three-fourth of the respondents knew that Google Classroom can be accessed on Desktop, PC, Android and Apple devices.

Overall knowledge of the respondents regarding selected e-learning platforms

- The respondents possessed good knowledge regarding Zoom platform as their MPS was found to be 74.9. Categorisation of the respondents into various knowledge categories highlight that good knowledge regarding Zoom was possessed by nearly two-third of the respondents (65.66%),

Table 4: Knowledge of respondents regarding Google Meet platform (n=300)

Particular	Frequency	Percentage
Host have right to deny entry and remove the users during a session	80	26.66
Screen sharing is possible	90	30.00
Recording support is available for host	58	19.33
Participants can mute or unmute their microphone on permission by host	75	25.00
Participants can start and stop their video	90	30.00
Access to features like chat, raise hand, dial-in is available	71	23.66
One can leave the meeting in between	81	30.33
Participants can add private comments to the host or other participants	49	16.33
There is time limit for a single session	39	13.00
It can be accessed on Desktop, PC, Android and Apple devices	199	66.33

Table 5: Knowledge of respondents regarding Google Classroom platform (n=300)

Particular	Frequency	Percentage
Participants can upload assignment such as video, pdf file, Google docs or Google Forms survey	150	50.00
Participants can add private comments to the host or other participants	166	55.33
Participants can check their grades after evaluation done by the host	200	66.66
It can be accessed on Desktop, PC, Android and Apple devices	258	86.00
Participants can unenroll themselves in the class	200	66.66

Table 6: Extent of knowledge of the respondents regarding selected e-learning platforms

E-learning Platforms	Good		Average		Poor		MPS
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Zoom	197	65.66	46	15.33	57	19	74.90
Cisco Webex	135	45	59	19.66	106	35.33	52.90
Microsoft Teams	35	11.66	47	15.66	218	72.66	22.23
Google Meet	71	23.66	23	7.66	206	68.66	26.76
Google Classroom	19	6.33	38	12.66	243	81	11.60
Overall	71	23.66	89	29.66	140	46.66	40.51

15.33 per cent falls under the category of average knowledge and 19 per cent of the respondents possessed poor knowledge. The findings get support by Rahuya (2020) who conducted study on Students' E-learning Experience through a Synchronous Zoom Web Conference System (Table 6).

- In Cisco Webex 45 per cent of the respondents comes under category of good knowledge, 19.66 per cent of the respondents possessed average knowledge and poor knowledge was possessed by 35.33 per cent of the respondents with MPS of 52.9 which clearly indicated that respondents possessed average knowledge regarding Cisco Webex.
- Regarding Microsoft Teams, majority of the respondents (72.66%) had poor knowledge about the e-learning platform, 15.66 per cent of the respondents possessed average knowledge of Microsoft Teams while only 11.66 per cent of the respondents possessed good knowledge. According to MPS (22.23) overall Microsoft Teams falls under poor category of knowledge.
- Majority of the respondents (70.33%) possessed poor knowledge with regard to Google Meet with MPS of 23.63, 16.33 per cent of the respondents falls under the category of average knowledge and only 13.33 per cent respondents possessed good knowledge regarding Google Meet.
- The respondents possessed poor knowledge about the Google Classroom with overall MPS of 11.6. Findings of the study clearly revealed that majority of the respondents (81%) falls under poor knowledge category followed by 12.66 per cent of the respondents who come under average knowledge category and only 6.33 per cent of the respondents possessed good knowledge about the Google Classroom. The results of the study are in line with findings of Gupta and Pathania (2020).

CONCLUSION

It can be concluded from the above findings that majority of the respondents had good knowledge about Zoom platform with MPS of 74.9 and average knowledge regarding Cisco Webex with MPS of 52.9 as both types of platforms were used more for classes, exams and webinars in comparison to other e-learning platforms by the faculty for online teaching. Respondents had poor knowledge about Microsoft Teams (22.23), Google Meet (26.76) and Google Classroom (11.6) as respondents were not aware of these platforms more during the starting phase of lockdown and had limited exposure to these platforms. The findings are in line with the study conducted by Thakker *et al.* (2020) on Systematic research of e-learning platforms for solving challenges faced by Indian engineering students.

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Economics of Paddy Cultivation by Different Sowing Methods in Samba District of J&K

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ABSTRACT

Water-wise crop production is gaining enormous attention due to looming water crises in the world. System of rice intensification (SRI) and Direct and seeded rice (DSR) is a promising method for water-saving rice cultivation; however, SRI method is more labor-intensive than the traditional method of rice production. Direct seeding (DSR), SRI and Broadcasting may be evaluated for potential benefits over TPR method. Transplanting after repeated puddling is the conventional method of rice growing which is not only intensive water user but also cumbersome and laborious. Different problems like lowering water table, scarcity of labour during peak periods, deteriorating soil health demands some alternative establishment method to sustain productivity of rice as well as natural resources. Direct seeding is becoming an important alternative of rice transplanting. During 2019, 2020 and 2021 efforts has been made for resource conservation in paddy by introducing DSR, SRI and Broadcasting method at the farmers' fields of Samba district in Jammu & Kashmir. Tillage and crop establishment methods had a significant effect on rice yields. Total cost per hectare occurred in cultivation of paddy in SRI is Rs. 36881, in transplanting Rs. 32327, DSR it is Rs. 23899 and broadcasting Rs. 25375. The gross return per hectare of SRI was Rs. 133710, transplanting Rs. 97823, DSR Rs. 96255 and broadcasting Rs. 90910. The B:C ratio in SRI was (2.62), DSR (2.71), Broadcasting (2.58) and TPR (2.02). Major constraints in paddy cultivation were the lack of awareness regarding technologies and high input cost.

Key words: Benefit cost ratio, Broadcasting, Direct seeded rice, SRI, TPR, Water use efficiency, Yield

INTRODUCTION

Water for use in agriculture is becoming scare and the problem of water shortage expected to be more serious in the future. Declining water table in Indo-Gangetic Plains has been required due to over exploitation of ground water (Government of India, 2008). Furthermore, due to drastic depletion of ground water table in rice-wheat areas, electricity demand is increasing for irrigating the rice crop and it undermines the viability of the power sector as power for agriculture use is highly subsidized particularly in Punjab and Haryana (Government of India, 2007). In Transplanting Rice, water is required for raising rice seedlings in nurseries, puddling, transplanting operations and continued water submergence. Hence, DSR reduces overall water requirement for rice cultivation. The use of DSR method is not only reduces the water consumption, but the farmers can grow their rice in regions having water scarcity. With less water availability, rice cultivation may be switched towards the water saving production systems. Traditionally rice is cultivated in standing water and thus requires huge amount of irrigation water and more labour as well.

Several reports indicate substantial yield increase SRI system of rice production with significant decrease in water input (Uphoff, 2002, 2007). However, SRI requires more labor during transplanting in muddy fields (Moser and Barrett, 2003). High weed infestation in SRI, causing yield losses 30 100 per cent is another challenge (Dobermann and Fairhurst, 2000). Direct

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seeding in SRI also seems a better option to harvest the benefits of traditional transplanting systems. Direct seeding of rice is an attractive alternative of the traditional transplanting system, which saves water and labor requirement (Pandey and Velasco, 2002; Farooq *et al.*, 2011). However, stand establishment may be an issue in direct seeded rice in SRI. Direct seeding is a successful method of cultivation in many countries which save labour and is more economical than transplanting and also provides good crop establishment. Although transplanting has been a major traditional method of rice establishment in India. An economic factors and recent changes in rice production technology have improved the desirability of direct-seeding methods. Similarly direct seeding is becoming an attractive to transplanting of rice and spreading rapidly in Samba district, Jammu due to labour shortage and escalating cost of production. Hence, present study was undertaken with the objectives to compare the economics of SRI, DSR, Broadcasting and TPR methods of rice production and to examine the farmers' perception about the DSR and SRI method of rice production in Samba district, Jammu.

MATERIALS AND METOODS

The experiment was conducted at farmers' field in villages Ramgarh, Chachwal, Challyari, Paloora, Kotli Matkalian, Khor Salarian, Rakh Barothian and Harsath in Samba district of Jammu during Kharif season of 2019, 2020 and 2021. Conventional rice-wheat rotation was being followed on the field from several years. The data were collected on the basis of objectives of the study. The schedules were developed to provide necessary information regarding hired human labour, machine use, seeds, fertilizers, irrigation and plant production measures. All input and output parameters pertaining to rice production are based on three years average values with a view to minimize seasonal fluctuations in the variables data where analyzed using percentage, benefit-cost ratio and partial budget analysis techniques.

In conventional transplanting method, 30 days old nursery seedlings were transplanted manually using two seedlings per hill at 22.5 cm × 22.5 cm spacing, while in direct seeding, primed and treated seeds were directly sown in 30 cm × 30 cm spaced in muddy seedbed following SRI principles.

The modern cost concept was consider for estimation of cost of rice production. The cost included all direct expenses paid in cash and kind for crop production such as hired human labour, machine use, seeds, fertilizers, irrigation, plant production measures and imputed value of family labour. The cost of irrigation was calculated by multiplying time required to irrigate the farm with cost of electricity or diesel consumption per hour. The cost of human labour, machine use and diesel where taken as actual expenditure incurred for crop production. Gross income included the total value of main and by- products. Benefit-cost analysis was conducted to estimate the economic feasibility of experimental treatments. Net income was calculated by subtracting total expenditure from the gross income while benefit-cost ratio (BCR) was computed by dividing the net income with total expenditure.

RESULTS AND DISCUSSION

The results show that in DSR, the major hurdle was the paucity of knowledge for weed management. Most of the rice herbicides available have been developed for transplanted rice and these are not as effective in dry seeded rice. It has been observed that application of pre emergence herbicides and keeping fields submerged early in the season helps in controlling chlorosis and weeds. It has also been observed that puddling doesn't have much influence on rice yields. In general, a total of 1382 mm to 1838 mm water is required for the rice-wheat system accounting more than 80 per cent for the rice growing season (Gupta *et al.,* 2003). Direct seeded rice avoids repeated puddling, preventing soil degradation and plough-pan formation. It facilitates timely establishment of rice and succeeding crops as crop matures 10-15 days earlier. It saves energy, labor, fuel and seed besides solving laborer scarcity problem and reduces drudgery of labours.

Most of farmers opinioned that more weed infestation in DSR field. Several studies conducted in this aspect revealed that lower yield was obtained in DSR as compared to the TPR due to high weed manifestation (Singh *et al.,* 2010). Therefore, the major challenge for farmers in direct seeded rice is effective weed management and as the failure to eliminate weeds may result in very low yield (Moody and Mukhopadhyay, 1982; Moody, 1983). Many studies have indicated that direct seeded rice has potential as a replacement of transplanted rice, if weeds are controlled effectively (Singh *et al.,* 2001; Sngh, 2005).

The shortage of labour is emerging as a major problem in Samba district, Jammu which is hindering agriculture growth. In the study area, farmers used tractor for puddling operations before transplanting rice seedling in the field. The farmers who did not have their own tractors were facing the problem of none availability of tractor in time to carry out puddling operations for rice transplanting as it coincides with similar operations in the neighboring farms. Similarly, beneficiaries faced the problem of labour shortage for rice transplanting. Their main motive for a shift to DSR was to overcome the shortage of manpower and tractor during the peak period of transplanting. The DSR method generated significant savings of labour required for land preparation and crop establishment in rice cultivation.

Cost and return of paddy cultivation under different sowing techniques: The total cost of cultivation of paddy under different sowing techniques was shown in the Table 1, total cost occurred in cultivation of paddy in SRI is Rs. 36881, in transplanting Rs. 32327, DSR sowing it is Rs. 23899 and broadcasting Rs. 25375 (Table 1). The similar findings were reported by Makaida *et al.* (2014); Shelke *et al.* (2017).

The yield quintal per hectare was found to be more in SRI i.e. 69.00 quintal as compare to transplanting (50.55 quintal), DSR sowing (49.70 quintal) and broadcasting (46.92 quintal). SRI was found to be highest yield techniques because the planting design of SRI is such that every plant gets sufficient light, water and air which leads to profuse tillering which helps in getting higher productivity per unit area. Makaida *et al.* (2014); Bhatt (2015); Kirar *et al.* (2017); Agrawal *et al.* (2018). SRI was found to be good sowing techniques because the planting design of SRI is such that every plant gets sufficient light, water and air which leads to profuse tillering which helps in getting higher productivity per unit area. Makaida *et al.* (2014); Bhatt (2015); Kirar *et al.* (2017); Agrawal *et al.* (2018).

The net return obtained in SRI was found to be maximum. The net return per hectare in case of SRI (Rs 96829), DSR sowing (Rs. 70356), transplanting (Rs. 65496) and broadcasting (Rs. 67535), which indicated that SRI is not only superior over the other sowing techniques in physical terms as it giver higher productivity but at the same time it is giving better monitoring returns than other sowing techniques. Makaida *et al.* (2014); Agrawal *et al.* (2018); Mithra and Bhaskaran (2018) reported similar findings in their study (Table 2).

The return per rupees was found to be more (2.71) in DSR sowing, (2.62) in SRI, (Rs. 2.02) in transplanting and (Rs. 2.58) in broadcasting. Anon. (2015); Nirmala and Waris (2016); Mahala *et al.* (2016); Manohar *et al.* (2017) reported similar finding in their study (Table 2).

The paddy yield is high in SRI method as compared to the yields in transplanting, broadcasting and DSR sowing method of paddy cultivation. Although the B: C ratio was found to be high in DSR sowing method but yield, production and income can be increased using SRI method as it gave highest productivity and net return across various sowing techniques in the area under study, farmer can adopt method according to

Table 1: Cost of cultivation of different sowing techniques (Rs/ha)

Particulars	SRI method (Rs/ha)	DSR method (Rs/ha)	TPR method (Rs/ha)	Broadcasting method (Rs/ha)
Human labour charges	16239	5132	12955	8563
Machine use charges	4668	4748	4548	4643
Cost of seeds	1620	2095	2060	2195
Cost of fertilizer	7595	6824	6356	5865
Cost of herbicides	4312	3365	2765	2650
Cost of plant protection	965	875	1285	710
Irrigation charges	1482	860	2358	750
Total cost	36881	23899	32327	25375

Table 2: Yield and gross income of different sowing techniques

Particular	SRI method	DSR method	TPR method	Broadcasting method
Yield (qt/ha)	69.00	49.70	50.55	46.92
Price (Rs/qt)	1750	1750	1750	1750
By Product(qt/ha)	162	116	117	110
Price (Rs/qt)	80	80	80	80
Gross Income (Rs/ha)	133710	96255	97823	90910
Net Income (Rs/ha)	96829	70356	65496	67535
Benefit-cost ratio	2.62	2.71	2.02	2.58

its requirement (resource restrictions/financial constraints).

The comparative economics of different methods present a study for promoting SRI technology of rice production, as it results in higher margin to the farmers even if human labour is marginally higher than TPR. Farmers preferred to adopt direct seeding in rice cultivation due to highest benefit cost ratio and high labour requirement in TPR method. During transplanting of rice, farmers showed a keen interest in shifting TPR to DSR method. According to their opinion, DSR requires less labour and provides more economical gain in rice production. Nearly 90 per cent farmers expressed the view that there was high weed infestation to adopt this technology as risk of yield loss was higher. The other constraints expressed by farmers were limited availability and high cost of seed drill machine in the study area.

Constraints in paddy cultivation includes labour problem, unawareness of technologies, timely available of fertilizer, costly input cost. The paddy yield is high in SRI method as compared to the yields in transplanting, broadcasting and DSR sowing method of paddy cultivation. Although the B:C ratio was found to be high in DSR sowing but yield, production and income can be increased using SRI method as it gave highest productivity and net return across various sowing techniques in the area .

CONCLUSION

In the present scenario of rising inputs cost and labour shortage in agriculture, farmers need input saving alternative technologies to sustain crop production. The results indicated that DSR technology has potential to increase farmer's income and save scarce resources. Hence, DSR technology is a viable alternative to overcome the problems of rising cost cultivation, labour and water shortages for sustainable rice production. However, problems of seed drill availability and weed infestation need to be addressed to accelerate wider option of DSR technology.

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A Comparative Study on Social Media Utilization Pattern by Farmers of Different Age Groups

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ABSTRACT

The study was conducted in Hisar and Sonipat districts of Haryana, with an objective to understand the Social media utilization pattern and age wise comparison of social media use of the farmers. The data was personally collected from 200 respondents comprising 25 farmers from eight villages through a well-structured interview schedule and the collected data was analyzed using suitable statistical tools. Findings revealed that YouTube was the most used social media followed by WhatsApp and Facebook with majority of farmers making their regular use while Twitter was the least used social media with only a small proportion of farmers making its use. Around three-fourth of farmers were spending less than two hours on social media while a miniscule 03.00 percent farmers were spending more than 4 hours on browsing social media. In terms of utilization pattern of social media, most of the farmers were found using Facebook, WhatsApp and YouTube for agricultural information, News, connecting & chatting and entertainment whereas the use of Twitter, Telegram and Instagram were very limited. Comparison of social media utilization pattern using independent sample t-test for three age groups of farmers i.e., young, middle and old, revealed that there was significant difference in utilization pattern of different social media among the young, middle and old farmers except for WhatsApp which did not show any considerable difference in its utilization.

Keywords: Age-wise comparison, Farmers, ICT, Independent sample t-test, Social media, Utilization pattern

INTRODUCTION

Merriam-Webster (2015) defines social media as forms of electronic communication through which users can create online communities to share information, ideas, personal messages and other contents. Social media are interactive computer-mediated technologies that facilitate the creation or sharing of information, ideas, career interests and other forms of expression via virtual communities and networks. Social media provides opportunity to users to share information, ideas, personal messages and other forms of content by creation of communities online. This further help in opinion formation, discussions and relationship building. As per digital 2020, the number of mobile phone users in world was 5.2 billion while the number of internet users was 4.66 billion. The active social media users worldwide stood at 4.14 billion, a 53.00 per cent penetration. The world combine spends 10 billion hours on social media everyday with an average active user spending 2 hours 29 minutes per day on different social media platforms. India with a population of over 1.3 billion has 1.06 billion mobile phone connections. The active internet users in India were 687 million out of which 355 million were in rural India. The number of social media users in India are 450 million as in 2020. WhatsApp is the most used social media with 53 crores active users followed by YouTube (448 million) & Facebook (41 million). Instagram, Twitter and Telegram have 21 million, 4 million and 1.75 million active users respectively (Data reported, GOI data published in India today, 2021).

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Social media plays an important role in dissemination of agricultural information and transfer of technology. Social media has enabled farmers to improve their practices and marketing techniques. It provides opportunities to farmers for co-creating content and also promotes co-learning among farmers. Farmers now create groups on WhatsApp and Facebook where they communicate with each other and share ideas in real time and in an interactive way.

Social media can help extension professionals to provide professional guidance, direction and peer to peer interactions. Social media can be used to increase knowledge, change behaviour and assess the impacts of extension programmes. Moreover, it allows extension professionals with free and easily accessible tool that can be used for quick and widespread distribution of information, to their clients irrespective of their location (Gharis *et al.*, 2014 and Doyle and Briggeman, 2014). Social media helps in dissemination of practical, timely and scientific information to the clients by enhancing interactions among extension professionals and the clients who read that information (Jones *et al.,* 2011).

Social media platforms are not confined to transfer and sharing of agricultural information but also provide farmers with holistic knowledge about overall development in their surroundings. It makes them socially, economically, politically and culturally aware, which in turn helps them take better decisions and stay well informed and connected. Using Social media tools farmers are able to sell their products directly to consumers through forums like community supported agriculture. Further, it helps them to connect with extension workers and SMSs to get real time resolution to their problems. Progressive farmers are also using social media to sell their products directly to the consumers or retailers in urban areas.

MATERIALS AND METHODS

The study was conducted in Sonipat and Hisar districts of Haryana. Two blocks Hansi-1 and Hisar-2 were selected randomly from Hisar districts while Rai and Kharkhoda blocks were selected from Sonipat district. Further, two villages were selected from each of the four blocks randomly. In Hisar, Umra and Garhi were selected from Hansi-1 block whereas Balsamand and Arya Nagar were selected from Hisar-2 block. In Sonipat, Manouli and Halalpur were selected from Rai block while Kanwali and Rohat were selected from Kharkhoda block. Also, Twenty-five farmers having smart phone facility were selected from each of the villages, thus a total of 200 farmers were selected for the study. The data was collected through personal interview technique with the help of well-structured interview schedule prepared in collaboration with experts and analysis was done using MS Excel and Statistical Package for Social Sciences (SPSS). Statistical tools like mean, standard deviation, frequency, rank-order etc. were used in analysis of results. Further, independent sample t-test was conducted to compare the utilization pattern of social media between different age groups of farmers.

RESULTS AND DISCUSSION

1. Social media utilization pattern: Social media utilization pattern was studied in this study by finding out the use of different social media by the farmers, time spent on social media, purpose of social media use and utilization pattern for different social media by the farmers.

Use of different social media by the farmers: It was evident from Table 1 that YouTube (rank 1st) had the highest use among the farmers with weighted mean score of 2.745 followed by WhatsApp (rank 2nd) and Facebook (rank 3rd) with weighted mean score of 2.740 and 2.675 respectively. The findings are similar to the results obtained by Joshi and Dhaliwal (2019) which revealed that, more than half of the farmers regularly use Facebook while 82.00 per cent and 78.00 percent farmers were using YouTube and WhatsApp respectively. Twitter (rank 6th) was the least popular social media in terms of its use among the farmers with weighted mean score of 1.175. Instagram (weighted mean score of 1.700) and telegram (with weighted mean score of 1.465) came at rank 4 and 5 in terms of use respectively. It can be concluded here that while YouTube, WhatsApp and Facebook are the most used social media platforms with users from all age groups, Twitter and Telegram are less common among farmers. Instagram while not so popular among middle aged and old farmers have a good number of users among young farmers. The findings are backed by Balkrishna and Deshmukh (2017) who observed that YouTube, WhatsApp and Facebook were the most

Table 1: Use of different social media by the farmers (n=200)

S.No.	Social media	Regularly	Sometimes	Rarely	Total score	Weighted mean	Rank order
1	Facebook	152 (76.00)	31 (15.50)	17 (8.50)	535	2.675	III
2	WhatsApp	161 (80.50)	26 (13.00)	13 (6.50)	548	2.740	II
3	YouTube	163 (81.50)	23 (11.50)	14 (7.00)	549	2.745	I
4	Twitter	6 (03.00)	23 (11.50)	171 (85.50)	235	1.175	VI
5	Telegram	17 (8.50)	59 (29.50)	124 (62.00)	293	1.465	V
6	Instagram	49 (24.50)	42 (21.00)	109 (54.50)	340	1.700	IV

*Values in parenthesis denote percentage

popular social media among the farmers. The results are also backed by Khou and Suresh (2018) who found that YouTube was the most used social media followed by Facebook and WhatsApp.

Time Spent by farmers on social media: The data from Table 2 reveals that most of the farmers (76.00%) were using social media up to two hours followed by 21.00 per cent of farmers who were using social media from two to four hours. Also, only 3.00 per cent of farmers admitted using social media for more than four hours.

Table 2: Time spent on social media (n=200)

Category	Frequency	Per centage
Up to 2 hours	152	76.00
2-4 hours	42	21.00
More than 4 hours	6	03.00

Different uses of social media by farmers: It is evident from Table 3 that most of the farmers (46.50%) were using social media to read/watch agricultural news only 'sometimes' while another 37.00 per cent were using social media for the same purpose 'regularly'. The remaining 16.50 per cent farmers admitted that they 'rarely' make the use of social media to read or watch agricultural news. It can be concluded here that majority of farmers are using social media for reading and watching agricultural news at least sometimes. The findings are supported by Jain and Sanghi (2016) who observed that rural people access internet mainly for consumption of news and videos.

The Table 3 reveals that 48.00 per cent of farmers were 'regularly' using social media to get agriculture related information and updates while around 36.00 per cent were doing it 'sometimes.' Remaining 16.00 per cent farmers were 'rarely' using social media to get agriculture related information and updates. It can be concluded here that majority of farmers are using social media to get agricultural related information and updates. The results are in line with the study of Singh *et al.* (2021) who observed that majority of farmers use social media for receiving and sharing of agricultural information. The findings are also in line with Panda *et al.* (2019) who revealed that biggest benefit extracted by farmers from ICT use was getting agriculture related information and updates.

It can be observed from data in Table 3 that majority of farmers (62.50%) were 'rarely' using social media to connect with extension functionaries. Only 08.50 per cent farmers admitted using social media to 'regularly' connect with extension workers, ADOs and other extension personal while 29.00 per cent of

Table 3: Different uses of social media by farmers (n=200)

Social Media Use	Regularly	Sometimes	Rarely
Reading/watching agricultural news	74(37.00)	93(46.50)	33(16.50)
Get agriculture related information & updates	96(48.00)	72(36.00)	32(16.00)
Connect with extension workers/ADO/SMS	17(08.50)	58(29.00)	125(62.50)
Learn about new innovations and techniques	77(38.50)	103(51.50)	20(10.00)
Chat/connect with friends & peers	152(76.00)	39(19.500	9(04.50)

*Values in parenthesis denote percentage farmers do it ‘sometimes’ only. It can be concluded here that most of the farmers are not able to make good use of social media when it comes to establishing a link with extension functionaries by connecting with them online.

It can be concluded from Table 3 that majority of farmers (51.50%) were using social media to learn about new innovations and techniques ‘sometimes’ while another 38.50 per cent farmers were regularly using social media for the above-mentioned purpose. Remaining 10.00 per cent farmers were rarely using social media to learn about new innovations and techniques. It can be concluded from these observations that most of the farmers are making good use of social media to learn about new innovations and techniques. The findings are supported by Saravanan and Bhattacharjee (2014) who observed that farmers use social media for discussing and learning about recent agricultural innovations such as hydroponics, permaculture, protected cultivation etc.

It is evident from Table 3 that more than three-fourth of farmers (76.00%) were ‘regularly’ using social media to chat/connect with friends and peers. Only a miniscule 04.50 per cent of farmers denied using social media to chat with friends and peers while another 19.50 per cent admitted doing so ‘sometimes.’ It can be concluded from these observations that farmers are using social media for establishing and building personal relationships by connecting with friends and peers online. The findings are in line with Singh et. al. (2020), who revealed that majority of farmers use mobile phone to communicate with fellow farmers and promote interpersonal relationships.

The Table 4 reveals that for agricultural information YouTube is the most popular choice of the farmers with 76.50 per cent using it followed by WhatsApp (66.50%) and Facebook (64.50%). The use of Twitter, Telegram and Instagram for the purpose of sharing or getting agricultural information is limited with only 02.50 per cent, 09.50 per cent and 05.50 per cent of farmers admitted using these platforms for agricultural information respectively. Also, for news YouTube is the most popular choice with 69.50 per cent farmers admitted using it followed by Facebook and WhatsApp with 59.00 per cent and 44.50 per cent farmers using them for news respectively. Only 12.00 per cent, 05.50 per cent and 03.50 per cent farmers accepted using Twitter, Telegram and Instagram for news purpose respectively. Similarly, Table 4 revealed that 86.50 per cent farmers use YouTube for some form of entertainment while 48.50 per cent, 38.00 per cent and 36.00 per cent farmers were found using Facebook, WhatsApp and Instagram for entertainment respectively. Only a miniscule 0.50 per cent and 01.50 per cent admitted using Twitter and Telegram for the sake of entertainment. Also, 91.00 per cent farmers were using WhatsApp to connect, chat and share information among friends and peers followed by Facebook and Instagram with 76.50 per cent & 34.50 per cent respectively. Also, 23.50 per cent farmers were using Telegram and 23.00 per cent farmers were using YouTube for the above-mentioned purpose. Only 6.00 per cent farmers admitted using Twitter for connecting and sharing information with friends and peers. The findings were supported by the study of Singh *et al.* (2021) who stated that majority of farmers (72.50%) were using social media for receiving and sharing of agricultural information, among them WhatsApp (61.50%) was the most preferred source of agricultural information followed by YouTube and Facebook. Joshi and Dhaliwal (2019) also found that 66.00 per cent farmers used social media to share agricultural information while 74.00 per cent used social media for fulfilling their requirements related to agricultural information. Among different social media Joshi and Dhaliwal (2019) revealed that 36.00 per cent always used Facebook for agricultural information while 48.00 per cent used it sometimes. In case of WhatsApp 70.00 per cent used it regularly while another 20.00 per cent used it sometimes to get agricultural information. Similarly, for YouTube they found that 66.00 per cent use it regularly while another 22.00 per cent used it sometimes to get and share agricultural information. Also, 96.00 per cent never used twitter while 94.00 per cent never used Instagram for the purpose of agricultural information.

2. Comparison of social media utilization pattern between different age groups: Independent sample t-Test was used in the study to find out whether there was any significant difference in the utilization pattern of different social media by different age groups of farmers by analysing their mean difference. For the purpose of the study three pairs were formed out of three age groups of farmers i.e., young-old, young-middle and middle-old. Further, five social media i.e.,

Table 4: Utilization pattern of different social media

S.No.	Social Media	Utilization Pattern	Yes	No
1.	Facebook	Agricultural information	129 (64.50)	71 (35.50)
		News	118 (59.00)	82 (41.00)
		Entertainment	97 (48.50)	103 (51.50)
		Connecting/ sharing information with friends and peers	153 (76.50)	47 (23.50)
		Any Other	12 (06.00)	188 (94.00)
2.	WhatsApp	Agricultural information	133 (66.50)	67 (33.50)
		News	89 (44.50)	111 (55.50)
		Entertainment	76 (38.00)	124 (62.00)
		Connecting/ sharing information with friends and peers	182 (91.00)	18 (09.00)
		Any other	47 (23.50)	153 (76.50)
3.	YouTube	Agricultural information	153 (76.50)	47 (23.50)
		News	139 (69.50)	61 (30.50)
		Entertainment	173 (86.50)	27 (13.50)
		Connecting/ sharing information with friends and peers	46 (23.00)	154 (77.00)
		Any other	19 (09.50)	181 (90.50)
4.	Twitter	Agricultural information	5 (02.50)	195 (92.50)
		News	24 (12.00)	176 (88.00)
		Entertainment	1 (00.50)	199 (99.50)
		Connecting/ sharing information with friends and peers	12 (06.00)	188 (94.00)
		Any other	7 (03.50)	193 (96.50)
5.	Telegram	Agricultural information	19 (09.50)	181 (90.50)
		News	11 (05.5)	189 (94.50)
		Entertainment	3 (01.5)	197 (98.50)
		Connecting/ sharing Information with friends and peers	47 (23.50)	153 (76.50)
		Any other	23 (11.50)	177 (88.50)
6.	Instagram	Agricultural information	11 (05.50)	189 (94.50)
		News	7 (03.50)	193 (96.50)
		Entertainment	72 (36.00)	128 (64.00)
		Connecting/Information sharing with friends and peers	69 (34.50)	131 (65.50)
		Any other	13 (06.50)	187 (93.50)

Facebook, WhatsApp, YouTube, Instagram and Telegram were used for doing the comparison of mean in between above mentioned three age categories of the farmers.

The data in Table 5 revealed that there was significant mean difference among young and old farmers in the utilization pattern of Facebook, YouTube, Telegram and Instagram with t-values of 3.414, 3.130, 7.002 & 5.761 (significant at 0.01 level of significance). Hence, it can be concluded that, there was considerable difference in the utilization pattern of Facebook, YouTube, Instagram and Telegram between young and old aged farmers. The Findings are supported by Jha (2017) who revealed that Facebook was very popular among young generation who spends several hours a day using and interacting through Facebook. Also, the difference between means of young and old farmers for WhatsApp is non-significant, which explained that there was not much difference in the utilization pattern of WhatsApp among young and old aged farmers.

In comparison between young and middle-aged farmers, it can be inferred from Table 5 that there was significant difference in means of these two groups in

Table 5: Age-wise Comparison of social media utilization pattern between young & old, young and middle and middle & old farmers

1) Young vs Old				
Social Media	**Mean (Young)**	**Mean (Old)**	**Mean difference**	**t-value**
Facebook	2.783	2.038	0.745	3.414**
WhatsApp	2.797	2.461	0.336	1.556^{NS}
YouTube	2.971	2.307	0.664	3.130**
Instagram	1.159	0.154	1.005	7.002**
Telegram	0.927	0.135	0.792	5.761**
2) Young vs Middle				
Social Media	**Mean (Young)**	**Mean (Middle)**	**Mean difference**	**t-value**
Facebook	2.783	2.671	0.112	0.593^{NS}
WhatsApp	2.796	2.608	0.188	0.983^{NS}
YouTube	2.971	2.595	0.376	2.550*
Instagram	1.159	0.633	0.526	3.257**
Telegram	0.927	0.405	0.522	3.583**
3) Middle vs Old				
Social Media	**Mean (Young)**	**Mean (Old)**	**Mean difference**	**t-value**
Facebook	2.671	2.038	0.633	2.970**
WhatsApp	2.608	2.461	0.147	0.730^{NS}
YouTube	2.595	2.307	0.288	1.710^{NS}
Instagram	0.633	0.154	0.479	4.350**
Telegram	0.405	0.135	0.270	2.951**

terms of utilization pattern of YouTube, Instagram and Telegram with t-values of 2.550, 3.257 and 3.583 respectively. Although for Facebook and WhatsApp the mean difference among young and middle-aged farmers were non-significant. Therefore, it can be concluded here that there was significant difference in the utilization pattern of YouTube, Instagram and Telegram for young and middle-aged farmers but when it comes to the utilization of Facebook and WhatsApp there's not much difference between the two age groups of farmers.

For middle and old-aged farmers, the data from Table 5 revealed that there was significant difference in the means of these two groups for Facebook, Instagram and Telegram while the mean differences were non-significant for WhatsApp and YouTube. Hence, it can be concluded that there was significant difference in the utilization pattern of Facebook, Instagram and Telegram among Middle and Old aged farmers but these two groups didn't differ significantly in the utilization of WhatsApp and YouTube. The above findings on the comparison of social media utilization pattern among three age groups of farmers could be attributed to the fact that young farmers were making much greater use of different social media as compared to middle and old aged farmers. The findings are supported by Balkrishna and Deshmukh (2017) who revealed that farmers in age group of 30-40 years are using social media for multiple purposes as compared to older farmers. The study is also in line with findings of Khou and Suresh (2018), which stated that farmers in age group of 30-40 years made maximum use of social media while those above fifty years made minimum use. Another important conclusion that could be drawn here is that there was not any significant difference among these three groups in terms of utilization of WhatsApp as farmers across different age groups were found using WhatsApp in similar ways but for other social media, the differences were quite significant. Moreover, social media like Telegram and Instagram were found to be much more popular among young farmers as compared to middle aged and old farmers. Facebook and YouTube also showed considerable differences in their utilization by the three age groups of farmers. Young farmers were found making more use of YouTube as compared to both middle and old aged farmers.

CONCLUSION

The results revealed that YouTube is the most used social media followed by WhatsApp and Facebook with 81.50 per cent, 80.50 per cent and 76.00 per cent regular user respectively. Also, around Three-fourth (76.00%) of farmers were found using social media for less than 2 hours per day followed by 21.00 per cent farmers who spent 2-4 hours on social media every day. In terms of utilization pattern of social media, most of the farmers were found using Facebook, WhatsApp and YouTube for agricultural information, News, connecting & chatting and entertainment whereas the use of Twitter and Telegram were very limited. Instagram was mainly used for the purpose of entertainment and connecting with friends and peers. Comparison of social media utilization pattern for three age groups of farmers revealed that there was significant difference in utilization pattern of different social media among the young, middle and old farmers except for WhatsApp which did not show any considerable difference in its utilization. This can be attributed to the fact that young farmers were making much greater use of different social media applications as compared to middle and old aged farmers

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A Test to Measure the Knowledge of Farmers about Lavender Cultivation

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ABSTRACT

Keeping in view the economic importance of lavender cultivation, the present study was conducted to develop a test for measuring the knowledge of farmers about different production recommendations of lavender crop. A preliminary test of sixteen knowledge items was initially administered to 36 lavender farmers for item analysis. Finally eight knowledge items were selected based on difficulty index (10 to 90) and discrimination index (0.10 to 0.90). The reliability of the test was measured with the help of split- half method and the reliability was found to be 0.99, which indicates that the test is reliable.

Keywords: Item analysis, Knowledge test, Lavender oil, Lavender, Production, Reliability

INTRODUCTION

Lavender is a small aromatic shrub cultivated primarily for its inflorescence which produces high value of essential oil which is mostly used in cosmetic and perfume industries (Gul *et al.,* 2016). Lavender have a typical productive life of about 10 years, although plants have been known to live for 20 years. Lavender ranks high as a sustainable crop because it does not rely on pesticides and fertilizers (Adam, 2006). The world production of lavender oil is estimated around 200 tonnes per year (Singh *et al.,* 2007). In 2017, the biggest lavender producing country, Bulgaria, alone produced 200 tonnes of lavender oil from an area of 4500 hectares (Giray, 2018). In 2018, France produced 116.62 tonnes of lavender oil from an area of 4662 hectares (Sestelo and Carrillo, 2020). In India, the lavender crop is cultivated in low rainfall regions and on the slopes of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and Uttarakhand. True lavender, spike lavender, lavandin and sher-e-kashmir are four types of lavender varieties majorly grown in India (Reddy, 2018). India imports 42 tonnes of lavender oil worth Rs. 18 million per annum (Shawl and Kumar, 2000).

In Jammu and Kashmir, lavender is being grown over an estimated area of 900 acres with an annual production of 3000 kgs of lavender oil (Devdiscourse, 2021). Lavender variety, RRL-12 is widely adopted in Jammu region. Around 500 farmers across villages in Doda district in Jammu had their incomes quadrupled after shifting from maize to lavender cultivation which is being called purple revolution (Drishti, 2021). Adequate knowledge about different production recommendations of lavender crop is must on part of farmers to increase its productivity so that the existing scenario of economic benefits from lavender oil production may be changed satisfactorily which will help in motivating the farmers to take up large scale cultivation of lavender crop. Evidently this knowledge assessment requires an appropriate measurement tool such as a cognitive scale (Raj Kamal, 2001). Therefore, a cognitive test to measure the knowledge of farmers about different production recommendations of lavender crop.

MATERIALS AND METHODS

In the present study, knowledge level of farmers refers to the level of knowledge possessed by an individual farmer about the different practices of lavender

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cultivation. For that purpose, a test was developed. A test is a set of questions, each of which has a correct answer, to which the people respond (Roy and Mondal, 1999). The test was developed by following the procedure of item analysis, selection of test items, testing the reliability and validity.

1. Item collection: Items were collected on the basis of their apparent lack of ambiguity, simplicity and representativeness. Initial items were chosen after carefully going through the concerned literature, discussion with extension specialists of the division and experts from agroforestry. The questions were designed to measure the knowledge level of farmers about different production and protection practices involved in lavender cultivation. The items were collected in relation to knowledge of farmers about time of sowing, types of different lavender varieties, manures and fertilizers to be used, pesticides to be used and method and time of harvesting. The selection of items was done on the following criteria: (i) it should promote thinking rather than memorization, (ii) it should differentiate the well informed respondents from the poorly informed ones.

On the basis of the above two criteria, a total of 16 items were initially constructed. A schedule was prepared with these items for administering to the respondents for item analysis and further screening out the final items. All the items collected for construction of the knowledge test were in objective form.

2. Item analysis: A test's item analysis typically generates two types of data: item difficulty and item discrimination. The index of item difficulty indicates how tough an item is, whereas the index of discrimination indicates how well informed individuals were separated from those who were not. The 16 items that were first prepared were given to 36 lavender cultivators. Each responder to whom the items were administered gave a score of 1 or 0 for each item based on whether the answer was correct or incorrect. A respondent's knowledge score was determined by the total number of right answers he gave to all of the items in the knowledge test. The possible score ranged from 0 to 16. Each respondent's overall score was determined. After that, all of the respondents' total scores were sorted into ascending order. Six equal groups of six respondents were formed from the thirty-six respondents who were given a specific item pool of practices. G1, G2, G3, G4, G5, and G6 were the names of these groups. G3 and G4 were excluded from the item analysis. For item difficulty and item discrimination calculations, only four extreme groups with high and low scores were used.

3. Calculation of difficulty index: The proportion of respondents who correctly answered an item was used to calculate the difficulty index of that item. This was calculated by the formula:

$$P_i = n_i / N_i * 100$$

Where, P_i = Difficulty index in percentage of i^{th} item

n_i = Number of respondents giving correct answer

N_i = Total number of respondents to whom the i^{th} item was administered.

Table 1 shows the difficulty index for all of the items included in the item analysis.

4. Calculation of discrimination index: The method suggested by Mehta (1958) was adopted for calculation of discrimination index. The formula by which the discrimination was calculated is given as below:

$$E_{1/3} = \frac{(G1+G2) - (G5+G6)}{N/3}$$

Where, $E_{1/3}$ = the discrimination index

G1, G2, G5 and G6 indicated the frequencies of correct answers given for the respective sub- groups of respondents for an item in the test.

N= Total number of respondents to whom the item was administered.

The discrimination index of all the items included for item analysis was calculated as shown in Table 1.

5. Selection of items for final format of knowledge test: After calculating the difficulty index and discrimination index, eight items were chosen for the knowledge test's final format. The underlying assumption in item difficulty statistics was that difficulty was proportional to an individual's level of knowledge about the subject. According to Coombs (1950), when a respondent answered an item properly, it was considered that the item was easier than his ability to

Table 1: Difficulty index and discrimination index of the knowledge test items

S.No.	Item	Difficulty Index	Discrimination Index
1.	Name the variety of lavender crop?	16.67	0.33
2.	What is the method of propagation of lavender?	100.00	0.00
3.	In which month the lavender plants are transplanted in the fields?	91.67	0.25
4.	Spacing between plant to plant	58.33	0.75
5.	What is the recommended dose of well rotten FYM per ha.	16.67	0.42
6.	What is the recommended dose of Urea per ha.	0.00	0.00
7.	What is the recommended dose of DAP per ha.	0.00	0.00
8.	What is the recommended dose of MOP per ha.	0.00	0.00
9.	How many irrigations should be given to the crop for better crop production?	8.33	0.17
10.	Name the method for harvesting the lavender crop.	100.00	0.00
11.	After how many years of planting, the harvesting of lavender starts?	47.22	0.83
12.	What are the appropriate weather conditions for the harvesting of lavender crop?	100.00	0.00
13.	What is the percentage of florets that should be open during harvesting?	88.89	0.33
14.	Please mention the length above the ground level from where the plant is harvested?	100.00	0.00
15.	What is the colour of flowers during the harvesting of lavender crop?	97.22	0.08
16.	In which month the harvesting is done?	25.00	0.58

cope with it. For the knowledge test, items with an index of difficulty of 10 to 90 and an index of discrimination of 0.10 to 0.90 were chosen.

Validity of the test: Validity of the test in terms of content validity was judged. Content validity is the representativeness or sampling adequacy of the content, the substance, the matter, the topics of measuring instrument (Kerlinger, 2004). Content validity of the test was found satisfactory since it was based on available literature and subjected to different experts' judgements. It was assumed that the test measures what it was intended to measure and hence valid.

Reliability of the test: Reliability is the accuracy or precision of a measuring instrument (Kerlinger, 2004). A test is reliable only when it gives consistently the same results when applied to the same sample. There are various methods to determine the reliability of the test but here split- half method was used for this purpose. The test (containing 8 statements) was divided into two halves based on odd and even statements. The total score obtained for odd and even number items were subjected for the calculation of correlation coefficient (r). The resulting value of r = 0.99 was considered as split-half reliability. To adjust the reliability into full test reliability, Spearman Brown's prophecy formula (Roy and Mondal, 2004) was used. The full test reliability was found to be 0.99. Thus, the test was considered to be reliable.

Table 2: List of items retained for final format of knowledge test

S.No.	Items
1.	Name the variety of lavender crop?
2.	In which month the lavender plants are transplanted in the fields?
3.	Spacing between plant to plant
4.	What is the recommended dose of well rotten FYM per ha.
5.	How many irrigations should be given to the crop for better crop production?
6.	After how many years of planting, the harvesting of lavender starts?
7.	What is the percentage of florets that should be open during harvesting?
8.	In which month the harvesting is done?

CONCLUSION

Keeping in view the increasing economic importance of lavender cultivation, it became imperative to work out the knowledge of lavender farmers about lavender cultivation because the high knowledge about cultivation practices of lavender would lead to increased production of lavender oil and will help in motivating the farmers to take large- scale cultivation.

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Impact Assessment of the KVK Cluster Frontline Demonstrations on Mustard Crop in Samba District of Jammu

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ABSTRACT

Over the years the Krishi Vigyan Kendra (KVK) system has enlarged its spectrum of activities in agriculture and allied sectors from vocational training, frontline demonstrations, technology testing/ refinement to bringing new concepts of entrepreneurship opportunities, convergence of extension activities, integrated farming system, crop diversification, value addition, biodiversity conservation, organic farming etc. Empirical evidences have highlighted that KVK System has positively impacted the rural farming community in terms of income, yield, productivity, sale price and above all capacity for optimal utilization of resources etc. In this line, a study was carried during the year 2019-20, to assess the impact of KVK's cluster frontline demonstration on mustard productivity and income of farmers in Samba district of Jammu. Cluster frontline demonstrations involve selection of farmers through interactive meetings, organizing these farmers into groups(10-15 per group), identifying gaps in adoption of existing package and practices, conducting frontline demonstration of newly developed or refined package of practices in farmers field, supply of required inputs in the form of high yielding seed, fertilizer, insecticides, weedicides etc, regular monitoring and technical support by KVK experts and at last impact assessment in terms of yield, productivity, selling price, quality etc. The data for the study was collected from farmers through personnel interview method. A total of 120 farmers were selected through multistage random sampling out of which 60 farmers were beneficiaries of KVK cluster frontline demonstrations and 60 were non-beneficiary farmers. The results of the study revealed that the average productivity per hectare of mustard was 12.25 quintal in case of beneficiaries of cluster frontline demonstrations as compared to 8.06 quintal in case of non beneficiaries. Further, an average income of Rs 63284/beneficiary/ hectare was received from the sale of mustard crop as compared to Rs 41106/non beneficiary/ hectare. From the results it is clear, that frontline demonstrations along with the material and technical support from KVKs have played an important role in increasing productivity and income per unit of land. In addition, the results have indicated and proved that KVK through its spectrum of activities are having a positive impact on farming community in terms of productivity per unit of land, income from agriculture, sustainable use of land and resource conservation.

Keywords: Entrepreneurship, Frontline demonstration, Integrated farming, Krishi Vigyan Kendra, Productivity, Resource conservation, Value addition

INTRODUCTION

Agriculture is the backbone of India's economy, as it provides food to people, feed to cattle, raw materials to primary and secondary industries, accounts for 13.9 percent of GDP and employs 54.6 per cent of the workforce (Wagh and Dongre, 2016; Sharma, 2012). Owing to diverse soil and climate conditions, vast varieties of crops such as cereals, pulses, millets, spices, oils, fruits, flowers are being grown in India. Among these crops grown India is one of the leading producers of pulses, cereals and spices in the world (Mishra *et al.*, 2021; Singh *et al.*, 2017; Thomas and Sanil, 2019). However, after cereals, oilseeds are among the major field crops grown in India (Narayan, 2016). And among oilseeds, nine oilseeds are the primary sources of oils

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in the country, out of which seven are edible oils (soybean, groundnut, rapeseed-mustard, sunflower, sesame, safflower and niger) and two are non-edible (castor and linseed). These oilseed crops are grown throughout the year, however mustard is the sole oilseed crop that is well-suited to rabi season. It is a key source of revenue and contributes significantly to the livelihood security of resource poor, small and marginal farmers living in rain-fed areas of the country. (Shekhawat *et al.*, 2012). Mustard plant belongs to the Brassicaceae family and Brassica or Sinapisgenera (Swati *et al.*, 2015). Its seeds are high in oil and protein, oil content ranges from 24 to 40 per cent and protein content ranges from 17 to 26per cent. The seeds of mustard are mostly processed for the extraction of oil, and the residue left behind known as mustard cake, is used for cattle feed (Kumrawat and Yadav, 2018). Efficient crop management practices such as selection of high yielding, disease pest resistant varieties along with adoption of proper crop rotation, timely planting, adequate plant stand, balanced plant nutrition, need base plant protection, irrigation and timely weed control have great influence on productivity of mustard. Package and practices for mustard are developed by agricultural universities, research institutes and are refined, demonstrated, popularised through Krishi Vigyan Kendras (KVK) and field extension departments in different states etc. Krishi Vigyan Kendra in particular from 1992 onwards have been on the forefront in providing farmers wide variety of services which involve vocational training, frontline demonstrations, technology testing/ refinement and popularising concepts of entrepreneurship, integrated farming system, crop diversification, value addition, biodiversity conservation, organic farming etc (Katole *et al.*, 2017). There are about 17 KVKs in Jammu and Kashmir, out of which seven KVKs are under the administrative control of Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (SKUAST–J Chatha). Empirical evidences have highlighted that KVK System has positively impacted the rural farming community in terms of income, yield, productivity, sale price and above all capacity for optimal utilization of resources etc (Singhal and Vatta, 2017; Alagukannan and Srinivasan, 2014). In this line, this study was carried during the year 2019-20, to assess the impact of KVK's cluster frontline demonstration on mustard productivity and income of farmers in Samba district of Jammu. Cluster frontline demonstrations involve selection of farmers through interactive meetings, organizing these farmers into groups (10-15 per group), identifying gaps in adoption of existing package and practices, conducting frontline demonstration of newly developed or refined package of practices in farmers field, supply of required inputs in the form of high yielding seed, fertilizer, insecticides, weedicides etc, regular monitoring and technical support by KVK experts and at last impact assessment in terms of yield, productivity, selling price, quality etc. (Singh *et al.*, 2020; Singh *et al.*, 2020; Jha *et al.*, 2020).

MATERIALS AND METHODS

Ex-post facto design was used to conduct the studyand multi stage sampling plan was followed for selection of ultimate respondents. Samba district was selected purposively because KVK, Samba has maximum number of Front Line Demonstrations (FLDs) under its Cluster Frontline Demonstration Programme. A list of 166 mustard growing beneficiaries was collected from KVK Samba. Out of the available list, 60 number of mustard growing beneficiary were selected by using random sampling technique. Equal number of non-beneficiary mustard growing farmers were also selected from the representative/adjoining villages. By this way total sample size comprised of 60 beneficiary and 60 non-beneficiary mustard growing farmers. Data was collected at individual farmer level, through open ended questionnaire particularly on production and economics of the mustard crop along with data on adoption practices, socio economics and constraints faced in mustard crop production. Data was tabulated and analyzed through SPSS software using Z-test and T-test.

RESULTS AND DISCUSSION

Table 1 reveals that the average productivity for the beneficiaries and non-beneficiaries was 12.25 (±1.84) and 8.06 (±1.41) and there was a significant difference found for beneficiaries and non-beneficiaries at 1 per cent level of significance with difference value of 4.19. Also, there was a significant difference found between beneficiaries and non-beneficiaries for selling their mustard produce at 1 per cent level of significance with difference value of 35 and the per cent was 45 and 10 for beneficiaries and non-beneficiaries. This maybe due to the reason that the beneficiaries are in

Table 1: Productivity of mustard crop

Parameter	Beneficiary (n=60)	Non-Beneficiary (n=60)	Difference	Statistics
Average productivity of mustard crop (qtl/ha ± S.D)	12.25±1.84	8.06±1.41	4.19	t=13.936** *p*=0.001
No. of farmers selling their mustard produce	27(45)	6(10)	35	z=5.542** *p*=0.001

*: Deviation significant at $p<0.05$, **: Deviation significant at $p<0.01$

frequent contact with the experts from KVK and were regularly visiting the KVK, Samba for their problems related to the specific crop.

Table 2 was reveals that the average productivity before FLD and after FLD was 8.76 (±1.69) and 12.25 (±1.84) respectively for beneficiaries and there was a significant difference for beneficiaries before and after FLD productivity at 1 per cent level of significance. And, there was also a significant difference between beneficiaries and non- beneficiaries for average productivity which was 12.25 (±1.84) and 8.06 (±1.41) quintal and there was a significant difference for average productivity between beneficiaries and non-beneficiaries at 1 per cent level of significance. The average sale price before FLD and after FLD was 5075.00 (±247.39) and 5166.66 (±240.19) rupees for beneficiaries and there was no significant difference for beneficiaries before and after FLD sale price. And, the average sale price of beneficiaries and non-beneficiaries was 5166.66 (±240.19) and 5100 (±219.08) rupees and there was also no significant difference found for average sale price between beneficiaries and non-beneficiaries, respectively. This is due to the reason that the beneficiaries are growing the seed varieties that were provided to them by KVK, Samba under their cluster frontline demonstration programme so that the farmers could generate more revenue from the crop which will increase their on-farm income. Further the results are in conformity with the study carried by Dwivedi *et al.* (2018) on black gram in Madhya Pradesh, Mishra *et al.* (2018) on green gram, Singha *et al.* (2020) on pulses, Saikia *et al.* (2018) on blackgram.

Table 3 reveals that the average productivity for the beneficiaries and non-beneficiaries was 12.25 (±1.84) and 8.06 (±1.41) and there was a significant difference found for beneficiaries and non-beneficiaries at 1 per cent level of significance with difference value

Table 2: Distribution of Respondents on the Basis of Productivity of Mustard Crop Before and After FLD

Parameter	Beneficiaries (n=60)		Non-Beneficiaries (n=60) (3)	Statistics (p-value) (1-2)	Statistics (p-value) (2-3)
	Before (Before FLD) (1)	After (FLD) (2)			
Average Productivity (qtl/ha ± S.D)	8.76±1.69	12.25±1.84	8.06±1.41	t=45.244** *p*=0.000	t=13.936** *p*=0.001
Average Sale Price (Rs/qtl ± S.D)	5075.00±247.39	5166.66±240.19	5100±219.08	t=2.295 *p*=0.30	t=0.623 *p*=0.537

*: Deviation significant at $p<0.05$, **: Deviation significant at $p<0.01$

Table 3: Income from mustard crop

Parameter	Beneficiary (n=60)	Non-Beneficiary (n=60)	Difference	Statistics
Average productivity of mustard crop (qtl/ha ± S.D)	12.25±1.84	8.06±1.41	4.19	t=13.936** *p*=0.001
Income from Mustard Crop/farmer/hectare	63,284	41,106	22178	–

*: Deviation significant at $p<0.05$, **: Deviation significant at $p<0.01$

of 4.19. Also, the income from mustard crop for each beneficiary and non-beneficiary is Rs. 63,284 and 41,106 for each farmer/crop/hectare with difference value of 22178 for beneficiaries and non-beneficiaries. This is due to the reason that the beneficiaries are following all the package of practices for mustard crop that are provided/demonstrated to them by the KVK experts/ scientists during their field visits/trainings.

CONCLUSION

Beneficiary farmers were getting higher productivity as well as good revenue from mustard crop as compared to non-beneficiary farmers as the beneficiary farmers were practicing all the package of practices that were demonstrated to them by the KVK experts during their field visits and cluster frontline demonstrations. In order to increase the benefit of CFLDs in horizontal way, lead farmers need to be further motivated to transfer the skill and knowledge to the fellow farmers in their vicinity through group discussion, panchayat sabhas etc. Further research station technology needs to be further popularised through extension programme as it has the potential of improving production of mustard at state level without increasing in area. Also the extension agencies in collaboration with KVKs should held demonstrations at regular interval so as to show the effects of new technology in mustard production and motivate farmers for adoption of new technology to bridge the yield gap between lab and land. Moreover, Krishi Vigyan Kendra in the state need to play more active and lead role in providing proper technical support to the farmers through different educational and extension activities to reduce the extension gap for better cereal, pulses, oilseeds, spices and fruit crop production in the state.

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Impact of Cluster Front Line Demonstrations (CFLDs) on Mustard (*Brassica juncea*) in Changthang region of Leh, Ladakh

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ABSTRACT

Mustard is an important oil seed crop of India which provides edible oils, green vegetables, condiments and animal feed. Krishi Vigyan Kendra, Nyoma-Leh, Ladakh conducted cluster frontline demonstrations on mustard to evaluate the outcome of technology interventions with the aim to increase the area, production, productivity and self-sufficiency. The results of two years study revealed that average yield of mustard under demonstration plots was 7.82 q/ha as compared to 6.58 q/ha in farmer's traditional practices which was 19.06 per cent more as compared to traditional practices. Further, results of the study revealed that average additional yield (1.24 q), additional returns (Rs. 4371), effective gain (Rs. 4236) and benefit: cost ratio (1.43) from one hectare was obtained under demonstrations as compared to traditional practices. The average technology gap, extension gap and technology index were found to be 7.18 q/ha, 1.23 q/ha and 47.87 per cent, respectively. Whereas overall adoption level of mustard production technology by the partner farmers was 62.09 per cent. It may be concluded that the adoption of improved production technologies of mustard leads to increase the productivity, productive, economically viable and feasible to local conditions as compared to existing farmer's practice.

Keywords: CFLDs, Mustard, Production, Economics, Extension gap, Technological gap

INTRODUCTION

India is the largest producer of oilseeds in the world and accounts for about 14.0 per cent of the global oilseeds area, 7.0 per cent of the total vegetable oil's production and 10.0 per cent of the total edible oil's consumption (Ojha and Bisht, 2020). Major oilseed producing countries in the world, viz. China, Canada, India, USA, Brazil and Argentina, account for 82 per cent of oilseed production in the world (Reddy and Immanuelraj, 2017). At the world level, estimated area, production and yield of rapeseed-mustard was 36.59 million hectares (mha), 72.37 million tonnes (mt) and 1980 kg/ha, respectively during 2018-19. The productivity of rapeseed-mustard has been a significantly increased from 18.40 q/ha in 2010-11 to 19.80 q/ha in 2018-19 and production has also increased from 61.64 mt in 2010-11 to 72.42 mt in 2018-19. The main contributors to such changes have been availability of improved oilseeds production technology and its adoption, expansion of cultivated area, price support policy, institutional support, particularly establishment of technology mission on oilseeds in India, 1986 (Hegde, 2004).

Among oilseed crops, mustard (*Brassica juncea*) is the third (28.6%) important group of oilseed crops in the world after soybean and palm oil. Mustard comprises groups of cultivated oilseed Brassicas within the family Brassicaceae (Singh *et al.,* 2020). Of the total area and production under the group's oilseeds crops grown in India, mustard accounts for 22.2 per cent of the acreage and 22.6 per cent of the production. In India, although Mustard is cultivated in all states, major states contribute in area >75 per cent are Rajasthan (45%), UP (13%), MP (10%), and Haryana (9%). More

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than ninety per cent production comes from six major states which includes Rajasthan (46%), Haryana (12%), MP (11%), UP (10%), West Bangal (7%) and Gujarat (5%) (Kumar *et al.,* 2019). Mustard, a rich source of fat and edible oil content (37- 49%) has various uses for human and animals.

Agriculture in Leh Ladakh is a way of life for the agrarian population and nearly 70 per cent population is directly or indirectly dependent on this sector. Despite the vast geographical area, 62 per cent of the households has less than 1 ha cultivable land. The majority of the households have small land holding; 49.4 per cent households have less than 0.5 ha land (LAHDC, Ladakh organic Policy 2019). As per Statistical Handbook, LAHDC Leh (2018-19), the total cropped area was 10358 ha, out of which oil seeds area are only 105 ha. In Changthang area of Leh-Ladakh, oilseed area is very less. Beside less area, productivity is also low. Major factors responsible for low yield potential of mustard crop in the Leh district of Ladakh includes use of local seed by the farmers, improper nutrient management, improper crop geometry, use of high seed rate, small & marginal land holding, poor adoption of improved technologies due to lack of awareness, short crop season due to adverse agro-climatic situation. The Government decided to achieve self-sufficiency in edible oilseed production through various technological interventions to overcome still oilseed production by supporting the latest production technologies in oilseed production. The government of India again initiated technology by approving a project "cluster frontline demonstrations on oilseeds" to ICAR-ATARI, Ludhiana under National Mission on Oilseeds and Oil Palm (NMOOP) and implemented by KVKs with the main purpose to increase the oilseed production. Cluster frontline demonstrations (CFLDs) are an important spreading process for technology transfer and to establish its production potential on the farmers' fields. The scheme is applied in a mission mode through KVKs system. The scheme purposes to target the adopted village by making available the improved technologies upgrade and spread likewise improved seeds, nutrient management, weed management, pest and disease management, awareness programme through extension activities like trainings, Kisan Gosthi, diagnostic and field visits, field days and mass media campaign. The aims of CFLDs were to demonstrate the improved technologies recommended technology by the Research Institutes and SAUs among the farmers, so as to improve the production, productivity and generate interest in the growing of oilseed crops.

Krishi Vigyan Kendra's play an important role in the transfer of technology in farmer's field. The main aim of KVK is to reduce the time lag between the generation of technology and its transfer to the farmers for increasing production, productivity and income from the agriculture and allied sectors on constant basis. CFLDs is a long-term educational activity conducted in a logical manner at farmers' fields to show the value of a new technology. Keeping all these views in mind, the CFLDs on Mustard using improved technology was started and implemented with the objective to evaluate the productive abilities of the new production technologies under actual farming situations as compared to the traditional cultivation practices of the mustard crop. Therefore, efforts have been made through CFLDs to introduce innovative technologies of mustard with a view to increasing its productivity in the Changthang region of Leh-Ladakh.

MATERIALS AND METHODS

The present study was carried out in eastern Ladakh under the Krishi Vigyan Kendra, Nyoma, which is the highest altitude (13,641 ft. amsl, 33° 206' N and 78°648' E) KVK in India during 2018-19 and 2019-20 for two consecutive years in the farmer's field in various villages of Rong-Chumathang and Nyoma blocks of Nyoma subdivision under the guide-line of CFLD by ICAR-ATARI (Zone-I), Ludhiana. Accordingly, CFLDs on mustard crop are laid out in villages namely-Nidder, Mudh, Liktsey, Tukla, Hemiya, Kungyam and Teri. In this study, the total area of the two years under CFLDs programme on mustard was 3.20 hectares and a total of 55 partner farmers were involved from above mentioned villages. Partner farmers were identified through their participation and feedback received during the survey, awareness programme and training. All the participating farmers were trained to follow the improved practices of mustard cultivation. Regular visits to the demonstrations field by KVK scientists ensured proper guidance to the partner farmers. During course of demonstrations for capacity building, all the participating farmers were trained on various aspects of mustard production technologies. In the target villages for CFLDs programme on mustard cultivation, seed sowing was done in both the year in summer between second week to last week of May month with a seed rate of 10 kg/ha in line sowing with row to row spacing of 25 cm. More seed rate was used in the demonstrated of mustard plots, logically due to the very harsh agro-climatic situation, low humidity and early dryness in soil, as a result to avoid poor germination of seed. In context to nutrient management, only 150 qtls per hectare of farmyard manure (FYM) was applied at the time of field preparation. Manually one hand weeding was done about 30-35 days after sowing and approximately five irrigations were applied as per the crop requirement due to high evapotranspiration rate being dry summer during crop growth. In the crop demonstration years (2018-19 & 2019-20), no harmful effect was found by disease and insect pests, in some plots very minutely aphid attack was seen at crop maturity stage but no need to apply any plant protection measures. The crop was harvested from last week of August to the second week of September.

A field day was conducted with the active participation of demonstration holding farmers, other farmers, KVK Scientists, officials from state line departments and local extension functionaries to demonstrate the superiority of technology and to create awareness among the farmers. The basic information was recorded from the demonstration plots and control plots then analyzed for the comparative performance of CFLDs and farmer's practice. Further, the data of adoption of mustard production technologies were collected from the partner farmers by personal interview method with the help of pre-tested interview schedule. The collected data were classified, tabulated and analyzed by using suitable statistical tools.

The data on seed yield, cost of cultivation, gross and net return were collected from demonstration plots farmers. The benefit-cost (B: C) ratio was calculated based on gross return.

The extension gap was worked out (Katare *et al.*, 2011; Samui *et. al.*, 2000) as given below:

Net return (Rs./ha) = Gross Return (Rs./ha) - Cost of cultivation (Rs./ha)

Technology gap = Potential yield (q/ha) -Yield of demonstration plot (q/ha)

Extension gap= Yield of demonstration plot (q/ha) - Yield under farmer practice (q/ha)

$$\text{Technology index} = \frac{\text{Potential yield-Yield of demonstration plot}}{\text{Potential yield}} \text{ X } 100$$

Additional cost (Rs./ha) = Demonstration plot (Rs./ha) - Farmer practice cost (Rs./ha)

Additional return (Rs./ha) = Demonstration plot (Rs./ha) - Farmer practice return (Rs./ha)

Effective gain (Rs./ha) = Additional return (Rs./ha)- Additional cost (Rs./ha)

RESULTS AND DISCUSSION

Differentiation in technological interventions in demonstration plots and farmers practice in mustard crop: Before conducting CFLDs in the farmer's field, on the basis of survey data, major technological gaps were observed with respect to mustard production technology in Changthang region of Leh-Ladakh. The highest gap 62 per cent was recorded in the case of the method of sowing and spacing followed by weed management (57%), nutrient management (48%), irrigation management (43%), variety (37%), seed rate (29%), harvesting and threshing (24%) and sowing time (18%), respectively. Similar findings have also been observed by Balai *et al.* (2021).

Under the demonstration plots, the improved seed of mustard varieties RLM-514 and Pusa Mustard-25 was given to the beneficiary farmers by KVK Nyoma and all other package of practices (Table 1) were timely performed by the farmers themselves under the guidance and supervision of KVK scientists. In their practice, farmers use a high seed rate of local variety or a low-yielding variety of mustard without proper management. From the above data, it can be deduced that major gap was found in the method of sowing and spacing of mustard crop due to the lack of proper knowledge and as most of the farmers were having very less size of land holding, thereby facing difficulty to use modern farm machinery for seed sowing ultimately they use more seed rate by broadcasting method without maintain any spacing. Further, gap was observed in weed management practice due to poor

Table 1: Difference between technological interventions among demonstration plots and farmer's practice in mustard crop

Components	Demonstration plots	Farmer's practice	Gap (%)
Seed rate	10 kg/ha	12-14 kg/ha	29
Variety	RLM-514 and Pusa Mustard-25	Local	37
Sowing time	Month of May	May end-first fortnight of June	18
Method of sowing and spacing	Line sowing at 25 cm apart	Broad casting, uneven plant population	62
Nutrient management	FYM 150 qtls/ha	50-100 qtls/ha	48
Weed management	One hand weeding after 30-35 DAS	Not-follow weeding management	57
Irrigation management	5 Irrigations	Improper irrigations	43
Harvesting and threshing	Last week of August to second week of September month	Inappropriate time of harvesting and threshing	24

Table 2: Seed yield and gap analysis among Cluster Front Line Demonstrations (CFLDs) plots and farmer's practice in mustard crop

Year	No. of Demo	Area (ha)	Potential Yield (qt/ha)	Average Yield (qt/ha)		% increase in yield over Farmer's Practice	Technology gap (qt/ha)	Extension gap (qt/ha)	Technology index (%)
				DP	FP				
2018-19	25	1.18	15	7.3	5.97	22.28	7.7	1.33	51.33
2019-20	30	2.02	15	8.34	7.2	15.83	6.66	1.14	44.40
Total	55	3.20	-	-	-	-	-	-	-
Average			15	7.82	6.58	19.06	7.18	1.23	47.87

DP=Demonstration Plots; FP=Farmer's Practice

awareness and untimely and less availability of labour during the crop season. Likewise, next gap was observed in nutrient management because either mostly farmers were devoted to the organic cultivation practices or they were not acquainted about the proper organic nutrient management in the mustard cultivation. Similar findings have also been observed by Raj *et al.* (2013) and *Balai et al.* (2021).

Yield: The data in Table 2 revealed that the maximum average yield of mustard under demonstrations was recorded (8.34 q/ha) during year 2019-20 and the minimum average yield was recorded in 2018-19 (7.3 q/ha) and the average yield of two years was recorded 7.82 q/ha over farmer practices (6.58 q/ha). The average increase in yield was 19.06 per cent recorded during two years of study. The higher yield of mustard could be attributed due to the adoption of improved variety with improved production practices of mustard. The results clearly indicated the positive effects of CFLDs over the existing practices toward enhancing the yield of mustard in different clusters in Changthang region of Leh-Ladakh. These results corroborate the findings of Meena *et al.* (2020) and Tiwari *et al.* (2017) in mustard.

Extension gap: Evaluation of the findings of study (Table 2) stated that the extension gap was highest (1.33q/ha) during 2018-19 and lowest (1.14 q/ha) during 2019-20. Such gap might be attributed to adoption of improved technology especially timely sowing of high yielding varieties with suitable sowing method, proper seed rate, weed management and irrigation management measure in demonstrations. More use of improved production technologies with high yielding varieties will subsequently change this hurdle of extension gap. Similar findings were recorded by Meena *et al.* (2020).

Technology gap: The technological gap in the adoption of mustard cultivation technologies under demonstration and farmer's practices was measured. The technology gap was highest (7.70 q/ha) in the demonstrations plot during 2018-19 and lowest (6.66

q/ha) during 2019-20. The average technology gap of two years of demonstrations was 7.18 q/ha. The technology gap observed may be attributed to dissimilarity in crop management practices and some extent to variation in soil fertility and local micro-climatic conditions. Hence, a location-specific recommendation appears to be necessary to bridge the technology gap. Similar findings were recorded by (Tiwari *et al.,* 2017 and Meena *et al.,* 2020).

Technology index: Data on the technology index presented in Table 2 shows that the highest technology index (51.33%) and lowest (44.40 %) were recorded during the year of 2018-19 and 2019-20, respectively. Further, an average technology index 47.88 per cent was observed during two years of CFLDs of mustard, which shows the efficacy of good performance of technical interventions. The lower is the value of the technology index, more is the feasibility of technology and higher technology index reflected the inadequate transfer of proven technology to growers and insufficient extension services. However, fluctuation in technology index during the study period in a certain region may be attributed to the dissimilarity in soil fertility status and adverse weather conditions.

Economic analysis: Economics of improved production technology practices under cluster front line demonstrations of mustard as well as farmers' practice were estimated on the basis of prevailing market rates. The cultivation of mustard under demonstrations gave a maximum net return (Rs. 8116/ha) during the year 2019-20 due to higher seed yield. The higher additional returns (Rs. 4520/ha) and effective gain (Rs. 4370/ha) obtained during the year 2018-19 under demonstration could be due to improved technology and non-monetary factors, timely operations of crop cultivation and scientific monitoring. Further, front line demonstrations averaged over two years, higher average gross return (Rs. 27431/ha), additional returns (Rs. 4371/ha), average net return (Rs. 8096/ha), effective gain (Rs. 4236/ha) were recorded as compared to farmer practice. The lowest and highest benefit: cost ratio of 1.37 and 1.48 during 2019-20 and 2018-19, respectively (Table 2) depends on yield difference, cost of cultivation and local market sale rates. Overall average benefit: cost ratio was obtained 1.43 under demonstration plots. The results suggested that increase in yield and economic viability of mustard were obtained by adoption of improved practices under specific agro-ecological situation. Similar results have earlier been reported on mustard by Chaudhary *et al.* (2018) and Meena *et al.* (2020) on mustard.

Adoption level of mustard production technology by the partner farmers: The adoption level of different technological parameters of mustard crop growing practices for enhancing the production of mustard in the eastern region of Ladakh was analyzed separately such as seed rate, variety, sowing time, method of sowing and spacing, manure management, weed management, irrigation management and harvesting and threshing. The relative importance of adoption level of all eight technological parameters of the mustard cultivation was highlighted by ranking them in descending order on the basis of their per centage of adoption and data have been presented in Table 4.

The data revealed that the partner farmers had maximum adoption in 'sowing time' was 73.25 per cent and assigned rank first. The second rank was accorded to the 'seed rate' as it was adopted to the 71.27 per cent and the third rank was assigned to the 'variety' with the adoption of 68.14 per cent. Likewise 'irrigation management' (64.31%), 'method of sowing and spacing' (63.23%), 'manure management' (55.14%),

Table 3: Economical comparison among Demonstration Plots and Farmer's Practice in mustard crop

Year	Average Cost of cultivation (Rs/ha)		Additional cost in DP	Average Gross Return (Rs/ha)		Additional return in DP	Average Net Return (Rs/ha)		Effective gain (Rs/ha)	Benefit-Cost Ratio	
	DP	FP	(Rs/ha)	DP	FP	(/ha)	DP	FP		DP	FP
2018-19	16750	16600	150	24826	20306	4520	8076	3706	4370	1.48	1.22
2019-20	21920	21800	120	30036	25815	4221	8116	4015	4101	1.37	1.18
Average	19335	19200	135	27431	23061	4371	8096	3861	4236	1.43	1.20

DP=Demonstration Plots FP=Farmer's Practice

Table 4: Technological parameter wise adoption level of mustard production technology by the partner farmers (PF=55)

S. No.	Technological parameters	Partner farmers	
		Extent of adoption (%)	Rank
1	Sowing time	73.25	I
2	Seed rate	71.27	II
3	Variety	68.14	III
4	Irrigation management	64.31	IV
5	Method of sowing and spacing	63.23	V
6	Manure management	55.14	VI
7	Harvesting and threshing	54.21	VII
8	Weed management	47.17	VIII
	Overall adoption	62.09	

PF = Number of Partner Farmers

'harvesting and threshing' (54.21%), and 'weed management' (47.17%) were assigned ranked IV, V, VI, VII and VIII, respectively. Further the data in Table 4 also indicated that overall adoption of technological parameters by the partner farmers in mustard production technology was 62.09 per cent. The results of the study are in line with the findings of Balai *et al.* (2021).

From the adoption level of individual technological parameters of mustard cultivation, it was concluded that the partner farmers had more adopted to the 'sowing time'. The results seemed to be quit natural because of the fact that the farmers were more acquainted to the 'sowing time' due to their past experience of the climatic conditions of the crop growing area, whereas less adopted to the 'weed management' practice. This might be due to fact that the farmers had more focus on mustard cultivation by the organic practices, so they were not applied any weedicide for weed management. Other manner by manually weeding, they were faced labour scarcity during the crop growing season. Therefore, In order to convert less adoption to more adoption, extension agencies should give more emphasis on the methodologies of weed management by organically to transfer of technology in acceptable manner for the farmers.

CONCLUSION

Mustard is one of the important oilseeds crops in India. Its production increased by the use of improved varieties, proper sowing time, nutrient management, irrigation management *etc.* Keeping all these views in mind, CFLDs on mustard was conducted by Krishi Vigyan Kendra-Nyoma, Leh-Ladakh. It can be concluded that average highest yield 7.82 q/ha found in demonstrations plots against 6.58 q/ha in farmer practices. There was 19.06 per cent increase yield observed in demonstration plots over farmer practices. further adoption of mustard production technology *i.e.* 'sowing time' was widely adopted by the farmers because they have past experience about the sowing time and climatic situation of the particular area, where as 'weed management' practice was lees adopted due to labour scarcity during crop season and mostly farmers prefer the organic cultivation practices, so they were not applying the weedicide. From the above findings, it can be concluded that use of scientific technologies of mustard cultivation could reduce the technology gap to a considerable extent resulting in to increased production and productivity of mustard in Changthang region of Leh-Ladakh as compared to prevailing farmers practice under real farming situations. It requires collaborative extension efforts to enhance the adoption level of location and crop specific technologies among the farmers for bridging these gaps. Therefore, extension agencies in the district need to provide proper technical support to the farmers through various educational and extension methods in acceptable manner for the enhancement of area and production of oilseed crops in the Leh-Ladakh.

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Assessment of Sponge Gourd [*Luffa cylindrica* (L.) Roem.] Germplasm Collections of Assam for Important Productivity Traits

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ABSTRACT

An experiment was conducted at the farm site of Krishi Vigyan Kendra (KVK), Jorhat, Assam Agricultural University (AAU) during 2017 for assessment of sponge gourd germplasm collections of Assam. Among thirty-three genotypes collected from different districts of Assam, the genotype SGG29 exhibited the highest mean performance for primary branches (6.8), internode number (55.4), marketable fruit yield per plant (3.87 kg) and marketable fruit yield per hectare (16.13t). Maximum number of fruits per plant (10.0) as well as the highest fruit length (48.1cm) was exhibited by the genotype SGG30 while SGG2 recorded maximum fruit diameter (8.2cm). Minimum number of days to appearance of first female flower 40 and 41 days were exhibited by the genotypes SGG29 and SGG26, respectively.

Keywords: Sponge gourd, Genotypes, Female flower, Fruit weight, Marketable fruit yield

INTRODUCTION

Sponge gourd or smooth gourd [*Luffa cylindrica* (L.) Roem.] belongs to the family Cucurbitaceae. It is a cross-pollinated crop and has somatic chromosome complement of 2n = 26. The origin of smooth gourd is South and South East Asia. It has been cultivated for centuries in the Middle East, India, China, Japan and Malaysia (Porterfield, 1955). In India it is largely cultivated in Uttar Pradesh, Bihar, West Bengal, Odisha, Assam and Madhya Pradesh. It is an emerging high potential crop in Asia though it is considered as an underutilized vegetable. Sponge gourd is grown in tropical and subtropical climate and requires a long growing season and warm climate and it cannot withstand frost condition. Temperature requirement for its growth is 25°-27°C and average annual rainfall is 1500-2500 mm.

It is an annual vine crop with slim and five angled stems. The vine bears tendrils and has long cylindrical or oblong fruits of approximately 10-40 cm in length and 6-10 cm in diameter. It is a monoecious plant; staminate flowers develop in an inflorescence, whereas pistillate flowers develop singly or in association with staminate flowers (Takahashi, 1980). Huge variation has been observed in sponge gourd genotypes for various traits. The north eastern region including Assam has rich diversity and variability in genetic resources of smooth gourd. It is cultivated on a commercial scale and also grown in homestead garden for its immature fruits and used as cooked vegetable. Although smooth gourd is a very important vegetable crop, yet the reports on variability studies on the germplasm of this region are not available. Therefore, an experiment was conducted for assessment of sponge gourd local collections of Assam.

MATERIALS AND METHOD

The investigation was conducted at the farm site of Krishi Vigyan Kendra (KVK), Jorhat, Assam Agricultural University (AAU) during 2017. Kaliapani, the farm site of KVK Jorhat, is situated approximately at 86.6 meters above the mean sea level with latitude of 26.83°N and longitude of 94.45°E. The site has a hot and humid climate during summer and cool and dry weather in the winter season. The experimental

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materials comprised of thirty-three genotypes of sponge gourd collected from different districts of Assam in the year 2016. An improved variety Pusa Sneha from IARI, New Delhi was also included as a check variety. The genotypes were SGG1, SGG2, SGG3, SGG4, SGG5, SGG6, SGG7, SGG8, SGG9 SGG10 SGG11 (Pusa Sneha), SGG12, SGG13, SGG14, SGG15, SGG16, SGG17, SGG18, SGG19, SGG20, SGG21, SGG22, SGG23, SGG24, SGG25, SGG26, SGG27, SGG28, SGG29, SGG30, SGG31, SGG32 and SGG33.

The experiment was laid out in a Randomized Block Design with two replications at 2.0 m x 1.2 m row to row and plant to plant spacing. All the recommended package of practices were followed to raise a healthy crop. Five randomly selected plants were tagged to record the observations on various traits viz., primary branches, internode length (cm), days to appearance of first female flower, internode number, node number at which first female flower appears, days to first fruit harvest, fruit length (cm), fruit diameter (cm), female flowers per plant, fruits per plant, fruit weight (g), male-female flower ratio, marketable fruit yield per plant (kg) and marketable fruit yield per hectare (t/ha).

RESULTS AND DISCUSSION

Analysis of variance for the characters under study presented in Table 1 revealed that replication mean square value was significant for days to appearance of first female flower and the same was highly significant for the traits *viz.*, primary branches, internode length, fruit length, female flowers per plant, fruits per plant, male-female flower ratio, marketable fruit yield per plant and marketable fruit yield per hectare. The genotype mean square for each of the traits was found highly significant. The study revealed that there is existence of considerable variability among the genotypes studied.

In the investigation the mean performance of the sponge gourd genotypes showed significant variations in respect of various growth and yield characters among themselves due to their genetic constitutions leading to expression of morphological, physiological and other attributes. The mean values of the traits are presented in Table 2.

Primary branches: Higher numbers of primary branches are important for better vigour of plant because, as the number of primary branches increase,

Table 1: Analysis of variance for fruit yield and its different components

Characters	Mean squares		
	Sources of variation		
	Replication df 1	Genotype df 32	Error df 32
Primary branches	8.085**	2.497**	0.078
Internode length	18.773**	21.084**	1.780
Days to appearance of first female flower	10.801*	170.101**	1.691
Internode number	12.393	95.774**	9.950
Node number at which first female flower appears	0.095	11.063**	0.202
Days to first fruit harvest	0.015	172.802**	2.094
Fruit length	37.576**	137.794**	0.775
Fruit diameter	0.044	1.559**	0.091
Female flower per plant	15.323**	3.301**	0.448
Fruits per plant	14.655**	4.448**	0.389
Fruit weight	822.560	7424.583**	1640
Male-female flower ratio	3.83**	7.027**	0.386
Marketable fruit yield per plant	1.607**	1.110**	0.065
Marketable fruit yield per hectare	28.030**	19.283**	1.138

* Significant (P=0.05), ** Highly significant (P=0.01)

Table 2: Mean performance of sponge gourd for various characters

Genotypes	Characters													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SGG1	2.8	14.4	55	34.4	10.7	70	31.3	4.6	7.5	6.4	275	10.2	1.77	7.37
SGG2	2.7	22.7	60	30.6	11.3	75	16.9	8.2	5.5	3.5	265	11.7	0.97	4.01
SGG3	1.9	19.9	60	31.9	11.0	77	20.0	4.5	7.2	6.4	267	10.4	1.70	7.08
SGG4	4.4	15.5	55	34.9	10.8	71	22.8	4.6	8.4	6.8	265	12.6	1.80	7.51
SGG5	5.8	15.5	73	38.0	10.4	89	33.5	4.4	8.7	7.3	328	11.1	2.38	9.89
SGG6	2.2	18.2	63	30.9	11.4	78	13.7	5.8	6.4	4.3	310	12.2	1.33	5.52
SGG7	4.5	13.4	50	38.9	11.1	68	32.0	5.4	9.0	8.2	464	10.3	3.77	15.71
SGG8	4.6	21.2	59	32.6	11.2	75	23.5	3.9	7.9	6.4	220	15.5	1.41	5.85
SGG9	3.4	15.0	60	38.1	13.5	75	13.2	6.3	7.0	5.3	281	11.8	1.41	5.88
SGG10	4.4	17.2	53	35.3	10.9	69	29.8	5.2	7.9	6.4	316	11.1	2.03	8.46
SGG11	3.2	10.6	49	49.7	15.7	64	25.8	5.2	8.8	6.9	376	10.5	2.60	10.81
SGG12	4.4	11.4	66	45.1	13.4	81	34.8	5.6	8.8	7.7	355	11.0	2.72	11.31
SGG13	3.5	10.3	72	39.8	15.9	87	26.0	5.5	9.8	7.6	317	9.7	2.35	9.79
SGG14	3.4	17.9	72	37.7	16.0	88	33.8	5.0	8.5	6.9	265	8.5	1.85	7.69
SGG15	4.7	16.1	70	35.4	16.8	88	37.8	4.8	8.3	6.4	278	8.8	1.78	7.39
SGG16	4.2	15.6	60	46.6	11.6	77	16.8	6.1	9.2	6.6	301	8.6	1.89	7.85
SGG17	4.4	14.9	54	43.4	11.2	70	18.7	6.0	8.4	5.0	215	9.0	1.07	4.44
SGG18	3.8	20.0	60	29.1	17.0	76	35.0	5.2	5.3	3.4	320	12.5	1.11	4.63
SGG19	3.8	14.5	72	33.9	15.7	86	26.5	6.2	7.2	4.3	256	10.9	1.09	4.54
SGG20	4.4	15.3	73	37.6	16.8	90	40.0	5.8	8.8	6.7	266	8.9	1.78	7.39
SGG21	2.9	16.6	69	30.1	15.3	85	34.3	6.4	9.5	5.2	237	9.5	1.23	5.11
SGG22	4.5	11.8	63	52.4	13.8	77	19.3	6.4	10.8	7.8	290	6.9	2.25	9.38
SGG23	3.2	16.4	52	31.6	11.4	67	36.0	5.3	7.7	6.2	400	12.9	2.47	10.29
SGG24	2.0	20.0	60	36.0	13.7	76	25.1	5.8	6.1	3.7	332	14.6	1.20	5.00
SGG25	3.4	12.7	60	40.1	12.7	76	28.0	4.8	7.8	5.2	372	10.5	1.92	7.98
SGG26	4.9	15.2	41	47.0	9.9	57	28.8	4.7	8.4	5.5	405	9.6	2.23	9.26
SGG27	3.6	14.8	58	41.7	12.1	73	27.0	5.5	8.7	5.8	329	9.8	1.89	7.88
SGG28	3.2	20.7	53	32.0	11.4	67	33.7	5.0	8.2	5.7	271	10.6	1.53	6.37
SGG29	6.8	10.8	40	55.4	9.6	55	36.6	5.9	9.4	9.0	431	10.4	3.87	16.13
SGG30	5.7	16.0	46	46.2	9.9	60	48.1	3.5	10.9	10.0	370	7.7	3.71	15.43
SGG31	4.7	14.6	66	39.4	15.3	82	41.3	4.3	7.4	6.0	309	12.6	1.85	7.71
SGG32	2.4	11.8	51	41.7	10.8	67	25.8	5.5	7.2	5.7	400	11.6	2.27	9.44
SGG33	5.1	11.9	46	49.5	10.4	62	23.5	4.7	8.8	7.1	343	8.4	2.40	10.00
SEd	0.28	1.33	1.30	3.15	0.45	1.45	0.88	0.30	0.67	0.62	40.51	0.62	0.26	1.07
CD 0.05	0.6	2.7	3.0	6.4	0.9	2.9	1.8	0.6	1.4	1.3	83	1.3	0.52	2.13

(1) Primary branches; **(2)** Internode length (cm); **(3)** Days to appearance of first female flower; **(4)** Internode number; **(5)** Node number at which first female flower appears; **(6)** Days to first fruit harvest; **(7)** Fruit length (cm); **(8)** Fruit diameter (cm); **(9)** Female flowers per plant; **(10)** Fruits per plant; **(11)** Fruit weight (g); **(12)** Male-female flower ratio; **(13)** Marketable fruit yield per plant (kg); **(14)** Marketable fruit yield (t/ha) number of secondary and tertiary branches also increase. Increased number of primary branches might have resulted higher number of female flowers as well as fruits per plant. In the present investigation, the genotype SGG29 recorded the highest mean performance for primary branches with the values 6.8. The genotypes showed a range of 1.9 (SGG3) - 6.8 (SGG29). The check variety SGG11 (Pusa Sneha) showed the values of 3.2. The five top most genotypes surpassing the check for estimate of primary branches were SGG29 (6.8), SGG5 (5.8), SGG30 (5.7), SGG33 (5.1) and SGG26 (4.9). Singh *et al.* (2019) evaluated twenty-eight genotypes of sponge gourd and observed that the number of primary branches per plant ranged from 3.26 to 8.26.

Internode length: Increased internode length results in increased length of vine. Longer vine length yields more number of branches as well as fruits per vine. Shorter internode may also produce a greater number of nodes per plant as a result there will be a greater number of primary branches as well as fruits per plant. Genotypes SGG2 (22.7 cm), SGG8 (21.2 cm) and SGG28 (20.7 cm) showed the highest mean values for the trait internode length. Out of the genotypes tested, the genotypes with the shortest mean value for internode length were SGG13 (10.3 cm), SGG11 (10.6 cm), SGG29 (10.8 cm), SGG12 (11.4 cm). SGG22 (11.8 cm), SGG32 (11.8 cm), SGG33 (11.9 cm) and SGG25 (12.7 cm). The genotypes were in the range of 10.3 cm (SGG13) - 22.7 cm (SGG2) for the trait. Truong *et al.* (2017) revealed that internode length varied from 17.76 - 20.18 cm among the seven inbred lines of sponge gourd they studied.

Days to appearance of first female flower: Minimum number of days to first female flower appearance is a preferred trait in sponge gourd as it indicates the earliness of the variety. In the present investigation, smaller number of days to appearance of first female flower was observed in SGG29 and SGG26 with 40 days and 41 days, respectively. The genotypes SGG29 (40 days) and SGG26 (41 days) recorded lower value of days to appearance of first female flower as compared to the check variety (49 days). Thirty-three genotypes showed ranges of 40 days (SGG29) –73 days (SGG5). Som *et al.* (2020) also observed similar results of 56.00 - 69.33 days to anthesis of first female flower in fifteen numbers of sponge gourd genotypes.

Internode number: Higher number of internodes results in higher number of nodes as well as number of primary branches. Increased number of primary branches increases the number of fruits and yield of the plant. The highest number of internodes were observed in the genotypes SGG29 (55.4), SGG22 (52.4), SGG11 (49.7) and SGG33 (49.5). The range was from 29.1 (SGG18)-55.4 (SGG29) for the trait internode number. None of the genotypes outperformed the check (49.7) for internode number. Khan *et al.* (2015) noticed that sponge gourd variety Pusa Chikni had 41.33 numbers of nodes in a vine.

Node number at which first female flower appears: Earliness is a useful character for grasping the possible economic yield in a short time in sponge gourd. Lower position of the node of female flower is essential for getting early yield and, thus, lower estimate of node number at which first female flower appears is considered a desirable character. In the investigation, the genotypes which bore female flowers at nodes situated at lower position were SGG29 (9.6), SGG26 (9.9), SGG30 (9.9), SGG5 (10.4) and SGG33 (10.4). The range of genotypes was from 9.6 (SGG29) -17.0 (SGG18). Twenty-four genotypes exhibited lower values as compared to the check variety SGG11 (15.7). Findings on position of effective node at which first female flower appeared were reported by Choudhary *et al.* (2016) in which they got 11.8 - 18.8 node position in sponge gourd.

Days to first fruit harvest: Early varieties are mostly preferred for better yield and profitability in any crop. In the present study earliest genotypes with minimum days taken to first fruit harvest were SGG29 (55 days) and SGG26 (57 days). The genotypes tested in this year lay in the range of 55 days (SGG29) - 90 days (SGG20). Three genotypes namely, SGG29, SGG26 and SGG30 (60 days) recorded lower values as compared to the check variety SGG11 (64 days). The results were in agreement with the findings of a trial on performance of ridge gourd varieties by Karthick *et al.* (2017).

Fruit length: Fruit length is an important yield contributing trait. Longer fruits contribute to higher yield. SGG30 bore the longest fruits with a length of 48.1 cm. The genotypes were in the range of 13.2 cm (SGG9) - 48.1 cm (SGG30). Seventeen genotypes showed longer fruits as compared to the check (25.8 cm). Nazimuddin and Naqvi (1984) reported that the fruit length varied from 32.3 to 55.4 cm in sponge gourd.

Fruit diameter: Yield is influenced by diameter of the fruit. Maximum diameter of fruit was observed in the genotype SGG2 with a value of 8.2 cm while the minimum fruit diameter was observed in the genotypes, SGG30 (3.5 cm) and SGG8 (3.9 cm). The range of the genotypes for fruit diameter was between 3.5 cm (SGG30) and 8.2 cm (SGG2). Eight genotypes showed wider fruits as compared to the check SGG11 (5.2 cm). Som *et al.* (2020) reported that the fruit girth ranged from 6.4 - 11.69 cm in fifteen genotypes of sponge gourd.

Female flowers per plant: In all cucurbitaceous vegetables, greater number of female flowers is an important yield attributing trait. Fruits per plant are directly related to the number of female flowers per plant. Higher number of female flowers lowers the sex ratio in sponge gourd. Altogether three genotypes namely, SGG13 (9.8), SGG22 (10.8) and SGG30 (10.9) topped the list for number of female flowers per plant. The genotypes tested were in the range from 5.3 (SSG18) to 10.9 (SGG30). Two genotypes namely, SGG22 (10.8) and SGG30 (10.9) showed higher female flowers per plant as compared to the check variety (8.8). Truong *et al.* (2017) stated that the number of female flowers per vine varied from 17.33 - 22.33.

Fruits per plant: Fruit number is an essential yield contributing trait. Yield of the plant is directly related to the number of fruits. The highest value of fruits per plant was observed in SGG30 (10.0) and SGG29 (9.0). The range of the genotypes under test was 3.4 (SGG18) to 10.0 (SGG30) for the trait. Two genotypes namely, SGG30 and SGG29 outshined the check variety, SGG11 (6.9) for fruits per plant. Khan *et al.* (2015) reported that average number of fruits per plant was 9.33 in sponge gourd variety Pusa Chikni.

Fruit weight: Higher fruit weight is significant for obtaining higher yield in sponge gourd. Five genotypes namely, SGG7 (464 g), SGG29 (431 g), SGG26 (405 g), SGG23 (400g) and SGG32 (400 g) recorded the highest weight of fruit being statistically at par to each other. The mean fruit weight of thirty-three genotypes ranged from the lowest value of 215 g (SGG17) to the highest value of 464 g (SGG7). Out of the genotypes having largest fruits, only one genotype namely, SGG7outshined the check variety (376 g) while the remaining genotypes *viz.*, SGG29, SGG26, SGG23 and SGG32 were statistically at par with the check variety. Som *et al.* (2020) observed that the fruit weight ranged from 276.66-560.00 g in fifteen numbers of sponge gourd genotypes.

Male-female flower ratio: Low male to female flower ratio (sex ratio) is advantageous and economical in monoecious cucurbitaceous vegetables like sponge gourd because it results in greater number of pistillate flowers and thereby higher fruit set and yield. The genotypes SGG22 and SGG30 had the lowest value 6.9 and 7.7 of male- female flower ratio among the genotypes tested. The range of the genotypes for the trait was from 6.9 (SGG22) to 15.5 (SGG8). Eight genotypes showed lower male-female flower ratio values as compared to the check variety (10.5). Mahida *et al.* (2015) from an investigation conducted on Pusa Chikni variety of sponge gourd, reported that the male - female flower ratio was 17.25.

Marketable fruit yield per plant: Yield depends on various factors such as higher number of primary branches, higher number of female flowers, lower male-female flower ratio and larger values of all of the traits *viz.*, fruit numbers, fruit weight, fruit length and fruit girth. The highest marketable fruit yield per plant was observed in the genotypes *viz.*, SGG29 (3.87 kg), SGG7 (3.77 kg) and SGG30 (3.71 kg). The range of genotypes was from 0.97 kg (SGG2) – 3.87 kg (SGG29). These three genotypes outperformed the check variety SGG11 (2.60 kg) for the trait with yield superiority of 48.85 %, 45.00 % and 42.69%, respectively. Singh *et al.* (2019) reported that average fruit yield per plant ranged from 1.28 to 3.08 kg in sponge gourd genotypes.

Marketable fruit yield per hectare: The highest marketable fruit yield per hectare was observed in the genotypes *viz.*, SGG29 (16.13 t/ha), SGG7 (15.71 t/ha) and SGG30 (15.43 t/ha) and these genotypes outperformed the check variety by 49.21, 45.33 and 42.74%, respectively.

CONCLUSION

The genotype mean square for each of the traits under investigation was found highly significant. This indicates that there was ample variation among the genotypes for these traits. The genotype SGG29 exhibited the highest mean performance for primary branches, internode number, marketable fruit yield per plant and marketable fruit yield per hectare. Genotype SGG30 showed the maximum number of fruits per plant as well as the highest fruit length. Genotypes SGG26 and SGG29 exhibited minimum number of days to appearance of first female flower. Studies revealed that the genotypes SGG7, SGG29 and SGG30 were found to be promising for fruit yield with 15.71, 16.13 and 15.43 t/ha, respectively

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Promoting Resource Conservation Technologies using Community Irrigation Approach– An Initiative in Farmer FIRST Programme

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ABSTRACT

Resource conservation technologies offer judicious use of natural resource without impairing crop productivity. It minimizes the degradation of soil and water and improves the quality of it. Rice based cropping system is dominant in India and it requires high amount of irrigation water. Erratic and uneven distribution of rainfall increases dependency on supplemental irrigation in rice that exploited ground water. While, following cereal–cereal based cropping system exhaust plant nutrient from soil and hampered the productivity of next grown crop. Thus, to sustain its productivity and conservation of resources adoption of resource conservation technologies are required at farmer's field. Rainwater harvesting technology provides supplemental irrigation to maintain crop productivity and also groundwater recharge. Vermi-compost improves the soil health by providing essential nutrients and organic matter in the soil. These resource conservation technologies were adopted in the farmer's field under Farmer FIRST Programme in Chhattisgarh state in rice based cropping system. Thus, the present study is on farm trial conducted to assess the effect of resource conservation technologies in rice crop in terms of yield enhancement and economic gain. Rainwater harvesting technology and community irrigation was adopted by 100 farm families and 70 farm families, respectively for two year 2019-20 to 2020-21 and rice yield increased by 15.88 per cent to 30.06 per cent. Total 26 vermi-compost units established by 26 farm families for two year 2019-20 to 2020-21 and average 33.5 q/pit/year vermi-compost produced annually. These resource conserving technologies were promoted at farmer's field to save soil, water and other natural resources.

Keywords: Community irrigation, Natural resources, Rainwater harvesting, Sustainable development, Vermi-compost production, Water conservation technologies

INTRODUCTION

Indian economy backboned by agriculture as its 54.6 per cent total workforce is engaged in agricultural and allied sectors and accounts 17.08 per cent to Gross Value Added of the country for the year 2019-20 (Anonymous, 2021). Its food, nutritional, livelihood and economic security is based on the performance of agricultural sector (Bala *et al.,* 2019).

Rice is main staple food in India. It occupied larger area with the advent of green revolution. Improving and sustaining its productivity are main concern for primary food security. Rice crop is exhaustive in nature and heavy feeder of plant nutrients. It requires large amount of irrigation water for frequent irrigation. Erratic and uneven distribution of rainfall during cropping season is a reason behind occurrence of drought and increasing temperature may increase evapo-transpiration rate which demands continuous supply of irrigation during critical stages of crop. Exhaustion of natural resource not only hindered the production and productivity of rice but also increases the concern towards food security by depletion of natural resources and impact of climate variability.

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Growing population and poverty is still major challenge after producing sufficient amount of food grains to India (Bhan and Behera, 2014). Deprivation of biodiversity, loss of soil fertility and water scarcity impedes the production and productivity of the crop (McIntyre *et al.,* 2009). The intensive agriculture has impact on the environment that affects availability of natural resources. Degradation of soil and water has adverse impact on agricultural production and productivity.

To reduce the burden on natural resources and overcoming to these issues adoption of resource conservation technology is imperative to sustain productivity and livelihood of the farmers (Singh *et al.,* 2020). Resource conservation technologies offer the secure use and continuous supply of resources while maintaining their quality, value and diversity by planning and management of resources (Mandal *et al*., 2014). Rain water harvesting is one of the resource conservation technologies that offers continuous supply of irrigation water in absence of rainfall and also recharge ground water table. Vermi-compost and organic manure helps in increasing soil health by providing nutrients and adding organic matter which improves soli structure. It also helps in improving water holding capacity of the soil.

Keeping these facts in mind rain water harvesting, community irrigation and vermi-compost production as resource conservation technologies are promoted for adoption at farmer's field in rice-based cropping system under Farmer FIRST Programme to improve and sustain productivity of the rice crop and maintaining soil health by conserving natural resources. Thus, the study is based on the On-farm trials conducted in Chhattisgarh where Farmer FIRST Programme is operational that gave major emphasis on resource conservation technologies through renovation and recharging of old water harvesting structure, community fencing and sharing irrigation in rice crop and vermi-compost for soil health management.

MATERIALS AND METHODS

The On-Farm Trials on resource conservation technologies were conducted in district Rajnandgaon, Chhattisgarh under Farmer FIRST Programme. The district comes under Chhattisgarh Plains Agro-climatic zone and follows rice based cropping system.

The trial on resource conservation technology was conducted for two consecutive years 2019-2020 and 2020-21. Under this innovative approach, trials were conducted by involving 100 farm families on rain water harvesting technology by renovation of old water harvesting structure and recharging for these two consecutive years. Like-was trials on community fencing and sharing of irrigation conducted by involving 70 farm families for these two consecutive years. Under vermi-compost production technology 26 vermi-compost pit were also established by involving 26 farm families for these two consecutive year. The critical inputs were provided to the farmers after discussion with them and analysis their priority before operationalizing trials. The yield performance of rice crop for each trial and vermi-compost production for each unit was recorded time to time during the crop season.

RESULTS AND DISCUSSION

The data pertaining to Table 1 shows yield performance of rice under upland condition due to renovation of old water harvesting structure like ponds, shallow dug wells and small ditches and recharging them. The average yield 27.78 q/ha was found under renovation of old water harvesting structure compared to 24.35 q/ha in farmers' practice. The yield enhancement in renovation of old water harvesting was 14.09 percent over farmers' practice. It might be due to availability of irrigation in whole length of crop growth period. Hailu *et al.* (2021) concluded in his study that frequent application of irrigation ensures optimal crop growth and development. The renovation of old water harvesting structure is helpful in conserving rainfall efficiently and provides irrigation in absence of rainfall.

Table 1: Yield performance of rice due to rainwater management technology under upland condition

Practice	Yield (q/ha)		Average Yield (q/ha)	% increase over farmers practice
	2019-20	2020-21		
Farmers' Practice	21.1	27.6	24.35	14.09
Renovation of old water harvesting structure	25.28	30.28	27.78	

Economic analysis was presented by cost and return estimation of rice under upland condition in Table 2. Average gross income in renovation of old water harvesting structure and farmers' practice were Rs. 94325/ha and Rs. 73862.5/ha, respectively. Enhancement in average net income was Rs. 66490/ha in renovation of old water harvesting structure compared to Rs. 50450/ha in farmers practices which was 31.79 per cent more. The average cost of cultivation accounted [1] 27835/ha compared to Rs. 23412.5/ha in farmers' practice. The higher benefit cost ratio of 3.39 was observed in renovation of old water harvesting structure while it was 3.15 in farmers' practice.

The perusal of data presented in Table 3 shows yield performance of rice under midland condition due to renovation of old water harvesting structure like ponds, shallow dug wells and small ditches and recharging them. The mean yield 37.43 q/ha was found under renovation of old water harvesting system compared to 29.94 q/ha in farmers' practices. The yield enhancement in renovation of old water harvesting was 25.02 percent over farmers' practice. The water harvesting structure used as source of water for irrigation during dry spell which more sustainable source available at locally (Tamburino *et al.,* 2020).

Economic analysis of rice cultivation under midland condition was presented in Table 4. Average gross income in renovation of old water harvesting structure and farmers' practice were Rs. 123555.5/ha and Rs. 95540/ha, respectively. Average net income in renovation of old water harvesting structure was Rs. 88795.5/ha compared to Rs. 66755/ha in farmers' practices. Increasement in average net income was 31.79 percent over farmers' practice. The average cost of cultivation amounted as Rs. 34760/ha compared to Rs. 28785/ha in farmers' practice. The higher benefit cost ratio of 3.55 was observed in renovation of old water harvesting structure while it was 3.32 in farmers' practice.

Community fencing is helpful in protection of crop from grazing animals and community sharing of irrigation is beneficial to small and marginal farmers who can not afford of construction irrigation structure. The data presented in the Table 5 shows yield performance of rice in under community fencing and sharing of irrigation practice. The average yield 44.99 q/ha was found under community fencing and shared irrigation compared to 37.74 q/ha in farmers' practice. The yield enhancement in community fencing and sharing of irrigation was 16.12 percent over farmers' practice. The study of the Malik *et al.* (2008) concluded that there is marginal difference in yield of the rice crop between shared irrigation system and individual commands on irrigation systems.

Table 2: Economic gains in rice due to rainwater management technology under upland condition

Particulars	2019-20		2020-21		Mean Value	
	Farmers' practice	Renovation of old water harvesting structure	Farmers' practice	Renovation of old water harvesting structure	Farmers' practice	Renovation of old water harvesting structure
Cost of cultivation (Rs./ha)	22375	25795	24450	29875	23412.5	27835
Gross Income (Rs./ha)	72025	92035	75700	96615	73862.5	94325
Net income (Rs./ha)	49650	66240	51250	66740	50450	66490
% increase in net income	-	33.41	-	30.22	-	31.79
B:C ratio	3.22	3.57	3.10	3.23	3.15	3.39

Table 3: Yield performance of rice due to rainwater management technology under midland condition

Practice	Yield (q/ha)		Average Yield (q/ha)	% increase over farmers practice
	2019-20	2020-21		
Farmers' Practice	28.37	31.5	29.94	25.02
Renovation of old water harvesting structure	36.2	38.65	37.43	

Table 4: Economic gains in rice due to rainwater management technology under midland condition

Particulars	2019-20		2020-21		Mean Value	
	Farmers' practice	Renovation of old water harvesting structure	Farmers' practice	Renovation of old water harvesting structure	Farmers' practice	Renovation of old water harvesting structure
Cost of cultivation (Rs./ha)	27640	33285	29930	36235	28785	34760
Gross income (Rs./ha)	95530	120641	95550	126470	95540	123555.5
Net income (Rs./ha)	67890	87356	65620	90235	66755	88795.5
% increase in net income	-	28.67	-	37.51	-	33.02
B:C ratio	3.46	3.62	3.19	3.49	3.32	3.55

Table 5: Yield performance of rice in community fencing and sharing of irrigation

Practice	Yield (q/ha)		Average Yield	% increase over
	2019-20	2020-21	(q/ha)	farmers practice
Farmers' Practice	39.80	37.68	38.74	16.12
Community fencing and sharing of irrigation	46.27	43.70	44.99	

The data were analyzed on the basis of economic indicators as cost of cultivation, gross income, net income and B:C ratio to show economic gain in community fencing and sharing of irrigation. The data presented in Table 6 shows that mean gross income in community fencing and sharing of irrigation and farmers' practice were Rs. 120137.5 and Rs. 96295/ ha. Adoption of community fencing and sharing of irrigation increased net income Rs. 86327.5/ha as compared to farmers' practice Rs. 67695/ha. The average cost of cultivation per ha amounted to Rs. 33810 in community fencing and sharing of irrigation and Rs. 28600/ha in farmers' practices. The higher Benefit Cost ratio of 3.55 was observed in community fencing and sharing of irrigation and 3.37 in farmers' practice. The study conducted by Malik *et al.* (2008) on shared well irrigation in Punjab contradict with the result of present study which shows that income from individual irrigation systems were slightly higher than sharing irrigation system.

The data presented in Table 7 revealed yield performance of rice in without water harvesting under farmers' practice and with water harvesting system under improved practice of rice cultivation in five different sites of the district. The water harvesting system includes renovation of old water harvesting structure like pond, shallow dug well and small ditches and community fencing and sharing irrigation sources. Average yield enhancements varies 45.48 q/ha to 53.02 q/ha under water harvesting system while without water harvesting system it varies from 37.05 q/ha to

Table 6: Economic gains in rice due to community fencing and sharing of irrigation

Particulars	2019-20		2020-21		Mean data of both year	
	Farmers' practice	Community fencing and sharing of irrigation	Farmers' practice	Community fencing and sharing of irrigation	Farmers' practice	Community fencing and sharing of irrigation
Cost of cultivation (Rs./ha)	29370	34970	27830	32650	28600	33810
Gross income (Rs./ha)	98340	124360	94250	115915	96295	120137.5
Net income (Rs./ha)	68970	89390	66420	83265	67695	86327.5
% increase in net income	-	29.61	-	25.36	-	27.52
B:C ratio	3.35	3.56	3.39	3.55	3.37	3.55

Table 7: Yield performance of rice without and with water harvesting system

Area	Yield (q/ha)						% increase in yield over Without Water Harvesting System + farmers' practices
	Without Water Harvesting System + farmers practices			With Water Harvesting System + improved practices			
	2019-20	2020-21	Mean data of both year	2019-20	2020-21	Mean data of both year	
Site 1	40.85	40.68	40.76	53.19	52.85	53.02	30.06
Site 2	36.70	37.40	37.05	44.73	46.23	45.48	22.75
Site 3	41.50	42.70	42.10	53.20	51.10	52.15	23.87
Site 4	42.10	43.15	42.63	49.38	49.85	49.62	16.39
Site 5	46.35	41.30	43.83	51.30	50.27	50.79	15.88

Table 8: Soil health management by vermi-compost production

Year	No. of farm families	Yield (q/pit/year)	Cost of cultivation (Rs./pit/year)	Gross income (Rs./pit/year)	Net income (Rs./pit/year)	B:C ratio
2019-20	50	32	4250	23215	18965	5.46
2020-21	50	35	4850	24100	19250	4.97
Mean Value		33.5	4550	23657.5	19107.5	5.20

43.83 q/ha. Minimum average yield (37.05 q/ha) observed in site 2 and maximum average yield (43.83 q/ha) observed in without water harvesting system and farmers practice in site 5. While in with water harvesting structure and improved practices minimum average yield (45.48 q/ha) and maximum average yield (53.02 q/ha) was observed in site 2 and site 1, respectively. The percentage increase in rice yield over without water harvesting system and farmers practices was varies from 15.88 per cent to 30.06 per cent. It may be due to timely availability of irrigation water to crop due to water harvesting system and improved cultivation practices.

Vermi-compost production technology was adopted by the farming household in the district in their backyard of house and near to the water structure in shade area. The size of vermi-compost pit was 5x3x2 ft. The average annual production of vermi-compost was 33.5 q/pit/year.

Economic analysis showed that average cost of production, gross income and net income amounted Rs. 4550 per pit/year, Rs. 23657.5 per pit/year and Rs. 19107.5 per pit/year. The benefit-cost ratio was 5.20 in vermi-compost production. Vermi-compost can be produced at low cost and cost effective than chemical fertilizers. The use of vermi-compost reduces the cost of production and also acts as source of income to the farmers. Moreover it also reduces the irrigation requirements by nearly 30 to 40 percent by retaining soil moisture in large amount (Hussaini, 2013).

CONCLUSION

Resource conservation technologies are possible ways for sustainable agricultural production in era of modern production techniques for conserving soil and water. Under rain water harvesting, renovation of old water harvesting structures are helpful in storing of surface runoff and provide supplemental irrigation as per need of crop. These structures enhance the ground water table by recharging. Community fencing and sharing irrigation provide opportunities to small and marginal farmers who cannot afford irrigation facility at their farm and provides timely irrigation as per the requirement of the crop. Vermi-compost used as organic matter, enhanced the crop productivity by improving soil health condition. The adoption of rain water harvesting technology and community fencing with sharing irrigation sources increased the rice yield by 21.79 per cent and enhanced farmers' income too. Thus resource conservation technology not only saves natural resources but also increases yield and farmers income in a sustainable manner. The wider scale promotion at farmer's field required strengthened research - extension linkage and linked development efforts with formulation of policy for sustainable growth to increase adoption of these resource conservation technologies.

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Reading Behaviour of Farm Women Regarding Household Messages in Print Media

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ABSTRACT

The present investigation was conducted to analyze the reading behaviour of farm women regarding household messages in print media. A total of 200 farm women from five agro-climatic zones of Punjab state who were subscribers of selected newspapers i.e., *'Ajit'* and *'Jagbani'* and farm magazine *'Changi Kheti'* published by Punjab Agricultural University, Ludhiana constituted the sample for the study. Data were collected through a well structured and pre tested interview schedule. A medium level of reading was observed for majority of the respondents. Independent variables i.e., age, educational level, size of family and annual income of the family of respondents were positively correlated and contributing towards increasing the extent of reading behaviour.

Keywords: Reading behaviour, Farm women, Household messages, Print media

INTRODUCTION

In today's world, mass media is a major influencer. It has a catalytic effect on a large population, starting with books and ending with the internet. It works as a mass mobilizer unsuspecting of literacy. It sends out messages in a quick manner where even administrative staff is unable to reach. The darkest spot in the planet is touched by mass media. Technologies via communication and information have evolved into critical components for efficient technology transfer to rural people (Rajvi, 2014). Women, regardless of where they live, require information on a variety of topics, including family health, food and nutrition, family planning, and child education, credit, and government schemes and services but at the expense of government buildings, projects, and programmes for their engagement in agriculture and animal husbandry, the same rural women require information (Verma *et al.*, 2019).

Newspapers and magazines are most commonly used media among several mass media. Newspapers/ magazines are used for communicating current news, information and events. Print media also serve as learning and entertaining media besides spreading information about agriculture and household activities to the rural women. It has also played an important responsibility in disseminating the information on improved agricultural and household activities to rural women. Various messages related to daily household activities and homebased agricultural activities such as mushroom cultivation, bee-keeping, care of milch animals, effect of pesticides on animals, importance of tree plantation, nutritional recipes, drying of vegetables, household management, food management and storage, selection of kitchen tools, health and sanitation, mother and child care, adulteration of food etc. are covered in newspapers and magazines in different languages.

Although, newspapers and magazines have such a vast and diverse audience, they have the potential to communicate farm information to a huge number of individuals at the same time and in timely manner. Print media is a low-cost communication medium that also aids in the retention of knowledge for a longer period of time by clipping or digitization of desired items.

Increase in the literacy rate of women in the country and introduction of new digital technologies results in

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the change of message reading behaviour of rural women. However, considering the extensive circulation of newspapers and magazines in rural areas, it is expected that in present era too rural masses make use of print media. Thus, a survey of reading behaviour may give an indication of at what extent the farm women read the print media. Keeping in view the above facts present study was planned with the objectives to assess the reading behaviour of farm women and to determine the relationship between reading behaviour and socio-personal profile of farm women.

MATERIALS AND METHODS

The present study was conducted in five agro-climatic zones of Punjab state namely; Sub- Mountain undulating zone I, Undulating plain zone II, Central plain zone III, Western plain zone IV and Western zone V. Owing to the fact of maximum circulation in rural areas and containing household related messages two vernacular newspapers namely *'Ajit'* and *'Jagbani'* were selected for the purpose of the study.

Scientific farm magazine '*Changi Kheti*' published by Punjab Agricultural University, Ludhiana was purposively selected as it also contains household related articles. After selection of print media, a list regarding 'Changi Kheti' subscribers was obtained from Communication Centre, Punjab Agricultural University, Ludhiana. Then, from the obtained list, one district from each agro-climatic zone was selected with maximum subscribers. From the selected districts, two blocks from each district were selected randomly. Then, from each block 20 farm women were selected. Thus, 200 farm women constituted sample for the study.

From the selected print media, messages related to home science, general awareness and women related agricultural activities were selected for present study. After selection, a list of all such articles that appeared in *'Ajit', 'Jagbani'* and *'Changi Kheti'* during the time span of four months i.e., from October, 2020 to January, 2021 was compiled through scrutinizing each print media. The back issues of *'Changi Kheti'* were consulted in the Communication Centre of Punjab Agricultural University, Ludhiana and newspapers in the Punjab Agricultural University Library. Afterwards, selected messages were categorized into six categories i.e., food, nutrition and health, clothing selection, construction, maintenance and storage, household management, mother and child care and family relationships, general awareness, homebased agricultural activities.

The data were collected with the help of pre-tested interview schedule. The data collected were then tabulated and statistically analyzed by using frequencies, percentages, weighted arithmetic mean, category interval method and regression.

RESULTS AND DISCUSSION

Socio-personal profile: The socio-personal profile of the respondents was studied in terms of age, educational level, family size and annual income of the family of the respondents:

Age: It is evident from Table 1 that the age of the respondents ranged from 17 to 66 years with the highest per cent age of the respondents i.e., 34.50 per cent in the age group of 37 to 46 years, followed by 20.50 per cent in the age group of 27 to 36 years. Nearly same percentage of respondents were observed in the age groups of 27 to 36 and 47 to 56 years i.e., 20.50 per cent and 19.00 per cent, respectively.

Educational level: Table 1 indicates that large percentage of the respondents (38.50%) across all agro-climatic zones had education upto higher secondary followed by matriculation and graduation with 24.00 per cent and 15.00 per cent respectively. However, minor difference was observed in the percentage of respondents under middle school (6.00%), diploma holder (7.00%) and post-graduation (5.50%) categories. The findings were in line with the results of Sakeer and Anu (2006), Chitra (2011), Khan and Nisha (2014) and Nargawe and Gupta (2021) who also reported that the majority of the respondents were educated upto higher secondary level.

Family size: Table 1 further reveals the data regarding family size of the respondents. It was found that a large proportion of the respondents i.e., 72.50 per cent from agro-climatic zone II followed by 70.00 per cent from agro-climatic zone V, 65.00 per cent from agro-climatic zone I, 62.50 per cent from agro-climatic zone III and 55.00 per cent from agro-climatic zone IV had 6-8 members in their family. An equal number of respondents from agro-climatic zone I and agro-climatic zone III had upto five members in their families. Furthermore, in the category of above eight members,

Table 1: Distribution of respondents according to their personal profile (n=200)

Parameter	Zone I f(%)	Zone II f(%)	Zone III f(%)	Zone IV f(%)	Zone V f(%)	Overall f(%)
Age (years)						
(17-26)	6 (15.00)	8 (20.00)	5 (12.50)	7 (17.50)	9 (22.50)	35 (17.50)
(27-36)	7 (17.50)	8 (20.00)	9 (22.50)	6 (15.00)	11 (27.50)	41 (20.50)
(37-46)	13 (32.50)	11 (27.50)	14 (35.00)	19 (47.50)	12 (30.00)	69 (34.50)
(47-56)	9 (22.50)	10 (25.00)	8 (20.00))	5 (12.50)	6 (15.00)	38 (19.00)
(57-66)	5 (12.50)	3 (7.50)	4 (10.00)	3 (7.50)	2 (5.00)	17 (8.50)
Educational qualification						
Middle School	2 (5.00)	1 (2.50)	4 (10.00)	3 (7.50)	2 (5.00)	12 (6.00)
Matriculation	8 (20.00)	11 (27.50)	7 (17.50)	12 (30.00)	10 (25.00)	48 (24.00)
Higher Secondary	16 (40.00)	13 (32.50)	15 (37.50)	14 (35.00)	19 (47.50)	77 (38.50)
Diploma Holder	3 (7.50)	2 (5.00)	3 (7.50)	5 (12.50)	1 (2.50)	14 (7.00)
Graduation	4 (10.00)	6 (15.00)	8 (20.00)	5 (12.50)	7 (17.50)	30 (15.00)
Post Graduation	4 (10.00)	3 (7.50)	1 (2.50)	2 (5.00)	1 (2.50)	11 (5.50)
Total number of family members						
Upto 5 members	13 (32.50)	10 (25.00)	13 (32.50)	16 (40.00)	11 (27.50)	63 (31.50)
6-8 members	26 (65.00)	29 (72.50)	25 (62.50)	22 (55.00)	28 (70.00)	130 (65.00)
Above 8 members	1 (2.50)	1 (2.50)	2 (5.00)	2 (5.00)	1 (2.50)	7 (3.50)
Annual family income (Rupees)						
2.5-5 lakh	5 (12.50)	6 (15.00)	3 (7.50)	5 (12.50)	4 (10.00)	23 (11.50)
5.1-8 lakh	13 (32.50)	9 (22.50)	10 (25.00)	14 (35.00)	15 (37.50)	61 (30.50)
8.1-11lakh	15 (37.50)	11 (27.50)	14 (35.00)	10 (25.00)	17 (42.50)	67 (33.50)
More than 11 lakh	11 (27.50)	7 (17.50)	10 (25.00)	9 (22.50)	12 (30.00)	49 (24.50)

comparatively very less respondents (3.50%) were found. The findings of Rani and Lal (2019) were contradicting with results of the study as they found that large proportion of the respondents had up to 5 members in their family.

Annual income of the family: Annual income of the family was worked out by considering income from all sources. An overview of Table 1 shows that there was minor difference between the families with annual income 8.1 lakh to 11 lakh (33.50 %) and 5.1 lakh to 8 lakh (30.50 %). Nearly one fourth of the families (24.50 %) had annual income of more than 11 lakh and least number of families i.e., 11.50 per cent had annual income between 2.5 lakh to 5 lakh.

Message reading behaviour: The message reading behaviour was determined for theme-based reading behaviour of the respondents for newspapers and magazine and overall extent of reading behaviour of the respondents.

Table 2 shows that in newspapers, the reading of messages under the theme of clothing selection, construction, maintenance and storage was highest among all the theme-based categories as this theme secured first rank. This was followed by household management and food, nutrition and health. The reading of messages related to homebased agricultural activities and general awareness were found to be low as these categories secured fifth and sixth rank respectively.

While comparing zone-wise data, it can be inferred that except agro-climatic zone IV, clothing selection, construction, maintenance and storage was most preferrable theme among other categories by the respondents of agro-climatic zone I, II, III and V. Whereas, respondents from agro-climatic zone IV had household management as first preference in reading. Whereas, articles related to household management secured second rank by the respondents of agro-

Table 2: Theme-based reading behaviour of the respondents for newspapers (n=200)

Theme	Zone I	Zone II	Zone III	Zone IV	Zone V	Overall	Rank
Food, Nutrition and Health	2.02	1.82	2.10	1.87	1.90	1.94	III
Clothing selection, Construction, Maintenance and Storage	2.12	1.97	2.25	1.87	2.07	2.05	I
Household management	2.10	1.72	2.20	2.00	1.90	1.98	II
Mother and Child Care and Family Relationships	2.00	1.57	2.07	1.77	1.70	1.82	IV
General Awareness	1.72	1.60	1.85	1.70	1.65	1.70	VI
Homebased agricultural activities	2.00	1.75	2.00	1.62	1.67	1.80	V

Score range: 1-3

climatic zone I and III. Additionally, general awareness related messages were least read by respondents of agro-climatic zone II followed by agro-climatic zone V, agro-climatic zone I and agro-climatic zone III.

Table 3 illustrates that in farm magazine *'Changi Kheti'*, messages regarding food, nutrition and health were most readable and secured first rank followed by mother and child care and family relationships, general awareness and homebased agricultural activities themes with II, III and IV rank, respectively.

While, comparing agro-climatic zone wise data it was revealed that food, nutrition and health was most preferrable theme by the respondents of all the five agro-climatic zones. Whereas, home-based agricultural activities regarding messages were least read by respondents of agro-climatic zone II and IV with mean score of 1.40 and 1.67 respectively.

It can be inferred that while food, nutrition and health regarding messages obtained first rank for the farm magazine, viz. *'Changi Kheti'*. The same category obtained comparatively low ranking for the newspapers. It can be due to the reason that the articles in '*Changi Kheti*' are written by subject matter experts, readers may find them more beneficial than articles published in newspapers, which are not often authored by subject matter experts. This may have aided in the thorough reading of messages in this theme, resulting in the top ranking in '*Changi Kheti*'.

The theme homebased agricultural activities obtained the lowest rank in '*Changi Kheti*' and fifth rank in newspapers owing to the reason that the readers of these print media are unlikely to be directly involved in agriculture. Thus, they do not read messages under this theme.

The overall extent of message reading with respect to all the selected household messages in all the three print media presented in Table 4 shows variation in extent of reading. It was reported that 44.00 per cent of the respondents had moderate reading behaviour followed by 32.50 per cent who had low reading behaviour and 23.50 per cent who had high reading behaviour.

Table 4: Overall extent of message reading behaviour of the respondents (n=200)

Message reading behaviour	Distribution of respondents	
	f	%
Low reading behaviour (1-1.66)	65	32.50
Moderate reading behaviour (1.67-2.33)	88	44.00
High reading behaviour (2.34-3)	47	23.50

Table 3: Theme-based reading behaviour of the respondents for magazine (n=200)

Theme	Zone I	Zone II	Zone III	Zone IV	Zone V	Overall	Rank
Food, Nutrition and Health	2.12	1.87	2.22	1.92	1.90	2.00	I
Mother and Child Care and Family Relationships	2.12	1.70	1.92	1.70	1.60	1.80	II
General Awareness	1.70	1.50	1.85	1.77	1.70	1.70	III
Homebased agricultural activities	1.82	1.40	1.90	1.67	1.65	1.68	IV

Score range: 1-3

Table 5: Relationship of independent variables with reading behaviour

Variables	Age	Educational level	Size of family	Annual income of the family
Reading behaviour	0.281**	0.389**	0.186**	0.165*

** Significant at the 0.01 level; * Significant at the 0.05 level

Table 6: Relative contribution of independent variables to reading behaviour

Independent variables	Regression coefficient	Standard error	't'-value	Significance
Age	0.258	0.26	10.097**	0.000
Educational Level	0.138	0.20	7.014**	0.000
Size of family	0.107	0.042	2.560**	0.011
Annual income of the family	0.414	0.081	5.092**	0.000

**Significant at the 0.01 level; NS= Non-significant; $R^2 = 0.524$

It can be concluded that only 23.50 per cent of the respondents falls under high reading behaviour category. This could be because the respondents were preoccupied with their work and didn't have enough time to read. Second, instead of reading, people may prefer to unwind by watching television or talking on phones after a long day at work. Finally, people may have encountered numerous obstacles while reading written content, causing their attention to wane. There is a need to improve content by incorporating attention-seeking and need-based messaging into the appropriate print media. The similar result was revealed in the study of Ahire (2012), Horakeri (2015) and Tanaji (2019) that maximum number of respondents were having moderate reading behaviour owing to the fact of less reading time and use of electronic media.

Table 5 specifies that all independent variables were positively correlated with reading behaviour. These relationships were also resulted as statistically significant at 0.01 and 0.05 level of significance.

It can be inferred from the findings that with the increase in independent variables the reading behaviour of the respondents increase with respect to selected print media. The findings partially supports the findings of Hanumanaikar (2009); Sangama (2014); Singh and Singh (2014); Horakeri (2015); Anwar (2016); Chaitra (2017); Singh (2017) and Tanaji (2019).

The data in Table 6 depict that all the independent variables were found to be contributing towards increasing the extent of reading behaviour. The absolute per unit contribution with respect to age, educational level, family size and annual income of the family was 0.258, 0.138, 0.107 and 0.414 respectively. However, R^2 value was high ($R^2 = 0.524$) which means that selected variables were responsible for variation in the extent of reading behaviour. The result partially supports the findings of Hanumanaikar (2009).

CONCLUSION

It may be concluded from this study that the majority of the farm women resort to reading. Therefore, print media can be used as a potential source for imparting the household and homebased agricultural messages among the farm women. It was found that few of the messages were not read by majority of the respondents. Therefore, need-based messages should be added in the print media. Farm women exhibited keen interest in the messages pertaining to the household chores in contrast to messages related to homebased agricultural activities. Hence, it is imperative for the authors to present homebased agricultural messages which are authentic, relevant and interesting so that farm women may read majority of the messages published in print media.

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Advantages and Factors Affecting Adoption and Knowledge of Happy Seeder Farm Technology

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ABSTRACT

The study was conducted in two agro-climate zones of Haryana namely dry zone and wet zone. Two districts i.e. Kaithal and Fatehabad were randomly selected from both the zones and 30 adopters and 30 non-adopters respondents were selected from each block on the whole 120 respondents were selected for the purpose of the study 27.3 per cent of the respondents from backward class had low level of knowledge Analysis of data regarding advantages of adoption of Happy Seeder revealed that 51.6 per cent of the adopters agreed that happy seeder reduce fuel and labor cost whereas 11.6 per cent disagreed. Regarding the aspects chopped rice residue can be used as mulch and happy seeder reduce green house gas emission 58.3 per cent of the respondents agreed. More than 50.0 per cent of adopters agreed to the fact that increase yield than conventional method whereas 20.0 per cent disagreed. 40 per cent of adopters agreed that it gives high net return followed by 18.3 per cent who disagreed.

Keywords: Association, Association, Factors, Happy seeder

INTRODUCTION

Agricultural mechanization is the way of using machines and equipment to increase the productivity and reduce drudgery. Mechanization plays a crucial role in saving time which allows farmers including women to dedicate more time to other more profitable occupations than growing a crop, such as raising livestock, adding value with post-harvest processing or seeking off-farm employment (Agrawal *et al.*, 2020). India, due to a lack of adequate technology for drilling wheat into rice residues gathered by combine harvesters. Although burning is a quick and inexpensive option that allows for quick crop rotation, it has major health consequences for humans and animals due to air pollution, lower soil fertility due to nutrients and organic matter loss, and greenhouse gas (GHG) emissions. The Happy Seeder (HS), which was recently created, solves the technical issues connected with direct drilling into rice leftovers. Happy Seeder technology provides an altemative to burning for managing rice residues and allows direct drilling of wheat in standing as well as loose residues (Gathala *et al.,* 2009). The Combine harvesters have been introduced with exponential growth in mechanical harvesting of wheat in the better endowed rice-wheat growing area of north western India. (Singh *et al.,* 2020) concluded that sowing wheat crop with Happy Seeder in previous crop residues gave similar or slightly higher grain yield than wheat sown with normal drill after burning previous paddy residue. This method reduced cost of machinery operations for wheat crop establishment by reducing time taken for field operations, reduced weed control and labor cost. It avoids the need for burning and terrible air pollution due to burning. Retention of paddy residue in field added nutrients to the field along with organic matter. Happy seeder technology (HST) was one of the available alternatives which directly drill the wheat seed into the soil without removing the stubble (Sidhu *et al.*, 2007). The studies on HST had shown that it reduced the cost of cultivation, reduced the weed density due to mulching effect and improved the soil fertility. To manage the paddy straw, other machineries

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including HST such as baler, mould board plough (MBP), rotavator tillage (RT) was provided by the government on 50 to 80 per cent subsidy. The Government of India (GOI) has taken a number of steps to combat residue burning by providing crop residue management services (CRM) machinery to cooperative societies and farmer's organizations. Individual farmers receive 50-80 per cent subsidies. The government of India has invested Rs. 6,950 crores on a project. 'Agricultural mechanization for in-situ management of pests and diseases'. The project focused on capacity building and awareness creation among farmers. Besides, numbers of CRM machines were supplied to farmers through cooperatives as well as on individual basis. Adoption of inter-cultural practices that is earthing up helps in controlling weeds, provides better aeration in the root zone and prevents tuber forming stolons from turning into shoots due to their exposure to sun light. The majority (67.77%) of the unorganized respondents performed earthing up operation in the range between 25-30 days after sowing (DAS) followed by 32.22 per cent of these respondents who has performed earthing up operation in range between 30-35 days after sowing (DAS) in potato seed production (Singh *et al.,* 2020). Farmers reported various advantage of surface retention of paddy straw using HS technology over conventional sowing. Majority of the farmers reported less diesel consumption requirement (4-7 per ha) for sowing wheat using HS technology. Farmers also reported that wheat sowing using HS is completed in single operation after combine harvested paddy field, which saves time. Similarly, farmers also reported advantages of labor saving, irrigation water saving (1-2 irrigation), increase in soil fertility and less weed infestation. HS technology also ensured early sowing of wheat which also helped in checking the *gullidanda* (*Phalaris minor* Retz.) weed infestation (Singh *et al.*, 2020).

MATERIALS AND METHODS

The study was conducted in two agro-climate zones of Haryana namely dry zone and wet zone. Two districts i.e. Kaithal and Fatehabad were randomly selected from both the zones. From each of two selected districts, one block was i.e. Pundri from Kaithal & Ratia from Fatehabad were randomly selected for the purpose of the study. 30 adopters and 30 non-adopters respondents were selected from each block on the whole 120 respondents were selected for the purpose of the study. The data was collected by interview method from the respondents to gather information on dependent and independent variables. The collected data were coded, tabulated, analyzed and interpreted according to the objectives of the present study with the help of appropriate statistical techniques. The descriptive statistical tools such as frequency, percentage, chi-square, weighted mean and total weighted score were calculated to draw the inference.

RESULTS AND DISCUSSION

In Table 1 the factors associated with level of knowledge of the respondents regarding Happy Seeder are shown in Table 1 where age is found to be highly significant at chi-square value 15.49. It can be clearly seen that 55.6 per cent of the respondents who belonged from age group upto 25 years had high level of knowledge whereas 55.6 per cent of the respondents belonged to age group between 25-50 years had medium level of knowledge and 46.7 per cent of the respondents who belonged to age group between 51-65 years had low level of knowledge.

Data analysis shows that education was also highly significant in association with level of knowledge at chi-square value 15.75. It can be seen that 47.8 per cent of respondents had education up to secondary school and above had high level of knowledge whereas 47.8 per cent of the respondents had medium level of knowledge in same category and 54.5 per cent of the respondents were illiterate who had low level of knowledge.

Analysis revealed that caste was found to be significant in association with level of knowledge at chi-square value 9.07 where the highest percentage of the respondents belonged to general class (51.3%) had medium level of knowledge whereas 80.0 per cent of the respondents had high level of knowledge belonged to scheduled caste. 27.3 per cent of the respondents from backward class had low level of knowledge.

Analysis revealed that family type was found to be significant in association with level of knowledge at chi-square value 15.56. The highest percentage of respondents who belonged to joint families 65.5 per cent had high level of knowledge whereas 58.1 per cent of the respondents from nuclear families had

Table 1: Association between socio-economic variables and level of knowledge of Happy Seeder adopters (n=60)

Socio-economic variables	Knowledge Level			Total
	Low	Medium	High	
Age				
Up to 25 years	1(3.7)	11(40.7)	15(55.6)	27(45.0)
25-50 years	2(11.1)	10(55.6)	6(33.3)	18(30.0)
51-65 years	7(46.7)	5(33.3)	3(20.0)	15(25.0)
				χ^2 *Cal* =15.49**
Education				
Illiterate	6(54.5)	4(36.4)	1(9.1)	11(18.3)
Primary School	2(15.4)	5(38.5)	6(46.1)	13(21.7)
Middle School	1(7.7)	6(46.2)	6(46.1)	13(21.7)
Secondary School & above	1(4.4)	11(47.8)	11(47.8)	23(38.3)
				χ^2 *Cal*= 15.75**
Caste				
Scheduled class	1(10.0)	1(10.0)	8(80.0)	10(16.7)
Backward caste	3(27.3)	5(45.5)	3(27.4)	11(18.3)
General class	6(15.4)	20(51.3)	13(33.3)	39(65.0)
				χ^2 *Cal*= 9.07*
Family Type				
Nuclear	8(25.8)	18(58.1)	5(16.1)	31(51.7)
Joint	2(6.9)	8(27.6)	19(65.5)	29(48.3)
				χ^2 *Cal*= 15.56**
Family Size				
Up to 4 members	8(16.7)	11(36.7)	11(36.6)	30(50.0)
Between 5-8 members	1(6.3)	5(31.2)	10(62.5)	16(26.7)
Above 8 members	1(7.2)	10(71.4)	3(21.4)	14(23.3)
				χ^2 *Cal*= 14.58**
Size of landholding				
Marginal (<1 ha)	7(36.8)	3(15.8)	9(47.4)	19(31.7)
Small (1-2 ha)	1(5.6)	9(50.0)	8(44.4)	18(30.0)
Semi medium (2-4 ha)	1(8.3)	9(75.0)	2(16.7)	12(20.0)
Medium (4-10 ha)	1(9.1)	5(45.5)	5(5.6)	11(18.3)
				χ^2 *Cal*= 15.21**
Subsidiary Occupation				
Nil	8(50.0)	4(25.0)	4(25.0)	16(26.7)
Service	1(6.2)	7(43.8)	8(50.0)	16(26.7)
Small scale enterprise	1(3.7)	15(53.6)	12(42.9)	28(46.6)
				χ^2 *Cal*= 17.86**
Annual income				
Up to 1,50,000	1(3.5)	15(51.7)	13(44.8)	29(48.3)
Between 1,50,001-3,00,000	1(6.7)	7(46.6)	7(46.7)	16(26.7)
Above 3,00,001	8(50.0)	4(25.0)	4(25.0)	15(25.0)
				χ^2 *Cal*= 17.59**

Table 1 contd...

Socio-economic variables	Knowledge Level			Total
	Low	Medium	High	
Mass media exposure				
Low (4-6)	8(34.8)	10(43.5)	5(21.7)	23(38.3)
Medium (7-9)	1(4.6)	9(40.9)	12(54.5)	22(36.7)
High (above 10)	1(6.6)	7(46.7)	7(46.7)	15(25.0)
				χ^2 *Cal*= 10.68*
Social participation				
Not member of any organization	8(25.8)	16(51.6)	7(22.6)	31(51.7)
Member of 1 organization	1(6.4)	5(31.2)	10(62.4)	16(26.7)
More than 1 organization	1(7.7)	5(38.5)	7(53.8)	13(21.6)
				χ^2 *Cal*= 9.32
Extension contact				
Nil (1)	3(8.6)	18(51.4)	14(40.0)	35(58.3)
Low (2-3)	1(6.7)	6(40.0)	8(53.3)	15(25.0)
Medium (above 3)	6(60.0)	2(20.0)	2(20.0)	10(16.7)
				χ^2 *Cal*= 17.03**
Socio economic status				
Low (4-6)	6(66.7)	1(11.1)	2(22.2)	9(15.0)
Medium (7-9)	3(13.6)	11(50.0)	8(36.4)	22(36.7)
High (10-12)	1(3.4)	14(48.3)	14(48.3)	29(48.3)
				χ^2 *Cal*= 20.48**

Figures in parentheses indicate Percentage; **Significant at 1% level of significance; *Significant at 5% level of significance

medium level of knowledge. 25.8 per cent of the respondents from nuclear family and 6.9 per cent of respondents from joint families had low level of knowledge.

Family size was found to be highly significant in association with level of knowledge at chi square value 14.58. 62.5 per cent of the respondents who had members between 5-8 had high level of knowledge whereas 16.7 per cent who had members upto 4 members had low level of knowledge and 71.4 per cent of the respondents who had above 8 members had medium level of knowledge.

The association between level of knowledge and size of land holding was found to be highly significant with chi-square value at 15.21. 47.4 per cent of the respondents who had marginal land had high level of knowledge whereas 36.8 per cent of the respondents from same category had low level of knowledge and 75% of the respondents who had land between 2-4 ha had medium level of knowledge.

Occupation was found to be highly significant in association with level of knowledge at chi-square value 17.86. 50.0 per cent of the respondents who were in active service had high level of knowledge whereas 53.6 per cent of the respondents who had small scale enterprise had medium level of knowledge and 50.0 per cent of the respondents who had no subsidiary occupation had low level of knowledge.

Annual income was found to be significant in association with level of knowledge at chi square value 17.59. 46.7 per cent of the respondents who had income between 1,50,001-3,00,001 had high level of knowledge whereas 51.7 per cent of the respondents who had income upto 1,50,000 had medium level of knowledge and 50 per cent of the respondents who had income above 3,00,001 had low level of knowledge.

Mass media exposure was found to be significant in association with level of knowledge at chi-square value 10.68. 54.5 per cent of the respondents who had medium level of mass media exposure had high level of knowledge whereas 46.7 per cent of the respondents from same category had medium level of knowledge and 34.8 per cent of the respondents who had low mass media exposure had low level of knowledge.

Social participation was not found to be significant in association with level of knowledge at chi-square value at 9.32. 62.4 per cent of the respondents who were member of one organization had high level of knowledge whereas 51.6 per cent of the respondents who were not member of any organization had medium level of knowledge and 25.8 per cent from the same category had low level of knowledge.

Extension contact was found to be highly significant in association with level of knowledge at chi-square value 17.03. 53.3 per cent of respondents who had low extension contacts had high level of knowledge whereas 51.4 per cent of the respondents who had no extension contacts had medium level of knowledge and 60 per cent of the respondents who had medium extension contacts had low level of knowledge.

Socio-economic status was found to be highly significant in association with level of knowledge at chi-square value 20.48. 48.3 per cent of respondents who had high socio-economic status had high level of knowledge whereas 50 per cent of the respondents who had medium socio-economic status had medium level of knowledge and 66.7 per cent of the respondents who had low socio-economic status had low level of knowledge.

In Table 2 age was found to be significant in association with level of adoption at chi-square value at 10.45. 37 per cent of the respondents who belonged to age group up to 25 years had high level of adoption whereas 33.3 per cent of the respondents from the same category had low level of adoption and 73.3 per cent of the respondents who belonged to age group 51-65 years had medium level of adoption.

Education was found to be highly significant in association with level of adoption at chi-square value 17.88. 47.8 per cent of the respondents who had education up to secondary school and above had high level of adoption whereas 69.2 per cent of the respondents who had education up to middle school had medium level of adoption and 54.5 per cent of the respondents who were illiterate had low level of adoption.

Analysis revealed that caste was not found to be significant in association with level of adoption at chi-square value. 95 where 30.8 per cent of the respondents belonged to general class had medium level of adoption whereas 54.5 per cent of the respondents had medium level of knowledge belonged to backward caste. 30 per cent of the respondents from schedule class had low level of adoption.

Analysis revealed that family type was found to be significant in association with level of adoption at chi-square value at 13.16. The highest percentage of respondents who belonged to joint families 41.9 per cent had high level of adoption whereas 75.9 per cent of the respondents from joint families had medium level of adoption. 29 per cent of the respondents from nuclear family and 10.3 per cent of respondents from joint families had low level of adoption.

Family size was found to be highly significant in association with level of adoption at chi square value 14.46. 64.3 per cent of the respondents who had members above 8 members had high level of adoption whereas 66.7 per cent of the respondents who had members up to 4 members had medium level of adoption and 25 per cent of the respondents who had members between 5-8 had low level of adoption.

The association between Level of adoption and size of land holding was found to be highly significant with chi-square value at 13.10. 63.6 per cent of the respondents who had land between 4-10 ha had high level of adoption whereas 66.7 per cent of the respondents who had small land holdings had medium level of adoption and 31.6 per cent of the respondents who had marginal land had low level of adoption.

Subsidiary occupation was found to be significant in association with level of adoption at chi-square value 13.86. 46.4 per cent of the respondents who had small scale enterprise had high level of adoption whereas 62.5 per cent of the respondents who had no subsidiary occupation had medium level of adoption and 43.8 per cent of the respondents who were in service had low level of adoption.

Table 2: Association between socio-economic variables & level of adoption of Happy Seeder adopters (n=60)

Socio-economic variables	Adoption Level			Total
	Low	Medium	High	
Age				
Up to 25 years	9(33.3)	8(29.6)	10(37.0)	27(45.0)
25-50 years	2(11.1)	12(66.7)	4(22.2)	18(30.0)
51-65 years	1(6.7)	11(73.3)	3(20.0)	15(25.0)
				χ^2 *Cal*= 10.45*
Education				
Illiterate	6(54.5)	4(36.4)	1(9.1)	11(18.3)
Primary School	4(30.8)	7(53.8)	2(15.4)	13(21.7)
Middle School	1(7.7)	9(69.2)	3(23.1)	13(21.7)
Secondary School & above	1(4.3)	11(47.8)	11(47.8)	23(38.3)
				χ^2 *Cal*= 17.88**
Caste				
Scheduled	3(30.0)	5(50.0)	2(20.0)	10(16.7)
Backward	2(18.2)	6(54.5)	3(27.3)	11(18.3)
General	7(17.9)	20(51.3)	12(30.8)	39(65.0)
χ^2 *Cal*=.95				
Family type				
Nuclear	9(29.0)	9(29.0)	13(41.9)	31(51.7)
Joint	3(10.3)	22(75.9)	4(13.8)	29(48.3)
χ^2 *Cal*= 13.16**				
Family size				
Up to 4 members	7(23.3)	20 (66.7)	3(10.0)	30(50.0)
Between 5-8 members	4(25.0)	7(43.8)	5(31.3)	16(26.7)
Above 8 members	1(7.1)	4(28.6)	9(64.3)	14(23.3)
χ^2 *Cal*= 14.46**				
Size of landholding				
Marginal (<1 ha)	6(31.6)	11(57.9)	2(10.5)	19(31.7)
Small (1-2 ha)	3(25.0)	12(66.7)	3(16.7)	18(30.0)
Semi medium (2-4 ha)	2(12.5)	5(41.7)	5(41.7)	12(20.0)
Medium (4-10 ha)	1(7.7)	3(27.3)	7(63.6)	11(18.3)
				χ^2 *Cal*= 13.10*
Subsidiary occupation				
Nil	3(18.8)	10(62.5)	3(18.8)	16(26.7)
Service	7(43.8)	8(50.0)	1(6.3)	16(26.7)
Small scale enterprise	2(7.1)	13(46.4)	13(46.4)	28(46.6)
				χ^2 *Cal*= 13.86**
Annual income				
Up to 1,50,000	3(10.3)	15(51.7)	11(37.9)	29(48.3)
Between 1,50,001-3,00,000	2(12,5)	11(68.8)	3(18.8)	16(26.7)
Above 3,00,001	7(46.7)	5(33.3)	3(20.0)	15(25.0)
				χ^2 *Cal*= 10.84*

Table 2 contd...

Socio-economic variables	Adoption Level			Total
	Low	Medium	High	
Mass media exposure				
Low (4-6)	10(43.5)	9(39.1)	4(17.4)	23(38.3)
Medium (7-9)	1(4.5)	16(72.7)	5(22.7)	22(36.7)
High (above 10)	1(6.7)	6(40.0)	8(53.3)	15(25.0)
				χ^2 *Cal*= 17.80**
Social participation				
Not member of any organization	9(29.0)	17(54.8)	5(16.1)	31(51.7)
Member of 1 organization	2(12.5)	9(56.3)	5(31.3)	16(26.7)
More than 1 organization	1(7.7)	5(38.5)	7(53.8)	13(21.6)
				χ^2 *Cal*= 7.92
Extension contact				
Nil (1)	10(28.6)	20(57.1)	4(11.4)	35(58.3)
Low (2-3)	1(6.7)	8(53.3)	6(40.0)	15(25.0)
Medium (above 3)	1(10.0)	3(30.0)	7(70.0)	10(16.7)
				χ^2 *Cal*= 10.93**
Socio-economic status				
Low (4-6)	6(66.7)	1 (11.1)	2(22.2)	9(15.0)
Medium (7-9)	3(13.6)	14(63.6)	5(22.7)	22(36.7)
High (10-12)	3(10.3)	16(55.2)	10(34.5)	29(48.3)
				χ^2 *Cal*= 15.89**

Figures in parentheses indicate percentage; **Significant at 1% level of significance; *Significant at 5% level of significance

Income was found to be highly significant in association with level of adoption at chi-square 10.84. 37.9 per cent of the respondents who had income up to 1,50,000 had high level of adoption whereas 68.8 per cent of the respondents who had income between 1,50,001-3,00,001 had medium level of adoption and 46.7 per cent of the respondents who had income above 3,00,001 had low level of adoption.

Mass media exposure was found to be significant in association with level of adoption at chi-square value 17.80. 53.3 per cent of the respondents who had high level of mass media exposure had high level of adoption whereas 72.7 per cent of the respondents who had medium level of mass media exposure had medium level of adoption and 43.5 per cent of the respondents who had low mass media exposure had low level of adoption.

Social participation was not found to be significant in association with level of adoption at chi-square value 7.92. 53.8 per cent of the respondents who were member of more than one organization had high level of adoption whereas 56.3 per cent of the respondents who were member of one organization had medium level of adoption and 29 per cent of the respondents who were not member of any organization had low level of adoption.

Extension contact was found to be highly significant in association with level of adoption at chi-square value 10.93. 70 per cent of respondents who had medium extension contacts had high level of adoption whereas 57.1 per cent of the respondents who had no extension contacts had medium level of adoption and 28.6 per cent of the respondents from the same category had low level of adoption. Kaur *et al.* (2020) in their study revealed that majority of the respondents i.e. more than 65.00 per cent had medium level of extension contacts and were in frequent touch with IFFCO, Warehouses and Markfed personnel, but they have weak linkages with ADOs and SAUs. The reason may be that Markfed, IFFCO, Warehouses activities are closely related with FCI and they are in regular contact with them. Socio-economic status was found to be highly significant in association with level of adoption at chi-square value 15.89. 34.5 per cent of respondents who had high socio-economic status had high level of adoption whereas 63.6 per cent of the respondents who had medium socio-economic status had medium level of adoption and 66.7 per cent of the respondents who had low socio-economic status had low level of adoption respectively.

Analysis of data in Table 3 regarding advantages of adoption of Happy Seeder revealed that 51.6% of the adopters agreed that happy seeder reduce fuel and labor cost whereas 11.6 per cent disagreed. Regarding the aspects chopped rice residue can be used as mulch and happy seeder reduce green house gas emission 58.3 per cent of the respondents agreed. More than 50.0 per cent of adopters agreed to the fact that increase yield than conventional method whereas 20.0 per cent disagreed. 40 per cent of adopters agreed that it gives high net return followed by 18.3 per cent who disagreed. 36.6 per cent of the respondent agreed that using happy seeder increase soil fertility whereas 15 per cent disagreed. 63.3 per cent of adopters agreed that it is a labor saving technology as less weedicides were reported whereas 6.6 per cent disagreed with this statement. 53.3 per cent of adopters agreed that it helps in maintaining moisture thus reducing the need for at least one irrigation so it is a water saving technology whereas 10 per cent of adopters disagreed to it. 68.3 per cent of adopters agreed that it saves time and money as there is possibility of sowing wheat crop just after harvesting of rice followed by 10 per cent who disagreed. Singh *et al.* (2009) concluded that rice burning is a serious environmental issue. Happy Seeder is the most promising technology available to manage paddy residues and promote conservation agriculture in rice-wheat system. The area under HS Technology has increased from 50, 250 & 1000 acres in 2006-2007-08 & 2008-09, respectively with collaborative efforts of PAU and Department of Agriculture, Punjab. Iqbal *et al.* (2017) evaluated that HSZT (Happy Seeder zero tillage) produced maximum germination count followed by CM (conventional method). It was concluded that Happy Seeder zero tillage is a good option for growers of rice tract as it ensures timely sowing of wheat crop in a single pass. On the other hand crop sown by HSZT is also less affected by rain/over irrigation. HSZT not only ensures maximum yield but also save fuel, energy, hence it is almost economical practice. Pal *et al.* (2019) reported in their study that Happy Seeder not only conserves the most of the production inputs but also improves farmers income. Reduction in green house gas emission, nutrient recycling, soil health improvement added advantages of happy seeder technology. Requirement of heavy tractor and limiting operating condition (in fogy days operation of Happy Seeder become difficult) in the month of December. For wide spread of technology it should be promoted through custom hiring centres and huge subsidy. Singh *et al.* (2021)

Table 3: Advantages for adoption of Happy Seeder (n=60)

Aspects	Reason for adoption		
	Agree	Neutral	Disagree
Reduce fuel and labour cost	31(51.6)	22(36.8)	7(11.6)
Chopped rice residue can be used as mulch	35(58.3)	16(26.7)	9(15.0)
Increased yield than conventional method	31(51.6)	17(28.4)	12(20.0)
Higher net return by adoption of Happy Seeder	24(40.0)	25(41.7)	11(18.3)
Reduce greenhouse gas emission	35(58.3)	20(33.4)	5(8.3)
Increase soil fertility	22(36.6)	29(48.4)	9(15.0)
It is a labor saving technology as less weedicides are reported	38(63.3)	18(30.1)	4(6.6)
It helps in maintaining soil moisture thus reducing the need for at least one irrigation so it is a water saving technology	32(53.3)	22(36.7)	6(10.0)
Saves time and money as there is possibility of sowing wheat crop just after harvesting of rice.	41(68.3)	13(21.7)	6(10.0)

reported in their study that the overall average operational land holding of the respondents, in all the selected districts of Punjab, was 30.20 acre out of which, mean area under HST in the first year of adoption was 11.32 acre (37.42%) followed by 12.22 acre (40.46%) and 17.73 acre (58.60%) acre during second and third year of adoption respectively.

CONCLUSION

Annual income was found to be significant in association with level of knowledge at chi square value 17.59. 46.7 per cent of the respondents who had income between 1,50,001-3,00,001 had high level of knowledge whereas 51.7 per cent of the respondents who had income upto 1,50,000 had medium level of knowledge and 50 per cent of the respondents who had income above 3,00,001 had low level of knowledge. Socio-economic status was found to be highly significant in association with level of adoption at chi-square value 15.89. 34.5 per cent of respondents who had high socio-economic status had high level of adoption whereas 63.6 per cent of the respondents who had medium socio-economic status had medium level of adoption and 66.7 per cent of the respondents who had low socio-economic status had low level of adoption respectively. Analysis revealed that family type was found to be significant in association with level of adoption at chi-square value at 13.16. The highest percentage of respondents who belonged to joint families 41.9 per cent had high level of adoption whereas 75.9 per cent of the respondents from joint families had medium level of adoption. 29 per cent of the respondents from nuclear family and 10.3 per cent of respondents from joint families had low level of adoption. Analysis of data regarding advantages of adoption of Happy Seeder revealed that 51.6 per cent of the adopters agreed that happy seeder reduce fuel and labor cost whereas 11.6 per cent disagreed. Regarding the aspects chopped rice residue can be used as mulch and happy seeder reduce green house gas emission 58.3 per cent of the respondents agreed. More than 50.0 per cent of adopters agreed to the fact that increase yield than conventional method whereas 20.0 per cent disagreed. 40 per cent of adopters agreed that it gives high net return followed by 18.3 per cent who disagreed. 36.6 per cent of the respondent agreed that using happy seeder increase soil fertility whereas 15 per cent disagreed.

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Constraints Faced by Beneficiary Farmers of Pradhan Mantri Krishi Sinchayee Yojana- Per Drop More Crop (PMKSY-PDMC) in Uttarakhand

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ABSTRACT

As per UN-Water (2021), 72 per cent of all fresh water withdrawals are used by agriculture. Hence, sustainable water use in agriculture is key solution to present water crises worldwide. At present, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched in July, 2015 by the Central Government for this purpose. The present study was conducted to analyse the constraints faced by beneficiary farmers of PMKSY-PDMC in Uttarakhand. The study revealed that technical constraints were 'Damage of laterals, submain and main line', 'Leakage of irrigation system', 'Difficulty in use of micro irrigation technology', 'Irrigation system pose hindrances for other intercultural operation', 'Requirement of high maintenance' and 'Blockage of water pipes and clogging of emitters'. Infrastructural constraints were 'Materials and equipment's supplied by the company are of lower quality', 'Services provided by the company are unsatisfactory', 'Unavailability of spare parts' respectively, 'After sales services are not up to mark', 'Insufficient and Irregular supply electricity for irrigation' and 'MIS provided is not sufficient or won't fit the field demand'. Institutional constraints were 'Inadequate number of demonstrations and trainings to motivate and develop skill for MI', 'Lack of knowledge about operation of micro irrigation', 'Lack of systematic campaign for popularizing the MIS', 'Inadequate awareness about micro irrigation, 'Lack of individual contact with the expert related to micro irrigation'. Financial constraints were 'Installation cost is high', 'High cost of spare parts', 'Time taken in subsidy disbursement is lengthy process' and 'Provision of subsidy is less'. Climatic and geographical constraint were 'Damage to MIS due to cold and high temperature or high temperature', 'Choice of MIS does not match crop requirements', 'Undulated topography and fragmented land holding', 'Improper and Inadequate water source or water storage structure' and 'Unavailability of clean water'.

Keywords: PMKSY, Per crop more drop, Constraints, Beneficiary farmers of PMKSY, Micro irrigation, Water conservation

INTRODUCTION

Water is a scarce natural resource which is inevitable for existence of life on earth. In larger perspective, water security is fundamental to poverty alleviation, and water resource management impacts almost all aspects of economic activity, including food production and security, industry, energy production, and transport (Word Bank, 2009). In a developing nation like India, water management hold utmost importance as India is home to 17.50 per cent of world population with only 2.5 per cent of geographical land and 4 per cent of the world's renewable water resources. The need of food grain production and simultaneously, India is experiencing a very significant water struggle. Achieving food security for India, with its rising population, is going to be a significant challenge, and water scarcity will make the goal tougher to attain (NITI Aayog, 2019).

Setting aside several roles of water in running life on earth, role of water in agricultural production is

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indispensable. Water is a critical input for agricultural production and plays an important role in food security and overall development of the agriculture sector is largely dependent on the availability and use of water in agriculture. As per UN-Water (2021), agriculture currently accounts for 69 per cent of global water withdrawals, which are mainly used for irrigation but also include water used for livestock and aquaculture. This makes agriculture the largest user of water. It is also important to underline that globally about 40 per cent of irrigation water is supplied by ground water and in India it is expected to be over 50 per cent (Dhawan, 2017). This excessive dependence on groundwater has led to over exploitation of groundwater, which is another matter of concern. Present scenario on demand, availability and excessive use water urges that sustainable water management seems only solution of this alarming situation. Since, agriculture is major sector responsible for maximum water withdrawal. so, Water management in agriculture by managing irrigation water & following water conservation practices could be a solution to the problem.

Meanwhile, In India, 42.02 per cent of operational land holdings are wholly unirrigated and 12 per cent are partially irrigated. Total area under irrigation is 64.70 mha, which is 52.6 per cent of total area under irrigation (MoA, 2019). With more than half of the operational land holdings being partially irrigated or wholly unirrigated and almost half of agricultural land under irrigation (52.60%), data points towards the vast scope of irrigation management in agriculture sector of India both in terms of increasing area under irrigation and efficient water use.

Keeping this in view, irrigation related policies and programmes of central and state government play a pivotal role in paving the way for sustainable agricultural water management. In contemporary India too, irrigation and water conservation has been the focus of agriculture and development programmes of government and civic bodies. At present, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched by the Central Government to ensure access to some means of protective irrigation for all agricultural farms in the country and to produce more output per unit of water. The scheme has been launched with budget of 50,000 crore for period of 5 years (2015-16 to 2019-20). The PMKSY (Per Drop More Crop) includes installation of micro-irrigation systems, use of efficient water conveyance and precision water application devices like drips, sprinklers, pivots and rain-guns in the farm "(Jal Sinchan)", and extension activities for promotion of scientific moisture conservation and agronomic measures including adoption of proper cropping patterns, to maximize use of available water including rainfall and minimize irrigation requirement "(Jal Sanrakshan)". The realistic challenge arises when it comes to technology dissemination, adoption, implementation and utilization. Likewise, when it comes to adoption of novel technology like micro irrigation through PMKSY, beneficiary farmers confronted numerous constraints. Pradhan Mantri Krishi Sinchayee Yojana was launched in year 2015 and the programme has successfully completed five years but there have not been empirical studies on constraints faced by beneficiary farmers of PMKSY. The present study attempted to do so in Uttarakhand state.

MATERIALS AND METHODS

The study was conducted in Uttarakhand state during 2021. Two districts i.e., Uttarkashi and Dehradun districts of Uttarakhand, which were purposively selected based on the highest fund allocation under Pradhan Mantri Krishi Sinchayee Yojana in Uttarakhand (PMKSY) from year 2015-16 to 2018-19. Two blocks i.e., Doiwala and Chakrata from Dehradun district and Naugaun and Bhatwari from Uttarkashi were selected by following simple random sampling procedure, thus making a total of four blocks. Three villages from each block were selected by following simple random sampling procedure. From each of the selected villages, twenty farmers were selected by following lottery method of simple random sampling procedure. Thus, sample size constituted of 240 respondents from twelve villages.

The respondents were requested to express their constraints with regard to implementation of PMKSY. Constraints like technical, infrastructural, institutional, financial and climatic and geographical etc. were enlisted through interview schedule and were ranked with the help of Garrett's Ranking Technique. Garrett's Ranking Technique was used to identify and rank the constraints.

RESULTS AND DISCUSSION

The constraints experienced by the beneficiary farmers of PMKSY-PDMC and their ranking is presented in

Table 1: Constraints faced by the beneficiary farmers with regard to implementation of PMKSY-PDMC (n=240)

S.No.	Constraints	Mean Score ($\bar{x}$)	Rank
Technical Constraints			
1.	Damage of main line, submain and lateral	66.70	I
2.	Leakages of irrigation system	51.43	II
3.	Difficulty in use of micro irrigation system	49.67	III
4.	Micro Irrigation system hinders other intercultural operation	35.83	VI
5.	Requirement of high maintenance	33.53	IV
6.	Blockage of water pipes and clogging of emitters	12.50	V
Infrastructural Constraints			
1.	Materials and equipments supplied by the company are of lower quality	55.97	I
2.	Services provided by the company are unsatisfactory	48.40	II
3.	Unavailability of spare parts	41.60	III
4.	After sales services are not up to mark	32.83	IV
5.	Insufficient and Irregular supply electricity for irrigation	12.17	V
6.	MIS provided is not sufficient	10.70	VI
Institutional Constraints			
1.	Inadequate number of demonstrations and trainings	53.93	I
2.	Lack of knowledge about operation of micro irrigation	33.17	II
3.	Lack of systematic campaign for popularizing the MIS	26.83	III
4.	Inadequate awareness about micro irrigation system	22.63	IV
5.	Unavailability of expert related to micro irrigation	18.70	V
Financial Constraints			
1.	High installation cost	15.87	I
2.	High cost of spare parts	13.81	II
3.	Time taken in subsidy disbursement is lengthy process	13.65	III
4.	Less provision of subsidy	1.67	IV
Climatic and Geographical Constraints			
1.	Damage to MIS due to cold or high temperature	53.07	I
2.	Choice of MIS does not match crop the requirements	29.53	II
3.	Undulated topography and fragmented land holding	25.40	III
4.	Improper and Inadequate water source or water storage structures	19.07	IV
5.	Unavailability of clean water	10.23	V

Table 1. The data shows that among the technical constraints, 'Damage of laterals, submain and main line' (I ranked) was major technical constraint faced by PMKSY beneficiary farmers followed by 'Leakage of irrigation system' (II ranked), 'Difficulty in use of micro irrigation system' (III ranked), 'Irrigation system pose hindrances for other intercultural operation' (IV ranked), 'Requirement of high maintenance' (V ranked) and 'Blockage of water pipes and clogging of emitters (VI ranked)'. 'Damage of laterals, submain and main line' was the most prominent technical constraint which might be due to the reason that rodents might find it a source of water and so, sometimes they bite the drippers and pipes leading to leakage of the system, which caused improper irrigation water distribution. Similarly, improper management of water pipes on the part of farmers during intercultural operations, removal, storage and re-installation of the MIS might also damage the water pipes. Similar findings were reported by Mrudala (2012) and Kiruthika (2020). Leakage of

the irrigation system near valves, joints and from broken lateral caused loss of water and decreased life span of the MIS which could be attributed to the lack of skills of farmers on maintenance of the MIS and also because of lower quality of micro irrigation material. Kumar (2010) also supported the findings of the present study. 'Difficulty in use of micro irrigation system' was the third most important constraint where farmers confessed that they weren't able to use micro irrigation technology due to various reason like no prior exposure of MIS, their lack of understanding on different parts and functioning, operation of these parts of MIS, difficulty on decision making on selecting right crop and its maintenance, less education. 'Irrigation system hinders for other intercultural operation' was a very common constraint because every crop requires intercultural operation and submain, laterals and spare parts of MIS create hurdle for implements and they get damaged. 'Requirement of high maintenance' was a minor constraint faced by some of the farmers who expressed that MIS required more time and care apart from demanding technical know-how. The reason behind it could be that some farmers were less educated and also some farmers owned less resources. These farmers found it difficult to invest more energy on this novel irrigation method. Requirement of high maintenance included its storage, installation in field for next crop, changing damaged parts, preventing it from theft in some regions, regular cleaning of parts, applying for micro irrigation subsidy support again. Some of the beneficiary farmers reported 'Blockage of water pipes and clogging of emitters' as constraint because some farmers that filter in MIS was not working well and was not replaced on time, thereby causing blockage of water pipes. Similar findings were observed with the study of Bunker (2011).

Among infrastructural constraints, 'Materials and equipments supplied by the company are of lower quality' (I ranked) was the most predominant infrastructural constraint followed by 'Services provided by the company are unsatisfactory' (II ranked), 'Unavailability of spare parts' (III ranked) respectively, 'After sales services are not up to mark' (IV ranked) and 'Insufficient and Irregular supply electricity for irrigation' (VI ranked) and 'MIS provided is not sufficient' (VI ranked). 'Materials and equipment supplied by the company are of lower quality' was most prominent among infrastructural constraints. Beneficiary farmers highlighted that some micro irrigation companies have supplied poor quality material with an aim to make higher profit. Although designated companies are accountable to provide BIS material only but still farmers reported their concern over quality of MIS material provided. This aspect of subsidy was changing their perception on adoption of micro irrigation in near future, if subsidy support on micro irrigation stops. Similar constraint was observed by Shashidhar *et al.* (2007). It was also observed that beneficiary farmers were not satisfied with the services provided by company which installed MIS in their farm. Beneficiary farmers expressed that once MIS installation is done; company agents don't respond to their problem regarding operation of MIS. They often face problems but company agents either won't respond or respond to their problem late, when already much losses have happened to the farmers. As per the PMKSY guidelines, designated company people are accountable to look after installed MIS in farmers' field. But due to no follow up activity by the company and responsible authority, MIS in farmers' fields remained unnoticed. Moreover, 'Unavailability of spare parts' could be due to the location of their farm. Farmers resided in outskirts of the district headquarter and companies have their outlets in capital city in most cases i.e., in Dehradun. As farmers have to bring spare parts from far of places, it is a financial burden on the beneficiary farmers. The results were in conformity Radhika (2007); Karpagam (2009) and Manish (2016). 'After sales services are not up to mark' was also a constraint because micro irrigation companies were interested in new installation rather looking after sale service for their old installations. Farmers in some cases highlighted that after sales services are not looked upon and within two year, their installed MIS damages and they could not use same system again. Moreover, subsidy providers opined that they lack staff and technicians for follow up activities and after sales services. Similar constraint was identified by Karpagam (2009) and Prajapati *et al.* (2016). Furthermore, beneficiary farmers expressed that didn't receive ample amount of electricity for irrigation for more time. Since, there was lack of natural water reservoirs in nearby areas like, lake, pond, natural stream. So, farmers were highly depended on borewell water. In such condition, insufficient and irregular supply electricity made it problematic for farmers to irrigate their crop. Here, farmers were highly dependent on diesel operated borewell, which is yet another problem. 'Micro irrigation system isn't sufficient' was last but an important infrastructural constraint faced by the beneficiary farmers. This constraint showed problem of basically two categories of farmers. First one was those farmers who had ample resources and large land holding to adopt micro irrigation. But due to land ceiling of upto 5 ha, these farmers were not able to avail more benefit of the programme. Large farmers affirmed that they were able to employ MIS only due to subsidy support and if it was not there, they would not have adopted it. These farmers felt that MIS was not sufficient due to land ceiling. Similarly, Kapur *et al.* (2016) opined that land ceiling has been seen as one of the impediments in faster growth of micro irrigation. Second category of farmers were those who possessed fragmented land holding. These farmers reported that they were not able to cover much of their farm under assured irrigation through MIS because pipes length provided was not sufficient and also, they could not manage MIS from one water source. Under the study it was found that, for 0.4 hectare of land 250 meter and for 1 hectare of farm, 400m length lateral pipe was provided. But demand of each farm varies as per topography. This constraint highlighted a major concern behind non adoption of MIS in hill areas by small and marginal farmers.

Among institutional constraint, it was observed that 'Inadequate number of demonstrations and trainings' (I ranked) was viewed as most significant institutional constraint followed by 'Lack of knowledge about operation of micro irrigation' (II ranked), 'Lack of systematic campaign for popularizing the MIS' (III ranked), 'Inadequate awareness about micro irrigation system' (IV ranked) and 'Unavailability of expert related to micro irrigation' (V ranked). 'Inadequate number of demonstrations and trainings' could be due to less focus on institutions on training part. It was observed that companies mostly performed training for beneficiary farmers. But number of trainings and demonstrations were not sufficient to cover all the farmers. The results were in conformity with Radhika (2007). Beneficiary farmers reported that 'Lack of knowledge about operation of micro irrigation' which might be due to lack of institutional discussion and counselling on technical know-how of the MIS. Beneficiary farmers expressed how they didn't receive technical advice on MIS from the concerned officials and mostly such advisory is done by subsidy providers. The finding was in accordance with the finding of Karki (2019). 'Lack of systematic campaign for popularizing the MIS' and 'Inadequate awareness about micro irrigation' were another institutional constraint because there was less focus on promotion of micro irrigation technology on part of government and micro irrigation companies. This could be a reason behind why still so many farmers follow traditional irrigation method despite systematic efforts of the government. Here, it was observed that both government and subsidy providers paid less interest on popularizing MIS. The finding was in accordance with the finding of Patidar (2015). Some of the farmers reported that 'Unavailability of expert related to micro irrigation' as constraint, which could be due to the occasional discussion on micro irrigation with experts. These constraints pointed towards the wide ratio of extension worker to farmer ratio which was not in workable position. In this case, extension workers also expressed that the staff is inadequate to cater to the agricultural needs of the farming community.

Among financial constraint, 'Installation cost is high' (I ranked) was the major financial constraint followed by 'High cost of spare parts' (II ranked), 'Time taken in subsidy disbursement is lengthy process' (III ranked) and 'Provision of subsidy is less' (IV ranked). 'Installation cost is high' was very prevalent financial constraint because in comparison to conventional irrigation methods, micro irrigation requires more inputs and expertise. Moreover, the scale of their production was less and making profit was big task for marginal and small farmers. So, they might have felt that MIS is costly. The finding was in accordance with the finding of Dholariya (2015) and Dinakar (2020). Some of the farmers reported 'High cost of spare parts', 'Time taken in subsidy disbursement is lengthy process', 'Provision of subsidy is less' as minor constraints. This could be attributed to the fact that some beneficiary farmers in study area had lower saving and purchasing spare parts was costly for them. They installed MIS on subsidy but again investing on spare parts which was not available in nearby area was costly for them. Moreover, subsidy disbursement in case of some farmers took more time due to lack of required documents and slow procedure on part of the concerned department. Some farmers even expressed that provision of subsidy is less and government should provide more subsidy on micro irrigation. The finding was in accordance with the finding of Shashidhar *et al.* (2007) and Karpagam (2009).

Among climatic and geographical constraint, 'Damage to MIS due to cold or high temperature' (I ranked) was the most predominant constraints followed by 'Choice of MIS does not match crop requirements' (II ranked), 'Undulated topography and fragmented land holding' (III ranked), 'Improper and Inadequate water source or water storage structure' and 'Unavailability of clean water' (V ranked). 'Damage to MIS due to cold temperature or high temperature' was most prominent constraint because the region received frost which hardens the laterals and other pipes. Meanwhile, in some places high temperature also damaged pipes making them more vulnerable to breakage. 'Choice of MIS does not match crop requirements' was second most significant constraints which was due to less experience of beneficiary farmers on MIS. There are various types of MIS like drip irrigation, sprinkler irrigation and raingun, mini, micro, etc. and selection of the right MIS as per farm requirement is very important for success of micro irrigation. In some cases, it was observed that the selection of MIS as per crop was not at all taken under consideration while providing subsidy to the farmer. Under subsidy scheme, no consideration was given in respect of field sizes, shape, topography, location of the water sources and crop to be grown. Therefore, farmers were not getting desired satisfaction from system installed and were asking to replace the system with another one. Lack of knowledge on choice of MIS and crop on the part of farmers and extension functionaries and ignorance on the part of subsidy providers resulted in several problems. 'Undulated topography and fragmented land holding' were most commonly found constraint in the study area. Many farmers in possessed fragmented land holding because in hill topography seldom farmers have all their land in continuous stretch at a single place. In such cases, they had to install separate micro irrigation units for each fragment which could be financially and technically stressful for farmers. The finding was in accordance with the finding of Kumar (2010). 'Improper and inadequate water source or water storage structure was one of the major constraints faced by the beneficiary farmers especially hill areas of the study areas. In such places, it could be due to the fact that farming is largely rainfed and water source available runs dry in summer season. In addition to it, lack of water storage structure and their improper maintenance made it difficult for beneficiary farmers to irrigate their crops in summer season. Beneficiary farmers expressed that they were provided by the MIS without arrangement of assured water source in many cases. In general, PMKSY makes it mandatory for the concerned department to arrange assured water source in the target area and then provide the micro irrigation facility. But in study area it was found that the work of constructing water source like *hauz* i.e., water tank lies with horticulture and agriculture department both. Due to lack of synchrony between departments or delay in release of fund for construction, farmers faced this problem. Meanwhile, farmers also confessed that already existing water sources also demanded repair and renovation. The finding was in accordance with the finding of Karki (2019). It was found that a few farmers faced 'Unavailability of clean water' as constraint as their farm near to industrial localities. During rainfall, water pollutants, plastic waste entered their farm, causing loss to them.

Suggestions by the beneficiary farmers to overcome constraints

PMKSY is a flagship scheme of government of India which needs continuous improvement and beneficiary farmers from the time of availing scheme have been facing the problems. By virtue of experience, beneficiary farmers put forth some valuable suggestion for successful implementation of the scheme at grassroot level. In this context, an attempt was made to compile their suggestion given by beneficiary farmers to overcome the constraints, which are presented in Table 2. Organizing training programmes and demonstration on micro irrigation and water conservation was first and most important constraints given by the beneficiary farmers. They highlighted training on operation, care and maintenance of micro irrigation system, package of practices for various crops under MIS etc. should be more in number and frequent. Beneficiary farmers

Table 2: Suggestions given by PMKSY-PDMC beneficiary farmers (n=240)

S.No.	Suggestions	Frequency	Percentage
1.	Organizing training programmes & demonstration on micro irrigation & water conservation	224	93.33
2.	Supplying of standard quality material	200	83.33
3.	Availability of local dealers should be provided with spare parts	170	70.83
4.	Promotion and implementation of fertigation	150	62.50
5.	MIS should be planned and designed based on specific crop and farm.	130	54.16
6.	Promotional activities, campaigns and more mass media coverage	128	53.33
7.	Water sources have to be built and renovated before giving subsidy support on micro irrigation	128	53.33
8.	Increase the technical field staff who are working upon micro irrigation & ensuring follow up	90	37.25
9.	Developing on cold and frost resistant pipes	90	37.25
10.	Regular visits by extension officials	81	33.75
11.	Different guidelines for hill and plain region of the state	75	31.25
12.	Removal of land ceiling of 5 ha	60	25.00
13.	Uninterrupted power supply and providing water solar pumps	50	20.55
14.	Encourage farmers to actively participate in meetings and improve their social participation with regard to micro irrigation and water conservation	40	16.66
15.	Financial advice should be given to famers on micro irrigation aspects by extension personnels.	32	13.33

suggested to provide quality material to them and also, they should be provided spare parts at economic cost within stipulated time period without delay. Companies can run outlets at district level so that farmer can reach them for help as and when needed. Moreover, beneficiaries of PMKSY felt that they need proper training and guidance on care and maintenance of MIS i.e., on storage, removal and re-installation, functioning, repair of various parts etc. For this manufacturers and company agents can play a vital role by providing services and guidance. Meanwhile, adoption of micro irrigation is still in budding phase in Uttarakhand, an active role of the manufacturer is essential in promoting drip irrigation as well as developing confidence among the farmers about the usefulness of the new technology. Fertigation is mandatory as per the guidelines of PMKSY per crop more drop but it was observed that many farmers did not go fertigation. Hence, fertigation as integrated nutrient management technique should be promoted. Looking at its importance, extension workers need to provide proper knowledge and training to farmers on fertigation. Also, adoption of fertigation has to be ensured by the extension workers. Micro Irrigation system needs to be tailor made i.e., planned and designed based on location specific parameters is an important suggestion made by the beneficiary farmers. It has to be emphasised and ensured that farmers receive proper knowledge and skills on MIS and its appropriateness as per farm and crop. The indicative cost of the MIS should be made flexible in such cases. Moreover, operational guidelines of PMKSY could be made more flexible, so that farmers can take subsidy support as per their need within a certain limit. Horticulture/agriculture officers expressed that they follow operational guidelines and in case of farmers with small and fragmented land holding, these guidelines made it inflexible to install micro irrigation system as per need. Promotional activities and campaigns on micro irrigation was yet another suggestion given by the beneficiary farmers. For this, extension materials like leaflet, pamphlets, video shows should be made for popularizing micro irrigation among farmers, informing farmers on subsidy support and fertigation. Radio and Television as mass media support to micro irrigation campaign could be helpful in this direction. Water source is the most important for micro irrigation and since PMKSY ensures to provide both assured water source and efficient irrigation method to farmers i.e., MI. So, water sources have be built and renovated before providing subsidy support on MI. Since, these tasks are often performed by two different department. So, the missing synchrony between department should be addressed or the same department can be given both tasks. Water tanks i.e., *Hauzes* which were constructed under old scheme and which are still under use should be renovated and repaired. Beneficiary farmers also suggested to increase the technical field staff who are working upon micro irrigation and to ensure follow up service by the government functionaries and micro irrigation company. Since micro irrigation is crucial component which not only deals with crop management but also address global issue of water management. So, special units on sustainable water management in agriculture could be established at district level who would be connecting farmers and help in proper implementation of the programme. In case of those places where cold and frost was causing big damage to pipes and therefore, counselling farmers on maintenance by the company agents becomes very important. In near future, corporate can try to make such pipes which can resist breakage from cold temperature. It is a matter of manufacturing better MIS equipments and government can encourage companies to innovate on this part of the technology. Beneficiary farmers felt that they won't have regular contact with extension workers with regard to PMKSY specifically. So, extension workers can make frequent visit to farmers field to see the performance of their crop under installed micro irrigation system. Some beneficiary farmers suggested that there should be different guidelines for hill and plain region on micro irrigation because of different climatic and socio-economic situations of farmers. Beneficiary farmers with large land holding felt that land ceiling of 5 ha prevented them to adopt micro irrigation at larger scale. As majority of farmers had 4 to 10 ha farm size, so it was an important suggestion. In such cases separate guidelines can be issued by the central government where they can decrease the provision of subsidy from 55 per cent or 45 per cent, so that large farmers could cover more area also under micro irrigation. Innovations in arena of micro irrigation on the part of manufacturing companies regarding feasibility and cost of MIS can help farmers to purchase MIS. Uninterrupted and quality power supply is necessary for farmers who faced issues of inadequate and insufficient electricity for irrigation and it was suggested to provide solar water pumps to them or to ensure uninterrupted and quality power supply for irrigation purpose. It was also observed that encouraging farmers to actively participate in meetings and improve their social participation with regard to micro irrigation and water conservation can also be helpful in successful implementation of the programme.

CONCLUSION

PMKSY is a flagship scheme of government of India which was launched in 2015 ensure access to some means of protective irrigation for all agricultural farms in the country. The study identifies and analysed constraints faced by beneficiary farmers who availed micro irrigation subsidy support under PMKSY-PDMC component. It was found that major constraint in five categories were 'damage of laterals, submain and main line', 'Materials and equipments supplied by the company are of lower quality', 'Inadequate number of demonstrations and trainings to motivate and develop skill for MI', 'Installation cost is high' and 'Choice of MIS does not match crop requirements. The study suggest intensive efforts are needed at implementation level like promoting fertigation and ensuring its adoption by beneficiaries, organizing more trainings and demonstration, assuring water source, supplying quality materials, selecting upon MIS as per the farm and crop yield etc. Moreover, the study also suggests some reforms in PMKSY guidelines like removal of land ceiling, more provision of subsidy, flexibility in choosing the subsidy provider by beneficiaries, specific and detail provisions for farmers having fragmented and undulated land holdings, farmers living in climatically vulnerable areas and maintaining synchrony between related departments.

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Status of Girl Child Education in Rural and Tribal Areas of Telangana State

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ABSTRACT

Education of a girl child is necessary for the overall development of our country. Encouraging girl child education is known to delay the age at marriage and also reduce fertility levels, maternal and child mortality levels and promote the quality life of the entire family and next generation. The results of the study indicated that majority (80.83%) of the respondents were illiterates and majority (42.96%) of girls had secondary school education followed by primary (31.69%) and intermediate (16.19%) and very few (9.16%) had graduation and above. More than half (54.55%) of the respondent's girl children dropped out at secondary school level followed by primary (27.27%) and intermediate (18.18%) level of education. The major reason for being dropouts by the respondent's girl children were due to economic reasons (72.72%) followed by 40.90 per cent of the dropouts due to other reasons like migration and lack of interest in studies. A large majority in rural (91.67%) and tribal (88.33%) and in total (90.00%) of the respondents were showing favorable attitude towards education of girl child and majority (98.33%) of the respondents were aware of Government scheme i.e., Kasturba Gandhi Balika Vidyalaya supporting girl child education; majority (98.33%) of the respondents has awareness.

Keywords: Education, Girl child, Rural, Tribal, Women

INTRODUCTION

Education is an essential part of a living being, whether it is a boy or a girl. Education helps an individual to be smarter, to learn new things and to know about the facts around the world. Especially women education in India is the need of the hour. In terms of inhabitants, India is the second largest nation in the world but the rate of girl education in India is extremely low. Educating the girl child must be a necessity for the overall development of the country as women play an essential part in the all-around process of the country (Abhilasha Gaur, 2017).

Discrimination in education: Gender inequality in education is a persistent problem in Indian society, especially for girls from rural areas and lower socioeconomic backgrounds. During the past several decades, India has achieved success in moving toward universal school enrollment and in enacting policies to address educational inequalities such as those 2 based on gender. However, education gaps still exist (White, 2016). The history of female education in India is not much old. In fact, at the beginning of the 20th century, the female literacy rate was below 1% in every province of British India. According to Census 2011, in the state of Telangana, the female literacy rate is 65.5 per cent against the male literacy rate of 82.1 per cent. Although there has been a considerable improvement in literacy rate of female but still it is much lower compared to male. Male-female gap is predominant and nearly 20 per cent gap is remaining between male-female literacy rate. The problem of literacy is acute in rural India where nearly 43 per cent female are illiterate (Banerjee, 2013).

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Gender discrimination – Impact on Education: Experts often argue that women's education is the key to reducing discrimination against girls. However, female literacy rate has risen from 15 to 54 per cent, even as the juvenile sex ratio has fallen. Some studies have shown that educated mothers are far more "efficient" in discriminating against their daughters than uneducated mothers. Other studies have shown that though higher levels of maternal education decreases infant mortality for both boys and girls, the effect is larger for girls. Thus, higher levels of maternal education decrease gender differentials in child mortality. On the other hand, there is also evidence that maternal education at the district and household levels is weakly associated with increases in female survival. At a macro level, regions with high female literacy states – Kerala, Andhra Pradesh, Tamil Nadu, Karnataka and Goa - have shown less discrimination towards girls. However, in the past 20 years, high female literacy has not stopped Delhi, Gujarat, and Rajasthan from showing increased discrimination against girls.

The female child in India is often deprived from her right of an education. The number of girls dropping out of school far exceeds the boys because girls are expected to help at home, either with household work like washing and cooking or with taking care of younger siblings. Since girls spend more time performing domestic duties and this increases the gap between female and male equality in rural parts of India, it perpetuates the myth that education is of no help to the girl and her primary job will be to look after the household work, get married early, have children and then raise them. If this is the job she has must do, then education is of no importance to her and it is not imparted. Also, even with education and financial independence, women might not get the same rights and liberties which a man may have. It is through education in the early days of a child that we can bring about behavior changes and open doors to opportunities that will enhance their confidence, personality, and career.

The right to education has been recognized as a human right in a number of international conventions, including the International Covenant on Economic, Social and Cultural Rights which recognizes a right to free and compulsory primary education for all, an obligation to develop secondary education accessible to all, in particular by the progressive introduction of free secondary education, as well as an obligation to develop equitable access to higher education, ideally by the progressive introduction of free higher education. Today, almost 70 million children across the world are prevented from going to school each day. As of 2015, 164 states were parties to the Covenant. The main of the study was to know the existing status of the education of the girl child in the respondents' families and also to know their attitude towards education of the girl child.

MATERIALS AND METHODS

The study was conducted in rural and tribal areas of Telangana state. Purposive random sampling technique was used to select families which is having at least one girl child. A total 120 families were selected out of which 60 sample from rural area i.e., Ghattu mandal of Jogulamba Gadwal district and 60 sample from tribal area i.e., Achampet mandal of Nagar Kurnool district. Data was collected with the help of self-developed interview schedules and for studying the attitude towards education of girl child scale developed by Yashmati Karande (2008) with suitable modifications was used.

RESULTS AND DISCUSSION

Educational status of the respondents: Table 1 it can be noted that in rural population, majority (73.33%) of the respondents were illiterates followed by middle school education (11.67%), high school education (10.00%), primary school education (3.33%) and very few were having graduation & above (1.67%). In tribal population, majority (88.34%) of the respondents was illiterates followed by primary school education (3.33%), high school education (3.33%), middle school education (1.67%) and none of them were graduated. Out of the total population, majority (80.83%) of the respondents were illiterates followed by equal portion (6.67%) belonged to each of middle school education and high school education; primary school education (3.33%), college education (1.67%) and graduation & above (0.83%). Overall majority of the respondents were illiterates due to the reason that schools were located very far from their villages, safety and security aspects, lack of sufficient money and parent's negative attitude towards girl child education.

The results were in accordance with the results of Srinivas and Devoji (2015) wherein they stated that women literacy in Telangana in the year of 2011 is 62.08 in the district of Hyderabad which is highest percent. The lowest tribal women literacy percent was in district of Mahabubnagar (30.04) of Telangana state. This shows the high percentage of illiteracy among tribal population. Bihari *et al.* (2012) revealed that majority (62.00%) of the women respondents were illiterates, followed by 26.00 per cent of the respondents studied up to primary school and 12.00 per cent of the respondents studied up to middle school and above.

Educational status of girl children of the respondents: Table 2 indicates that in rural, majority (44.45%) of the respondent's girl children were educated up to secondary school followed by primary education (33.33%) and intermediate (17.46%) and very few (4.76%) were educated up to graduation and above. In tribal, daughterseducational status indicated that, majority (41.78%) of the daughters had secondary school education followed by primary (30.38%) and intermediate (15.18%) level of education and a considerable percentage (12.66%) were graduates. Out of the total sample of rural and tribal, the girl child education revealed that majority (42.96%) of girls had secondary school education followed by primary (31.69%) and intermediate (16.19%) and very few (9.16%) had graduation and above. The reason for these results were majority of the respondents belonged to young age and had school going children of secondary and primary school. The numbers of graduate daughters were found to be slightly more in tribal sample when compared to daughters of rural sample and the reasons found were age factor of respondents that they had college going children and they were making use of reservation and other free hostel and reservation facilities created by the government.

Dropout girl children of the respondents: Table 3 indicates that in rural, majority (42.86%) of the respondents'girl children dropped from their studies at secondary educational level followed by either primary (28.57%) or intermediate (28.57%) level and none got dropped at graduation and above. In tribal, majority (75.00%) of the girl children of the

Table 1: Distribution of respondents according to their educational levels (n=120)

Educational Level	Rural (n=60)		Tribal (n=60)		Total (n=120)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Illiterate	44	73.33	53	88.34	97	80.83
Primary School	2	3.33	2	3.33	4	3.33
Middle School	7	11.67	1	1.67	8	6.67
High School	6	10.00	2	3.33	8	6.67
College Education	0	0.00	2	3.33	2	1.67
Graduation & Above	1	1.67	0	0.00	1	0.83
Total	60	100.00	60	100.00	120	100.00

Table 2: Distribution of respondents'girl children according to their educational status (n=120)

Education of Girl child	Rural (n=63)*		Tribal (n=79)*		Total (n=142)*	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Primary	21	33.33	24	30.38	45	31.69
Secondary	28	44.45	33	41.78	61	42.96
Intermediate	11	17.46	12	15.18	23	16.19
Graduation and above	3	4.76	10	12.66	13	9.16
Total	63	100.00	79	100.00	142	100.00

* Total number of female children in the sample

respondents dropped out at secondary school followed by primary (25.00%). Out of the total, majority (54.55%) of the girl children of the respondents dropped out at secondary school level followed by primary (27.27%) and intermediate (18.18%) level. The results were supported by the study conducted by Deepak (2016), revealed that both girls and boys in the age group of 6 to 18 years were equally vulnerable to dropouts. About 90 percent of the school dropout children were from the government schools and 3 in 5 children in the age group of 15 to 18 years were dropped from the school.

Reasons for school dropouts among girl children: Table 4 indicates that in rural, reasons for being dropouts by the girl children of the respondents were due to economic reasons (71.42%) as stated by respondents had no sufficient money for education and due to their family debts followed by (42.85%) of the dropouts due to other reasons like due to migration of families to urban areas, student's lack of interest and school was far from their village. A next higher percentage, 28.57 of the girl children dropped out due to family reasons like taking care of siblings, help at home, single parent and after maturation they were not sending their children for education followed by 21.42 per cent of the respondents' children were dropped due to social reasons like relatives were not sending their children for education and afraid of love affairs. In tribal, reasons for being dropouts by the girl children of the respondents were due to economic reasons (75.00%) as stated by respondents had no sufficient money for education and due to their family debts followed by (37.50%) of the dropouts due to any other reasons i.e., due to migration and student's lack of interest. 25.00 per cent girl children were dropped out due to either of family reasons like taking care of siblings, help at home, single parent, after maturation they were not sending their children for education and social reasons like relatives were not sending their children for education and afraid of love affairs.

Out of total school dropouts, reasons for being dropouts by the girl children of the respondents were due to economic reasons (72.72%) as stated by respondents had no sufficient money for education and due to their family debts followed by (40.90%) of the dropouts due to any other reasons i.e., due to migration and student's lack of interest. 27.27 per cent of the dropped out due to family reasons like taking care of siblings, help at home, single parent and after

Table 3: Distribution of respondents' girl children according to the dropout level

Dropout level of girl children	Rural (n=14)*		Tribal (n=8)*		Total (n=22)*	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Primary	4	28.57	2	25.00	6	27.27
Secondary	6	42.86	6	75.00	12	54.55
Intermediate	4	28.57	0	0.00	4	18.18
Graduation and above	0	0.00	0	0.00	0	0.00
Total	14	100.00	8	100.00	22	100.00

* Dropout girl children in the respondents' family

Table 4: Reasons for school dropouts among girl children of respondents

Reasons for school dropout	Rural (n=14)*		Tribal (n=8)*		Total (n=22)*	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Economic reasons	10	71.42	6	75.00	16	72.72
Social reasons	3	21.42	2	25.00	5	22.72
Family reasons	4	28.57	2	25.00	6	27.27
Health reasons	0	0.00	0	0.00	0	0.00
Any other reasons	6	42.85	3	37.50	9	40.90

*Dropout girl children in the respondents' family maturation they were not sending their children for education. Very few (22.72%) of the respondents' children were dropped due to social reasons like relatives were not sending their children for education and afraid of love affairs. None of the girl children were dropped out due to health reason, lack of proper sanitation facilities in school. The reason for this might be that a large section of the families belonged to low income and were landless labour hence expressed economic as the major cause for dropouts of girl children and parents were illiterates. Another major cause for their children to become dropouts was student's lack of interest and migration to urban areas for their livelihood due to debts and no profits from agriculture. Similar findings were found in the study of Baruah and Goswami (2012) wherein the major factors inducing the school dropouts were found to be economic condition of the family, literacy of their parents, and lack of parental guidance in studies.

Attitude towards Education of girl child: Table 5 indicates that majority in rural (91.67%) and in tribal (88.33%) and in total (90.00%) of the respondents were showing favorable attitude towards Education of Girl child. Out of the total sample, majority (83.33%) of the respondents were seen to be accepting the idea that education of girls will help them to solve their problems. It was also observed that most (80.83%) of the respondents felt that Education makes the girls self-sufficient. It was further noticed that 78.33 per cent of the respondents' felt that educated girls are more helpful to make her own family and education of girls improve the future generation to come and 75.00 per cent of the respondents felt that educated girls were more helpful to their parents than uneducated girls. Nearly 48.33 per cent of the respondents felt that it was difficulty in search of life partner for highly educated girls. It was good finding that only 33.33 per cent of the respondents opined that it's waste of money to give education to girls, only 37.50 per cent of the respondents felt that the feeling of insecurity for keeping the girls outside for education nearly 40 per cent of the respondents opined that education spoils girls to become more fashionable and lazy. 38.33 there is no necessity of girls' education as they have to ultimately serve their spouses. On the whole it can be seen that respondents had positive attitude towards girl child education.

The results were in accordance with the results of Dattatrey (2017) in her study on Farm women attitude towards Girls Education. Regarding the parental attitude of girl child education, majority (90.00%) of the respondents had positive and favorable attitude towards girl child education and they want to educate their daughters more. To put this attitude into action the government should remove presumptions and highlight the needs of literacy. Reshma (2014) in her study on Parents Attitude towards Girl Child Education: A Sociological Study of Haryana, Parents of all caste

Table 5. Attitude towards Education of girl child (n=120)

Statements	Rural (n=60)		Tribal (n=60)		Total (n=120)	
	F	%	F	%	F	%
Encourage the education of the girl child	55	91.67	53	88.33	108	90.00
Educated girls are more helpful to their parents than uneducated girls	47	78.33	43	71.67	90	75.00
Educated girls are more helpful to make her own family	48	80.00	46	76.67	94	78.33
Education will help the girls to solve their day to day problems	52	86.67	48	80.00	100	83.33
Education of girls improve the future generation to come	48	80.00	46	76.67	94	78.33
Education makes the girls self-sufficient	49	81.67	48	80.00	97	80.83
Feeling of insecurity for keeping the girls outside for education	25	41.67	20	33.33	45	37.50
Do you think there is no necessity of girls' education as they have to ultimately serve their spouses	26	43.33	20	33.33	46	38.33
Do you think it's waste of money to give education to girls	24	40.00	16	26.67	40	33.33
Do you think education spoils girls to become more fashionable and lazy	26	43.33	20	33.33	46	38.33
Difficulty in search of life partner for highly educated girls	31	51.67	27	45.00	58	48.33

have highly positive attitude towards the education of their girl child. When compared with fathers, mothers have more positive attitude towards the education of their girl child. High Education level also positively effects the parent attitude towards girl child education. Parents belonging to the higher socio-economic status have more favorable attitude towards the education of their girl child.

Government schemes supporting girl child education –Kasturba Gandhi Balika Vidyalaya (KGBV): Table 6 indicates that in rural, majority (98.33%) of the respondents had awareness on Government schemes supporting girl child education; Kasturba Gandhi Balika Vidyalaya followed by attitude (like to admit) (88.33%) and practice (already admitted) (5.00%). In tribal, majority (98.33%) of the respondents has awareness on Government schemes supporting girl child education; Kasturba Gandhi Balika Vidyalaya followed by attitude (Like to admit) (91.67%) and Practice (Already admitted) (13.33%). Out of the total, majority (98.33%) of the respondents has awareness on Government schemes supporting girl child education; Kasturba Gandhi Balika Vidyalaya followed by attitude (like to admit) (90.00%) and practice (already admitted) (9.17%). The respondents were showed positive attitude towards government scheme supporting girl child education; Kasturba Gandhi Balika Vidyalaya schools, they all felt that these schools are boon for them, they want to join their daughters because these scheme was accessible at free of cost. The reason for this result was due to their low income level and majority of the respondents were illiterates, now they realized the value of education after doing drudgery in farms. The study of Ahamad and Narayana (2015) suggested that the Centrally Sponsored Schemes in School Education (CSS) will be helpful for their education. The establishment of Kasturba Gandhi Balika Vidyalaya (KGBV) residential schools will increase the literacy levels of girl child.

Government schemes supporting girl child – Beti Bachao, Beti Padhao: Table 7 indicates that in rural, majority (85.00%) of the respondents has no awareness on Government schemes supporting girl child; Beti Bachao, Beti Padhao followed by respondents had awareness on Government schemes supporting girl child; Beti Bachao, Beti Padhao (15.00%). In tribal, majority (96.67%) of the respondents has no awareness on Government schemes supporting girl child; Beti Bachao, Beti Padhao followed by respondents had awareness on Government schemes supporting girl child; Beti Bachao, Beti Padhao (3.33%). Out of total, majority (90.83%) of the respondents has no awareness on Government schemes supporting girl child; Beti Bachao, Beti Padhao followed by respondents has awareness on Government schemes supporting girl child; Beti Bachao, Beti Padhao (9.17%).

Kumar (2015) studied the impact of the programme; Beti Bachao and Beti Padhao (save the girl child and educate her) which included more than 50 per cent districts of the Haryana and an attempt has been made to analyze geographically the child sex ratio of Haryana using census data 1971-2011.The author suggested that it can be further improved with

Table 6: Government schemes supporting girl child education – Kasturba Gandhi Balika Vidyalaya (n=120)

KGBV	Rural(n=60)		Tribal(n=60)		Total(n=120)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Awareness	59	98.33	59	98.33	118	98.33
Attitude (Like to admit)	53	88.33	55	91.67	108	90.00
Practice (Already admitted)	3	5.00	8	13.33	11	9.17

Table 7: Government schemes supporting girl child – Beti Bachao, Beti Padhao (n=120)

BBBP programme	Rural(n=60)		Tribal(n=60)		Total(n=120)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
No awareness	51	85.00	58	96.67	109	90.83
Awareness	9	15.00	2	3.33	11	9.17
Total	60	100.00	60	100.00	120	100.00

campaigns to sensitize people towards the concern the girl child particularly in the districts where child sex ratio in decline trend during 2001-2011.

CONCLUSION

The study concludes that the right to education encompasses the obligations of the students to avoid discrimination at all levels of the educational system, to set minimum standards of education and to improve the quality of education. The Government of India has taken many initiatives for welfare of children with reference to female at different stages of their life to bring them to the main stream and also to reduce the disparity among boys and girls. Most of the majority of the respondents showed positive attitude towards girl child education. They wanted their children to achieve great heights in their life. The government scheme, Kasturba Gandhi Balika Vidyalayas (KGBV) providing free education and accommodation to the girl child, parents wanted to send their girl children to these schools.

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Career Preferences of Home Science Graduates and Post Graduates of Punjab Agricultural University, Ludhiana

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ABSTRACT

Home Science (now known as Community Science) is an academic discipline extremely popular among girl students and recently even amongst the boys also. In home science profession, there are numerous career options and the selection of right option would help the home scientist to deliver maximum with true spirit. Lack of clear perception of the realities of a career in home science profession could adversely affect young student's satisfaction and their long term commitment to it. Therefore, it was planned to study career preferences of graduates and post graduates of College of Home Science, Punjab Agricultural University, and Ludhiana. The study was carried on graduates and postgraduates of College of Home Science, Punjab Agricultural University (PAU), Ludhiana, who had completed their B.Sc. /M.Sc. / PhD. in field of Home Science during the year 2011-2014. The results of the study showed that the enrolment in the year 2008-09 and 2009-10 was 100 per cent i.e. fifty two students were enrolled. Out of which 61.54 per cent and 53.85 per cent completed their degree in the year 2012-13 and 2013-14 respectively. Findings further revealed that higher the degree level, larger is the proportion of students who preferred public sector employment (63.04% at bachelor, 73.53 per cent at Master's and cent per cent at the PhD level), whereas, majority (74.06%) of the respondents had no intention to start an enterprise. Further, large percentage of the students from all the degree levels utilized faculty members as a source of career information (74.05%).

Keywords: Home science, Career preferences, Entrepreneurship, Graduates and Post Graduates

INTRODUCTION

The major objective of education is to provide young people proper knowledge for realistically planning their career. Career plays an exceptional and major role in the life of an individual because it not only governs his level of income, but also because it affects his personality and perception of life. Career decision making is of critical importance as every student needs to choose his/her professional specialization after completion of their graduation. Career preferences has become complex with the advent of information technology, job competition and lack of information about different career options by the students.

Home Science (now known as Community Science) is an academic discipline extremely popular among girl students and recently even amongst the boys also. A landmark in the history of home science in higher education was its inclusion in State Agricultural Universities from 1961, with the objective to cater to the need of rural women to contribute to family, economy and improve their quality of life. And later on it was reorganised to make it more competitive, vocational oriented and suitable for graduates to face the new challenges of contemporary life. So, at present this degree programme is not only aimed at making girls better housewives, but is also useful to the society to enable them to provide expert advice to enrich social and family life and prepare students for different professions (Rana *et al.,* 2018).

In home science profession, there are numerous career options and the selection of right option would help the home scientist to deliver maximum with true spirit. Lack of clear perception of the realities of a

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career in home science profession could adversely affect young student's satisfaction and their long term commitment to it. Therefore, it was planned to study career preferences of graduates and post graduates of College of Home Science, Punjab Agricultural University, Ludhiana.

MATERIALS AND METHODS

The present study was carried on graduates and postgraduates of College of Home Science, Punjab Agricultural University (PAU), Ludhiana, who had completed their B.Sc. /M.Sc. / Ph.D. in field of Home Science during the period 2011-2014. Total number of students graduated during these years was 207. Questionnaire was mailed to all 207 students but response of only 185 students was received. So, the sample size for the study was 185 respondents comprising 92 students from B.Sc., 68 students from M.Sc. and 25 students from Ph.D. Pre tested questionnaire was selected as a research tool and the data was collected telephonically and through e-mail by the researcher. The data collected was tabulated and analyzed using frequencies, percentages, ranks and weighted mean score.

RESULTS AND DISCUSSION

Enrolment and retention of students in graduation programme: The data in Table 1 shows the comprehensive view of enrolment and retention of the students in B.Sc. (Hons.) Home Science programme during the academic sessions 2008-2011. The enrolment in 2008-09 and 2009-10 was 100 per cent i.e. fifty two students were enrolled. Out of which 61.54 per cent and 53.85 per cent completed their degree in the year 2012-13 and 2013-14 respectively. Whereas, the drop out percentage of these two years was 26.92 and 40.38 per cent respectively. Nearly 11 and 17 per cent of the students from each academic session completed their graduation late.

In 2010-11 number of students enrolled decreased and 90 per cent of the students were enrolled. Out of these students 60 per cent retained and 34 per cent left or were dropped out from the degree programme. Fourteen percent of the students from this batch completed their degree late.

Enrolment and retention of students in masters and doctorate programme: The data in Table 2 shows

Table 1: Enrolment and Retention of students in B.Sc. Home Science programme

Year of admission	Year of completion of degree	Total number of seats	Students admitted f(%)	Students graduated f(%)	Left + dropped students f(%)	Late graduation f(%)
B.Sc. 4 year programme						
2008-09	2011-12	52	52 (100)	32 (61.54)	14 (26.92)	6 (11.54)
2009-10	2012-13	52	52 (100)	28 (53.85)	21 (40.38)	9 (17.31)
2010-11	2013-14	50	45 (90.00)	30 (60.00)	17 (34.00)	7 (14.00)
Total		154	149	90	52	22

Table 2: Enrolment and Retention of students in M.Sc. and PhD programme

Discipline	Year of admission	Year of completion of degree	Number of students admitted	Number of students graduated
M.Sc.	2009-10	2011-12	30	29
	2010-11	2012-13	26	26
	2011-12	2013-14	25	25
Total			80	80
Ph.D.	2008-09	2011-12	10	10
	2009-10	2012-13	10	10
	2010-11	2013-14	11	11
Total			31	31

the enrolment and retention of the students in M.Sc. and Ph.D. programmes of different disciplines of Home Science. In the year 2009-10 number of students enrolled were 30 and graduated was 29(96%), while in the year 2010-11 and 2011-12 number of students admitted were decreased to 26 and 25 respectively and all the students completed their degree at time. Similarly in Ph.D. also retention of the students was 100 per cent. It can be concluded that retention of students in Masters and doctorate level was hundred percent. Findings are in line with those reported by Mittal *et al.* (2020).

Career preferences of students: Data in Table 3 reveals that about 72 per cent of the students preferred a public sector employment followed by any type of employment from public and private sector (49.19%) and exclusive private sector (41.62%). Higher the degree level, larger is the proportion of students who preferred public sector employment (63.04% at bachelor, 73.53% at Master's and cent per cent at the Ph.D. level).

In contrast to the public sector, with an increase in the degree level (i.e. from bachelor to doctoral level) there was decline in the percentage of students who preferred working abroad (21.74%, 19.11% and 8%) and home makers (32.61% and 7.35%). Similar results were also reported by Nakula *et al.* (2017) and Niranjan *et al.* (2018).

Entrepreneurship as a career: The perusal of Table 4 reveals the preference of students in entrepreneurship development .All the respondents were asked to share whether they wanted to start their own enterprise or not. Majority (74.06%) of the respondents had no intention to start an enterprise. They reported that they wanted to go for professional jobs.

Among the respondents who intended to become entrepreneurs 31.25 per cent reported that they wanted to start an enterprise in clothing like stitching, designing, dyeing, embroidery etc. Nearly thirty percent of the respondents planned to start their venture in handicrafts. Other ventures that students were interested were diet clinic (18.75%), bakery and confectionary (12.5%) and toy making unit (8.33%).

Sources of career information: In order to ascertain the information on the sources of career information used by the students, findings from table 5 affirm that

Table 3: Career Preferences of students at different degree levels

Career Preference	B.Sc (n_1=92) f (%)	M.Sc (n_2=68) f (%)	PhD (n_3=25) f (%)	Total (n=185) f (%)
Public sector	58(63.04)	50 (73.53)	25(100)	133(71.89)
Private sector	25 (27.17)	32 (47.06)	20(40)	77 (41.62)
Any (Public/ Private)	35(38.04)	42 961,76)	14 (56)	91(49.19)
Work Abroad	20 (21.74)	13 (19.11)	2(8)	35 (18.92)
Home Makers	30 (32.61)	5(7.35)	-	35 (18.92)

*Multiple responses

Table 4: Student's preference for choosing Entrepreneurship as a career

Items	B.Sc (n_1=92) f (%)	M.Sc (n_2=68) f (%)	PhD (n_3=25) f (%)	Total(n=185) f (%)
Interested in starting an enterprise				
Yes	25(27.17)	16(23.53)	7(28.00)	48(25.94)
No	67(72.83)	52(76.47)	18(72.00)	137(74.06)
Type of enterprise				
Clothing related (Boutique, Block Printing, Embroidery etc.	6(24.00)	5(31.25)	4(57.14)	15(31.25)
Own diet clinic	5(20.00)	2(12.5)	2(28.57)	9(18.75)
Handicraft	7(28.00)	6(37.5)	1(14.28)	14(29.16)
Toy making	3(12.00)	1(6.25)	-	4(8.33)
Bakery and confectionary	4(16.00)	2(12.5)	-	6(12.5)

out of the different sources of career information majority of the students from all the degree levels utilized faculty members as a source of career information (74.05%). Other major sources of career information used by Ph.D. students were advertisements in newspapers (80%) and websites (81%) followed by placement cell of the University (48%) and government employment services (28%).

As far as masters level students were concerned they too indicated faculty members as a major source of career information (76.47%) followed by advertisements in newspapers (63.23%) and placement cell of the University (33.82%). However, only few percentage of the students from B.Sc. degree used newspapers and placement cell of the University (3.36%) as a source of career information (Figure 1). So, it can be concluded that Ph.D. and M.Sc. students explored more sources for career information as compared to B.Sc. students.

CONCLUSION

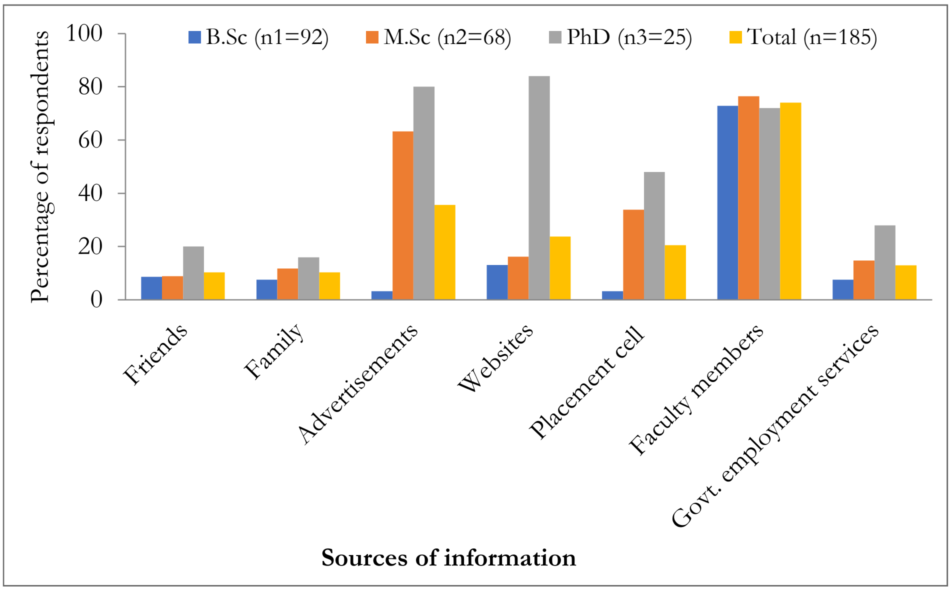
It can be concluded that a good number of students got admitted in the graduation and post graduation degrees of Home Science in the selected years. Public sector employment was the most preferred career option by the selected students. Only few graduates and post graduates had a preference to initiate an enterprise due to various insecurities involved in entrepreneurship development. Therefore, there is a need to impart need based entrepreneurial trainings to students and motivate them for entrepreneurship development.

Table 5: Sources of career information utilized by the students

Sources of information	B.Sc. (n_1=92) f (%)	M.Sc. (n_2=68) f (%)	Ph.D. (n_3=25) f (%)	Total (n=185) f (%)
Friends	8(8.69)	6(8.82)	5(20)	19(10.27)
Family	7(7.61)	8(11.76)	4(16)	19(10.27)
Advertisement in newspapers	3(3.26)	43(63.23)	20(80)	66(35.67)
Websites	12(13.04)	11(16.17)	21(84)	44(23.78)
Placement cell of the University	3(3.26)	23(33.82)	12(48)	38(20.54)
Faculty members	67(72.83)	52(76.47)	18(72.00)	137(74.05)
Government employment services	7(7.61)	10(14.70)	7(28)	24(12.97)

*Multiple responses

Figure 1: Sources of career information



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Creative Conundrum of Young Adolescents across School Environment Variables

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ABSTRACT

Since 20th century special emphasis is laid on creative abilities of students in the education field. As a result creativity has become one of the basic goals at schools in several different countries. If an individual has high level of domain-specific knowledge, but does not have creative problem solving skills accordingly then, utilization of the domain-specific knowledge possibly will be less effective (Renzulli *et al.,* 1974). When a person is in their early adolescence phase, the creative abilities are significantly influenced by its surroundings and school setting is one of those crucial factors. Hence, the present study was designed to investigate the mediating role of school environment in students' creative abilities. The primary research data was assembled from 300 academically bright young adolescents from rural vicinities. ANOVA was implemented to discover the impact of independent variables (school environment) on the dependent variables (seeing problem, inquisitiveness and persistency). Results of the study revealed that there were significant differences in respondents' seeing problem abilities, inquisitiveness and persistency across their academic class. Also, there were significant differences among adolescents' seeing problem abilities across their consecutive academic record. In addition significant differences were observed in adolescents' persistency skills across their role of teachers and the teaching method employed by them.

Keywords: ANOVA, Creativity, Haryana, School environment, SPSS, Young adolescents

INTRODUCTION

Research studies have revealed novice creative problem solvers can show improved creative problem solving abilities in situations when proper training especially focused on the improvement of such skills was employed (Basadur *et al.,* 1982; Dow and Mayer, 2004; Esquivel, 1995). The aptitude of agencies to proffer new products and services depends on the existence of creativity and the organizational competence of turning original ideas into innovations (Brown and Duguid, 2001). There are enormous demands positioned on organizations to fabricate innovative products, services or processes (Storey, 2000). In order to stay competitive, organizations often require learning to adapt, which can also be an expression of organizational learning or organizational innovation (Schein, 1996). For so many decades, many state departments of education, administrations and educators around the world have agreed that unproductive classroom management skills are a foremost problem for teacher retention and efficient teaching (Darling-Hammond and Bransford, 2007). Researchers observed that teachers who utilize their creative ability to explain diversity of problems in classroom are more successful in their teaching profession (Esquivel, 1995; Simplicio, 2000). Davidovitch and Milgram (2006) examined a positive correlation between creative problem thinking abilities of pupils and the keen role played by the teachers' effectiveness in guiding towards pragmatic classroom problem solving. Chant and Ross (2009) favored that teaching creative problem solving in schools is a constructive process for generating innovative

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curriculum that will facilitate students learn content of subjects as expected by State guidelines.

Creativity, learning and innovation are intertwined, but there is very little understanding, based on research studies, of how they interact when they are measured in accordance to home and school environment. In particular, there is very little understanding of the connection between creativity and learning within groups that produce new ideas. Thus, this study also discovers the importance of creativity and teachers' perception about creativity by reviewing various previous such studies. Torrance and Safter (1999) defined creativity as a mixture of divergent and convergent thoughts. Divergent thinking involves the creation of choices as in the thinking procedure, whereas convergent thinking consists of choosing ideas based on their uniqueness, quality and achievability (Kirton, 1987). Usually creativity is defined as a psychological process including the ruling of novel idea or concept, while numerous complex variables appearing as researchers examine in the large display of current talent field of creativity (Milbrandt and Milbrandt, 2011). Gowan (1975) defined creativity as a motivating supremacy deriving from the preconscious mind and conveyed in a way that is consistent with the individual's character. Additionally, Csikzentmihalyi (1996) gave his definition of creativity as an idea or creation that alters or modifies an existing spot.

The concept of creativity may be different according to the various investigators' viewpoint, but most investigators agree on the novelty and suitability of ideas or products. Additionally, the meaning of "novel" and "suitable" may also differ depending on the social situation and any invention may be considered as creativity in one society but not in another. Richards (2001) divided creativity into two parts i.e., Big-C and mini-c creativity. Typically Big-C creativity is extensive and broad in social context while mini-c is narrow and delicate when viewed in the same context. The notion of creativity based on Big-C is effective for teachers who are not successful to recognize the significance of "mini-c" levels of creativity in their classrooms (Beghetto and Kaufman, 2007). Each person has this unique ability to be creative. Richards (1990) stressed on the importance of everyday creativity while researchers accentuate on Big-C creativity rather than mini-c creativity. In addition, mini-c creativity has always been presented as creative potential of pupils that can ensue through the learning process, so making that echelon of creativity is a crucial part of educators' duties.

Creativity can also be judged in different ways and it depends on various objects or situations; sometimes a creative product can be regarded as original and useful by youngsters who do not have enough exposure to such topics on the other hand that same product may or may not be creative and original by adults who have a lot of exposure. Hence, it should be considered at this point that creativity among young students is absolutely based on their personal abilities and related to their life experiences, if the pupils' ideas or their solutions in problematic situation are narrative and suitable, after that they can be considered as a creative person (Runco and Chand, 1995).

Many researchers have accentuated on the significant role that teachers and school environment all together may contribute in the onset of such creative endeavors through by implementing special strategies and by providing appropriate environment. By keeping in view the relevance of such studies, the present research study was designed to assess the possible influence of school environment may have on students' on their creative potential.

MATERIALS AND METHODS

Study design: The objective of the study was to analyze the school environment influence on the creative abilities of the 300 academically bright rural young adolescents. To conduct this study Hisar district was chosen purposively as no such prior study was conducted in this locality. Academic brightness of the respondents was considered as the consecutive academic record of the young adolescents (12 to 14 years old students) who scored more than 85% from the last three consecutive academic classes. Consecutive academic record symbolized the cumulative academic performance of the pupils from the last three academic classes consecutively.

Data collection: The data was collected from the respondents by questionnaire cum interview to gather the valuable primary information.

Tool: The creativity of the respondents was examined by Passi tool of Creativity (PTC, 2006) created by Dr. B.K. Passi.

Statistical analysis: The software Statistical Package for the Social Sciences (SPSS) was used for statistical analysis. Mean, Standard Deviation and ANOVA were calculated to meet the objectives of the study.

RESULTS AND DISCUSSION

Table 1 revealed highly significant differences for seeing problem (F= 08.16, p< 0.01) and persistency (F= 11.83, p< 0.01), whereas, significant differences were elucidated in inquisitiveness (F= 4.56, p< 0.05). The eighth graders were better in seeing problem (Mean=22.29), while ninth graders performed significantly better in persistency (Mean=23.81) and tenth graders were significantly better in inquisitiveness (Mean= 4.59). The research results were also supported by the research findings of the study conducted by Reddy *et al.* (2015), which divulged that participant's academic class had significant impact on their creative abilities.

Table 2 portrayed significant differences in only one domain of creativity i.e., seeing problem (F= 2.27, p< 0.05) across consecutive academic record. Respondents who had consecutive academic record of 88 percent to 90 percent performed better in seeing problem abilities (Mean=22.25), persistency (Mean=21.78) and inquisitiveness (Mean=4.34). The research results were also supported by the research studies of Awamleh *et al.* (2019) and Sumangala (2014), which discovered significant differences for young adolescents' creative talents across their grade point average (GPA). While another study planned by Anwar *et al.* (2012) elucidated contradictory results i.e., there were no significant differences among high and low achievers in terms of their creative thinking abilities.

Another research study executed by Qadir (2014) to explore the impact of personality traits on the academic achievement of adolescents revealed that personality traits affected their school performance significantly in various subjects especially mathematics and general science. Another similar research study carried out by Patil *et al.* (2018) discovered that various personal and home-environment variables such as, age, gender, family income, parental education, parental occupation, health problems, lack of expected cooperation from family members and lack of concentration were probable hazard factors leading towards academic backwardness among adolescents.

Table 3 displayed significant differences in persistency (F=2.10, p< 0.05) across teaching method employed by teachers, whereas, no differences were revealed in the remaining sub-aspects of creativity. The students whose teachers made high level efforts were significantly better in seeing problem (Mean=22.94) and

Table 1: Comparison of respondents 'creativity across academic class (n=300)

Variables	Academic Class			F-value
	Eighth (n=131) Mean ± S.D.	Ninth (n=105) Mean ± S.D.	Tenth (n=64) Mean ± S.D.	
Seeing Problem (SP)	22.29±9.94	21.52±8.42	16.84±8.22	08.16**
Inquisitiveness (INQ)	03.86±02.49	03.6602.35	04.5902.77	02.90*
Persistency (PER)	20.33±09.28	23.81±10.65	16.09±10.52	11.83**

*Significant at 0.05 **Significant at 0.01; S.D.: Standard Deviation; n: Sample size

Table 2: Comparison of respondents' creativity across consecutive academic record (n=300)

Variables	Consecutive Academic Record			F- value
	85% to 87% (n=130) Mean ± S.D.	88% to 90%(n=103) Mean ± S.D.	91% and more(n=67) Mean ± S.D.	
Seeing Problem (SP)	19.66±08.84	22.25±10.12	21.04±08.60	2.27*
Inquisitiveness (INQ)	03.8002.60	04.3402.37	03.6302.55	2.02
Persistency (PER)	20.20±10.76	21.78±10.12	19.76±10.14	0.97

*Significant at 0.05 **Significant at 0.01; S.D.: Standard Deviation; n: Sample size

Table 3: Comparison of respondents creativity across role of teachers in adolescents'creativity enhancement (n=300)

Variables	Role of Teachers in Adolescents' Creativity Enhancement			F- value
	High (n=33) Mean ± S.D.	Medium (n=110) Mean ± S.D.	Low (n=157) Mean ± S.D.	
Seeing Problem (SP)	22.94±09.87	19.98±09.12	21.04±09.27	1.35
Inquisitiveness (INQ)	03.3602.28	04.0502.66	03.9902.46	1.01
Persistency (PER)	24.00±10.42	19.81±10.24	20.52±10.44	2.10*

*Significant at 0.05 **Significant at 0.01; S.D.: Standard Deviation; n: Sample size

Table 4: Comparison of respondents'creativity across teaching method employed by teachers (n=300)

Variables	Teaching Method Employed by Teachers			F- value
	Theoretical (n=126) Mean ± S.D.	Demonstration (n=129) Mean ± S.D.	Mixed (n=45) Mean ± S.D.	
Seeing Problem (SP)	21.37±09.16	20.98±09.65	19.11±08.55	0.99
Inquisitiveness (INQ)	03.9502.66	03.7702.32	04.4402.65	1.20
Persistency (PER)	22.68±09.99	19.14±10.20	19.24±11.35	4.26*

*Significant at 0.05 **Significant at 0.01; S.D.: Standard Deviation; n: Sample size

persistency (Mean=24). While, students whose teachers made medium level efforts were significantly in inquisitiveness (Mean=4.05). Similar results were elucidated by Rose (2016); Budsankom *et al.* (2015) and Devi (2015), who also supported the notion that positive student-teacher relationship and enhanced school environment, encouraged students in their creative endeavors.

Table 4 demonstrated significant differences in persistency skills (F= 4.26, p< 0.05) across teaching method employed by teachers. The participants whose teachers adopted theoretical teaching method performed significantly better in seeing problem (Mean=21.37) and persistency skills (Mean=22.68), while, the students whose teachers implemented combination of both teaching methods (theoretical and demonstration) were significantly better in inquisitiveness (Mean=4.44). Clark (2012) studied the influence of school environment on adolescents' creative abilities and result findings elucidated that the creative skills may be inhibited due to various factors such as, reward structure, supervisory restrictions, evaluation techniques, school deadlines and teachers' attitude towards carving students' creative potential. Along with, another research study executed by Hari *et al.* (2013) observed that the socio-cultural factors highly influenced the educational and occupational aspirations of rural youth of India. Certain human ecological factors such as parents, teachers, media, relatives, neighbors and social acceptance played keen role in the youth' educational and occupational preferences.

CONCLUSION

Results of the present research study revealed that there were significant differences in learners' seeing problem abilities, inquisitiveness and persistency across their academic class. Also, there were significant differences among students' seeing problem abilities across their consecutive academic record. In addition significant differences were also observed in respondents' persistency skills across the role of teachers and the teaching method employed by them in the classroom.

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Assessment of Genotype x Environment Interaction and Stability Analysis in Okra [*Abelmoschus esculentus* (L.) Moench] Genotypes under Kashmir Conditions

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ABSTRACT

An experiment was conducted to evaluate twelve genotypes of okra (*Abelmoschus esculentus* L. Moench) obtained from the Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir and some private vegetable seed companies for their performance and stability at three locations in Kashmir valley viz., Experimental fields of the Division of Vegetable science, SKUAST-K, Shalimar (E_1), Krishi Vigyan Kendra (KVK), Budgam (E_2) and Krishi Vigyan Kendra (KVK), Malangpora (E_3) during kharif 2020. The experiment was laid in a randomized block design with three replications at each location. The pooled analysis of variance for stability of genotypes over three environments indicated significant differences among the genotypes and environments for all the traits studied. The interaction component genotype × environment was significant for all the traits under study. The linear component of environment followed the same trend as non-linear component. According to environmental indices, the environment $E_{1,}$ i.e., the Experimental Farm of Division of Vegetable Science, SKUAST-K, Shalimar was found to be most favourable environment for the expression of almost all traits. Among the genotypes, Arka Anamika, SK-BS-11 and Pusa Sawani showed average stability for the most economic trait i.e., fruit yield plot^{-1}. The genotypes that were found to be stable in all environments for most of the traits were Arka Anamika, IC-18530, SK-BS-11and Pusa Sawani. This implied that these genotypes contributed less to the genotype x environment interaction. Therefore, these genotypes being stable for most of the yield attributing traits under study have been recommended to farmers for cultivation under Kashmir valley conditions.

Keywords: Okra, Genotypes, Environments, Yield, Genotype x Environment interaction

INTRODUCTION

Okra (*Abelmoschus esculentus* [L.] Moench) is an annual vegetable crop grown in tropical and subtropical regions of the world. Okra formerly known as Hibiscus esculentus belongs to Malvaceae (Jute) family and a close relative of one of the most important fibre crops, the kenaf. It is an important vegetable crop grown in tropical and sub-tropical regions for its tender green fruits. It has high nutritive value and export potential. The exact centre of origin of okra is not known, but its centre of genetic diversity is disputed to West Africa, India and Southern Asia (Hamon and Van-Sloten, 1988). Thompson and Kelley in 1957 reported that okra appears to have originated in South Africa or Asia. Okra is a self-pollinated crop; however 4 to 19 per cent cross pollination by insects has been reported (Choudhury and Choonsai, 1970), resulting in significant genetic variation. Okra is classified as an often cross pollinated crop because self-pollination is more prevalent than cross pollination. India is the largest producer of okra in the world, with okra cultivation over an area of 519 thousand hectares with an annual production of 6371 thousand metric tonnes (Anonymous, 2019). In India, it is commercially grown in states like Andhra Pradesh, Gujarat, Maharashtra,

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Karnataka and Tamil Nadu. In Jammu and Kashmir, it covers a total area of 3.62 thousand ha with an annual production of 149.85 thousand metric tonnes (Anonymous, 2018). In Okra cultivation, lack of high-yielding varieties/hybrids is a major constraint. In different environmental conditions, the performance of various okra genotypes varies. The failure of genotypes to show the same relative performance in diverse environments is known as Genotype x environment interactions (Baker, 1988). The occurrence of genotype x environment interaction is a common problem in plant breeding program and these interactions are present in pure lines, hybrids, synthetics or any other material used for breeding (Eberhart and Russell, 1966). The final phenotypic expression of a character is largely influenced by environment. When a genotype is grown in different environments, it is known to have a distinct phenotypic response. Environment modifies the expression of genes; therefore, genotypic expression of the phenotype is dependent on environment (Kang, 1998). Genotype x Environment interaction has been a challenge for plant breeder because it has a direct influence on performance of a genotype; hence it affects breeding programs and therefore hinders selection of superior genotypes. Thus, it is important to evaluate the performance of a crop in several environments in order to identify genotypes that provide high stability for yield and various yield attributing traits across a wide range of environments (Jindal *et al.*, 2008).

The genotypes stability in predictable and unpredictable conditions is a critical aspect in achieving optimal yield. In a country like India, where the environmental conditions under which crops are cultivated varies from region to region and even within the same region, phenotypically stable lies are especially important. This demands genotype screening and identification of phenotypically stable genotypes that can perform more or less uniformly under a variety of environmental conditions. Therefore, present investigation was undertaken to study the effect and magnitude of genotype-environment interactions among various okra genotypes and to identify more stable genotypes.

MATERIALS AND METHODS

The present investigation was carried out at three locations in Kashmir valley *viz.,* Vegetable Experimental Farm, Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar; Krishi Vigyan Kendra (KVK), Budgam and Krishi Vigyan Kendra (KVK), Malangpora, Pulwama during kharif Season 2020 to evaluate the performance and stability of twelve okra genotypes. The experimental material for the study comprised of 12 diverse genotypes of okra was laid out in a randomized block design with three replications at each location. Each replication consisted of double rows of each genotype, spaced at 45 x 30 cm.

Statistical analysis: The data were statistically analysed in accordance with method described by Eberhart and Russell (1966). Using Eberhart and Russell (1966) model of stability analysis, two parameters were obtained, b_i and S^2d_i (regression coefficient and mean squares of deviation from regression, respectively) of the performance on environmental indices. The experimental data collected was subjected to the above mentioned statistical and biometrical analysis with the help of the software developed by Indostat Ltd., Hyderabad.

RESULTS AND DISCUSSION

Analysis of variance for stability analysis: The pooled analysis of variance for stability of genotypes for various growth, maturity and yield attributing traits over three environments under study in the present investigation are presented in the Table 1. Scrutiny of data indicated that mean sum of squares due to genotypes was significant for all the traits studied demonstrating the presence of a high amount of variability in the material chosen for the study. Similarly, the mean sum of squares owing to environments was also significant for all the traits indicating that environments were effective in influencing the performance of genotypes. For all of the traits studied, the genotypes x environment interactions were also found to be significant. This revealed that genotype interacted significantly in different environments. Similar outcomes have been reported by Jindal *et al.* (2008); Hamed and Hafiz (2012); Olayiwola and Ariyo (2013); Javia (2014); Patel (2012); More *et al.* (2018).

The environment (linear) component followed the same pattern as non-linear component being significant for all the traits under study showing that environmental effects were predictable. The linear component of

Table 1: Mean squares of stability analysis for maturity and yield attributing characters in Okra (*Abelmoschus esculentus* L. Moench)

Source of variation	d. f.	Days to first flowering	Days to first fruit harvest	Days to last fruit harvest	Plant height (cm)	Number of nodes /plant	Number of fruits / plant	Fruit length (cm)	Average fruit weight (g)	Number of ridges /fruit	Fruit yield/ plant (kg)	Fruit yield/ plot (kg)
Replication within Environment	6	1.566	3.117**	0.767	3.233**	4.151**	7.385**	0.202	0.169	0.019	0.863*	0.055*
Genotypes	11	28.317**	35.211**	101.913**	2086.336**	60.753**	110.900**	7.771**	8.922**	0.218**	28.492**	1.823**
Environment + (Genotype x Environment)	24	10.308**	9.268**	12.007**	10.936**	6.420**	10.788**	3.213**	2.369**	0.071**	4.013**	0.257**
Environments	2	101.054**	90.218**	118.280**	107.463**	61.664**	100.802**	31.988**	19.154**	0.491**	38.688**	2.478**
Genotype x Environment	22	2.058*	1.909*	2.346**	2.161**	1.398*	2.605*	0.597*	0.843**	0.033*	0.861**	0.055**
Environments (L)	1	202.108**	180.437**	236.560**	214.927**	123.328**	201.605**	63.976**	38.308**	0.982**	77.376**	4.957**
Genotype x Environment (L)	11	3.302**	3.403**	3.608*	3.787**	2.280*	4.276**	0.727*	1.509**	0.053**	1.519*	0.097*
Pooled deviation	12	0.746**	0.380	0.993*	0.491	0.474	0.856	0.428*	0.163	0.011	0.185	0.011
Pooled error	70	0.290	0.224	0.240	0.916	0.971	0.915	0.204	0.203	0.001	0.298	0.019

*, ** significant at 5 and 1% probability levels respectively

genotype × environment was significant for all the traits indicating the significant linear response of genotype to environmental changes for these traits. For almost all of the traits, the linear component was found to be greater in magnitude than the corresponding non-linear component. The preponderance of linear components suggested that genotype performance for these traits may be predicted with greater precision across environments. The pooled deviation was significant for days to first flowering, days to last fruit harvest and fruit length. Similar findings were reported by Jindal *et al.* (2008); More *et al.* (2018); Sharma *et al.* (2019); Vekaria *et al.* (2019).

Environmental indices: The present study revealed that the environment E_1 i.e. (Experimental Farm of Division of Vegetable Science, SKUAST-K, Shalimar) was the most favourable environment for all the traits, as the environmental index for E_1 was the highest for all the traits (Table 2). The environment E_2 i.e., Vegetable Farm of Krishi Vigyan Kendra, Haran, Budgam was found to be suitable for expression of most traits *viz.*, plant height, number of nodes plant^{-1}, number of fruits plant^{-1}, fruit length, average fruit weight, number of seeds fruit^{-1} and 100 seed weight. The environment E_3 i.e., Vegetable Farm of Krishi Vigyan Kendra,

Table 2: Environmental indices for various maturity and yield attributing and quality traits in Okra (*Abelmoschus esculentus* L. Moench)

Character	Environmental index		
	E_1	E_2	E_3
Days to first flowering	-3.121	0.505	2.616
Days to first fruit harvest	-2.865	0.264	2.600
Days to last fruit harvest	3.176	-0.074	-3.102
Plant height (cm)	2.777	0.392	-3.169
Number of nodes plant^{-1}	2.210	0.110	-2.320
Number of fruits plant^{-1}	2.817	0.157	-2.973
Fruit length (cm)	1.556	0.144	-1.700
Fruit girth (cm)	0.097	-0.008	-0.089
Average fruit weight (g)	1.256	0.014	-1.271
Number of ridges fruit^{-1}	0.213	-0.022	-0.190
Fruit yield plant^{-1} (kg)	0.057	-0.001	-0.056
Fruit yield plot^{-1} (kg)	0.459	-0.009	-0.450
Number of seeds fruit^{-1}	2.488	0.079	-2.567
100 seed weight (g)	0.203	0.010	-0.213

Table 3a: Stability parameters for maturity and yield attributing characters in Okra (*Abelmoschus esculentus* L. Moench)

S.No.	Genotype	Days to first flowering			Days to first fruit harvest			Days to last fruit harvest			Plant height (cm)		
		Mean	β_i	S^2D_i	Mean	β_i	S^2D_i	Mean	β_i	S^2D_i	Mean	β_i	S^2D_i
1	Arka Anamika	57.707	0.756	0.309	63.518	0.516	-0.049	158.890	0.508	-0.079	143.050	0.487*	-1.108
2	Parbhani Kranti	57.441	1.206	-0.321	62.130	1.335	-0.390	144.940	1.262	3.010**	135.270	1.557	-0.995
3	Kashi Vardhana	60.497	1.157	-0.129	65.385	1.262	0.297	142.630	0.984	0.391	129.390	0.586	-0.912
4	Pusa-A-4	61.885	1.202	2.067*	67.085	1.299	-0.385	149.850	1.351	2.171	136.640	1.840	1.729
5	Elephant Tusk	60.820	0.533	0.270	66.385	0.327*	-0.463	159.910	0.445	-0.107	186.870	0.497*	-1.097
6	Hissar Unnat	60.190	1.707	0.910	63.376	1.250**	-0.465	144.010	1.518	0.403	133.140	1.168*	-1.108
7	Kashi Kranti	65.196	1.331	0.273	70.265	1.153	1.565*	153.350	1.215	-0.081	130.040	0.723	-0.969
8	Okra-7-Lines	64.897	0.883	0.599	71.362	1.515*	-0.450	150.770	1.075	-0.083	154.310	1.423	-0.662
9	IC-18530	60.642	0.613	0.908	66.617	0.990	0.548	157.060	0.800	-0.012	194.890	0.782	-1.003
10	EC-306748	66.152	1.304	0.014	72.164	1.611*	-0.463	151.900	1.703	3.336***	184.740	1.233	0.757
11	SK-BS-11	58.607	0.764	-0.313	63.474	0.276*	-0.445	156.350	0.718*	-0.277	192.500	0.701	-1.058
12	Pusa Sawani	65.217	0.543*	-0.395	69.941	0.467	-0.325	155.100	0.419	-0.163	169.150	1.004	-1.011
	Population Mean	61.604	1.000		66.809	1.000		152.060	1.000		157.660	1.000	

Table 3b: Stability parameters for maturity and yield attributing characters in Okra (*Abelmoschus esculentus* L. Moench)

S.No.	Genotype	Number of nodes plant^{-1}			Number of fruits plant^{-1}			Fruit length (cm)			Average fruit weight (g)		
		Mean	β_i	S^2D_i	Mean	β_i	S^2D_i	Mean	β_i	S^2D_i	Mean	β_i	S^2D_i
1	Arka Anamika	29.507	0.353*	-1.225	32.707	0.732	-0.474	9.286	1.096	-0.203	10.163	0.843	-0.105
2	Parbhani Kranti	20.984	1.281	0.163	27.575	0.471	-0.962	8.363	1.411	1.837**	6.681	0.322	0.023
3	Kashi Vardhana	19.818	0.959	-0.852	24.106	1.655	4.005	8.840	0.784	-0.186	7.262	2.142	0.001
4	Pusa-A-4	24.031	1.479*	-1.230	23.308	0.580	-1.380	6.886	1.114	0.879*	5.814	0.540	0.476
5	Elephant Tusk	31.796	1.011	-1.105	38.274	0.293*	-1.449	11.111	0.865	0.030	9.526	0.286	-0.157
6	Hissar Unnat	20.873	0.632	-1.104	24.007	1.474	-1.187	8.151	0.933	0.135	6.511	1.730	-0.180
7	Kashi Kranti	19.918	1.143	-0.978	24.842	1.359	-1.243	6.577	0.569	-0.068	5.793	0.413	0.032
8	Okra-7-Lines	22.830	0.616	-1.215	27.142	1.733	0.769	7.097	1.063	-0.048	6.442	1.640	-0.177
9	IC-18530	29.941	0.642*	-1.233	35.285	0.810	-1.344	9.545	0.656**	-0.204	9.903	0.274	-0.156
10	EC-306748	25.908	2.016	1.299	28.396	1.179	-1.046	9.007	0.418	-0.060	7.657	1.878	0.070
11	SK-BS-11	30.774	0.789	-0.891	40.886	0.442*	-1.430	10.930	1.519	0.575	10.110	0.737	-0.104
12	Pusa Sawani	27.763	1.180	-0.775	35.096	1.270	-1.430	9.032	1.571	0.003	9.021	1.192	-0.175
	Population Mean	25.345	1.000		30.135	1.000		8.735	1.000		7.907	1.000	
	SE (±)	0.487	0.214		0.654	0.225		0.462	0.283		0.285	0.226	

Table 3c: Stability parameters for maturity and yield attributing characters in Okra

S.No	Genotype	Number of ridges fruit^{-1}			Fruit yield plant^{-1} (kg)			Fruit yield plot^{-1} (kg)		
		Mean	β_i	S^2D_i	Mean	β_i	S^2D_i	Mean	β_i	S^2D_i
1	Arka Anamika	5.193	0.046*	-0.012	0.331	0.801	0.208	2.661	0.804	0.013
2	Parbhani Kranti	5.135	0.654	-0.011	0.196	0.597	-0.344	1.565	0.595	-0.022
3	Kashi Vardhana	5.324	1.839	-0.009	0.183	1.592	-0.185	1.463	1.589	-0.012
4	Pusa-A-4	5.133	1.039	0.006	0.139	0.682	-0.005	1.107	0.681	0.000
5	Elephant Tusk	5.200	0.000**	-0.012	0.365	0.383	-0.277	2.916	0.383	-0.017
6	Hissar Unnat	5.173	0.186	-0.010	0.159	1.298*	-0.344	1.270	1.302*	-0.022
7	Kashi Kranti	5.200	0.984	-0.011	0.151	0.949	-0.126	1.207	0.949	-0.008
8	Okra-7-Lines	5.266	2.077	-0.061*	0.181	1.539*	-0.341	1.446	1.540*	-0.021
9	IC-18530	5.822	0.829	-0.012	0.349	0.440	-0.160	2.791	0.441	-0.010
10	EC-306748	5.933	0.433	0.009	0.223	1.681	0.127	1.781	1.680	0.007
11	SK-BS-11	5.133	0.665	-0.003	0.413	1.025	-0.164	3.305	1.027	-0.011
12	Pusa Sawani	5.333	1.249	0.002	0.317	1.011	-0.301	2.538	1.009	-0.019
	Population Mean	5.320	1.000		0.251	1.000		2.004	1.000	
	SE (±)	0.077	0.382		0.009	0.200		0.076	0.169	

*, ** significant at 5 and 1% probability levels respectively

Malangpora, Pulwama was found to be the most unfavourable for expression of all traits as indicated by the lowest environmental index for days to last fruit harvest, plant height, number of nodes plant^{-1}, number of fruits plant^{-1}, fruit length, fruit girth , average fruit weight , number of ridges fruit^{-1}, fruit yield plant^{-1} , fruit yield plot^{-1}, number of seeds fruit^{-1} and 100 seed weight and highest for days to first flowering and days to first fruit harvest. The influence of various environments as depicted by estimates of environmental indices was also reported by Babariya *et al.* (2009); Srivastava *et al.* (2011); Kachhadia *et al.* (2011); Patil *et al.* (2017); Vekaria *et al.* (2019).

Stability analysis: According to Eberhart and Russell (1966), a stable genotype would be one that possessed high mean performance, unit regression coefficient (b_i = 1) and least deviation from regression i.e., as far as possible equal to zero (S^2d_i = 0). The above three measures of assessing the stability of genotype *viz.,* mean, regression coefficient (b_i) and the mean square deviation (S^2d_i) were employed in assessing the stability of genotypes included in the present study.

As indicated by the stability parameters (Table 3a, 3b and 3c), the genotypes that exhibited average stability i.e., well adapted to all the environments (high mean, regression coefficient near unity and least deviation from regression) were Arka Anamika, Parbhani Kranti, Kashi Vardhana and SK-BS-11 for days to first flowering; Kashi Vardhana and IC-18530 for days to first fruit harvest; Kashi Kranti, IC-18530 for days to last fruit harvest; IC-18530, EC-306748, SK-BS-11 and Pusa Sawani for plant height; Elephant Tusk, SK-BS-11 and Pusa Sawani for number of nodes plant^{-1}; Arka Anamika, IC-18530 and Pusa Sawani for number of fruits plant^{-1}; Arka Anamika, Kashi Vardhana and Elephant Tusk for fruit length; Arka Anamika, SK-BS-11 and Pusa Sawani for average fruit weight; IC-18530 and Pusa Sawani for number of ridges fruit^{-1} , Arka Anamika, SK-BS-11 and Pusa Sawani for fruit yield plant^{-1} and fruit yield plot^{-1}.

Of the 12 genotypes (Table 4), Pusa Sawani was found to be stable for seven traits viz., plant height, number of nodes plant^{-1}, number of fruits plant^{-1}, average fruit weight, number of ridges fruit^{-1}, fruit yield plant^{-1} and fruit yield plot^{-1} followed by SK-BS-11 stable for days to first flowering, plant height, number of nodes plant^{-1}, average fruit weight, fruit yield plant^{-1} and fruit yield plot^{-1}; Arka Anamika stable for days to first flowering, number of fruits plant^{-1}, fruit length, average fruit weight, fruit yield plant^{-1} and fruit yield plot^{-1} (6 traits each). IC-18530 was stable for 5 traits viz., days to first fruit harvest, days to last fruit harvest,

Table 4: Stability of Okra (*Abelmoschus esculentus* L. Moench) with respect to different traits

S.No.	Genotypes	Traits for which genotypes show average stability
1.	Arka Anamika	Days to first flowering, Number of fruits plant^{-1}, Fruit length (cm), Average fruit weight (g), Fruit yield plant^{-1} (kg), Fruit yield plot^{-1} (kg)
2.	Parbhani Kranti	Days to first flowering
3.	Kashi Vardhana	Days to first flowering, Days to first fruit harvest, Fruit length (cm)
4.	Pusa-A-4	-
5.	Elephant Tusk	Number of nodes plant^{-1}, Fruit length (cm)
6.	Hissar Unnat	-
7.	Kashi Kranti	Days to last fruit harvest, Fruit length (cm)
8.	Okra-7-Lines	-
9.	IC-18530	Days to first fruit harvest, Days to last fruit harvest, Plant height (cm), Number of fruits plant$^{-1,}$ Number of ridges fruit^{-1}
10.	EC-306748	Plant height (cm)
11.	SK-BS-11	Days to first flowering, Plant height (cm), Number of nodes plant$^{-1,}$ Average fruit weight (g), Fruit yield plant^{-1} (kg), Fruit yield plot^{-1} (kg)
12.	Pusa Sawani	Plant height (cm), Number of nodes plant^{-1}, Number of fruits plant^{-1}, Average fruit weight (g), Number of ridges fruit^{-1}, Fruit yield plant^{-1} (g), Fruit yield plot^{-1} (kg)

plant height, number of fruits plant^{-1} and number of ridges fruit^{-1}. Kashi Vardhana was stable for days to first flowering, days to first fruit harvest and fruit length (3 traits). Elephant Tusk was stable for number of nodes plant^{-1} and fruit length; Kashi Kranti for days to last fruit harvest and fruit length (2 traits each). Parbhani Kranti was stable for days to first flowering; EC-306748 for plant height (1 trait each). Among the all genotypes, Pusa-A-4, Hissar Unnat and Okra-7-Lines were not found to be stable for any trait. For fruit yield plant^{-1} and fruit yield plot^{-1}, Arka Anamika, SK-BS-11 and Pusa Sawani were found to be stable.

In the present study, the genotypes *viz.,* Arka Anamika, SK-BS-11 and Pusa Sawani showed average stability for the most economic trait i.e., fruit yield plot^{-1}. The genotypes that were found to be stable in all environments for most of the traits were Arka Anamika, IC-18530, SK-BS-11 and Pusa Sawani. These genotypes being stable for most of the yield attributing traits under study could be recommended to farmers for cultivation under Kashmir valley conditions.

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Workplace Facilities: A Correlated Parameter of Satisfaction of Polyhouse Workers of Ludhiana District

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ABSTRACT

Polyhouse is a new technique in agriculture, where farmers can cultivate crops by giving favorable atmospheric conditions to plants. Polyhouse farming is advanced methods of farming, where farmers give full care to the plants. The Government is also supporting farmers for lifting up of polyhouses by providing them various types of facilities. Therefore, the present study was undertaken to analyze job profile and satisfaction regarding various aspects i.e. wage satisfaction and facilities provided at workplace. The results revealed that (55.00%) were working on permanent basis and 45.00 per cent were employed on contractual basis. Regarding facilities provided by the owners at workplace maximum mean score (4.56) was obtained with regards to general facilities, followed by medical facilities (2.30) and gender specific facilities (1.78). Low mean score was obtained for Personal Protective Equipment (PPE) (1.20). Regarding wage satisfaction perceived by respondents, it was found that maximum number of respondents (68.33%) were not satisfied with amount they got from owners. It can be conclude that working in polyhouses requiring highest manual involvement and less focus on the human factors of the workers. The main motive of polyhouses was high productivity and workers comfort was highly neglected.

Keyworks: Satisfaction level, Facilities, Personal protective equipment (PPE)

INTRODUCTION

Polyhouse farming is used to protect crops from the adverse climate conditions such as: wind, cold, precipitation, excessive solar radiation, extreme temperature, insects and disease. It reduces dependency on rainfall and makes the optimum use of land and water resources. By using polyhouse farming, one can modify temperature and can produce any type of crop in any place at any time by providing suitable environmental conditions and minimum labor. Currently, from Himachal Pradesh, Punjab and Maharashtra states, farmers are taking interest to do polyhouse farming (Planning Commission, GOI, 2009). Polyhouses are utilized as micro-climate environment to make the plants grow well in unfavorable climatic conditions. The main objective of raising polyhouse farming is to get higher credits and infect-free-seedlings in off-season to raise early crop in protected condition. While doing polyhouse farming, there are several tasks which are considered dangerous for unskilled agricultural workers' health. The tasks are: pesticide crop sprayers, use of biological products, use of hazardous agricultural tools and machinery. The unskilled agricultural workers are vulnerable to occupational induced health problems, due to ignorance and lack of education. Dhananjayan and Ravichandran (2018) also studied occupational health risk of farmers exposed to pesticides in agriculture. In general most pesticides have not been adequately tested for safety and therefore pesticide exposure is one of the most widely studied occupational risk factors (Singhvi, 2009). To control the ill effects of pesticides, the agriculture community needs the implementation of a new agricultural concept regarding food production, which will safe for farmers, farm workers and the environment. The world health organization (WHO), estimates occupational health problems as the

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tenth leading cause of morbidity and mortality (Pingle, 2011). Wherever, the poor working condition exist, there are the potentials of problems to worker's health as well as their safety. To work in such a different condition workers get very few wages and incentives. Present study was planned with the following objectives:

a) To study the job profile of respondents
b) To find out various facilities provided at various polyhouses.
c) To assess the satisfaction level of respondents engaged in selected polyhouses.

MATERIALS AND METHODS

The study was carried out on 60 workers, engaged in polyhouse activities. This study was conducted in Ludhiana district in the month of February to mid of June. An interview schedule was designed to collect the general and specific information regarding job profile, facilities and provisions at workplace. Worker's satisfaction level with regard to available physical facilities on time was also assessed on five point scale.

Analysis of data

Frequency and Percentages: Frequency and percentages were worked out to various parameters related to job profile viz. type of job, extent of involvement and personal monthly income. Information related to various facilities like: general facilities and gender specific facilities were also collected. Satisfaction level of respondents with respect to facilities provided was also assessed on five point scale.

Mean scores: Mean scores were calculated by using the following formula:

$$\text{Mean score} = \Sigma Sn / N$$

Where, S = Scores assigned to respondents
n = Frequency distribution
N = Total number of respondents

Further the mean ranks were assigned on the basis of calculated mean scores

RESULTS AND DISCUSSION

1. Job profile of respondents

Job type: Regarding type of job, it was found that more than half of respondents (55.00%) were working on permanent basis and 45.00 per cent were employed on contractual basis.

Work tenure: Work tenure means the number of years for which worker is working in a polyhouse. Although, some respondents were not permanent but owners of polyhouses' used to call same workers in every season to raise the crops in polyhouses. Regarding work tenure of respondents, it was found that large number of respondents (67.00%) had work tenure of less than one year followed by 30 per cent had work tenure between 1 to 5 years and very few (3.00%) of respondents had work tenure of more than 5 years.

Work duration: Work duration means total working hours per day and is presented in Table 1. Result shows that less than half of respondents (40.00%) used to work for more than 6 hours followed by 6-8 hours (31.60%) and more than 8 hours a day (28.30%).

Holidays per week: Holidays are essential for breaking the boredom of work and performing some other important activities. Provision of holidays for workers was recorded in the study and presented in Table 1 and it was found that irrespective of polyhouses type, more than half of respondents (55.00%) were getting one holiday per week. It was further recorded that holidays for different major festivals like: *Dussehra*, *Diwali, Holi, Eid and Lohri* were also provided to them from their respectivr owners.

Breaks per day and its duration: Rest break is a form of allowances in which relaxation allowance is taken in a specific activity. Instead of making a standard way to indicate the required rest gaps, normally a work activity is allowed to give 10-15 minutes tea break time. According to Singh (2016), rest breaks increase work efficiency, reduces boredom and reduces fatigue. Table 1 displays that nearly half of respondents (45.00%) were getting only one break per day and 38.33 per cent of respondents were getting two breaks per day. On the other hand, only 16.67 per cent of respondents reported that the number of breaks were provided according to the workload and varied on daily basis. It was further observed that sometimes workers were provided with only one break for taking their lunch. The average time of first and second break was found as 14 minutes and 30 minutes respectively.

Pattern of work: Regarding pattern of work is concerned, it was found that more than two third

Table 1: Job profile of polyhouse workers

Job Characteristics	Category	Frequency (%)			Total
		NVPH (n=30)	AINSH (n=20)	HI-TECH (n=10)	(n=60)
Job type	Permanent	15 (50.00)	10 (50.00)	8 (80.00)	33 (55.00)
	Temporary	15 (50.00)	10 (50.00)	2 (20.00)	27 (45.00)
Work tenure (year)	< 1	15 (50.00)	17 (85.00)	8 (80.00)	40 (67.00)
	1-5	13 (43.00)	3 (15.00)	2 (20.00)	18 (30.00)
	>5	2 (7.00)	-	-	2 (3.00)
Average work tenure		10±7	6.66±9.07	3.33±4.16	19.99±20.24
Extent of involvement (hours)	Less than 6	11 (36.60)	8 (40.00)	5 (50.00)	24 (40.00)
	6-8	10 (33.33)	4 (20.00)	5 (50.00)	19 (31.60)
	More than 8	9 (30.00)	8 (40.00)	-	17 (28.30)
Holidays per week	No	11 (36.67)	8 (40.00)	8 (80.00)	27 (45.00)
	1	19 (63.33)	12 (60.00)	2 (20.00)	33 (55.00)
Breaks per day	1	10 (33.33)	7 (35.00)	10 (100.00)	27 (45.00)
	2	13 (43.33)	10 (50.00)	-	23 (38.33)
	Depends on workload	7 (23.33)	3 (10.00)	-	10 (16.67)
Duration of first break (min)	10	6 (20.00)	4 (20.00)	2 (20.00)	12 (20.00)
	20	6 (20.00)	8 (40.00)	2 (20.00)	16 (26.67)
Average duration of first break		6	6	2	14
Duration of second break (min)	30	29 (96.67)	17 (85.00)	3 (30.00)	49 (81.67)
	30-45	1 (3.33)	3 (15.00)	7 (70.00)	11 (18.33)
Average duration of second break		15	10	5	30
Pattern of work***	Same task whole day	19 (63.33)	16 (80.00)	8 (80.00)	43 (71.67)
	Irregular work pattern	25 (83.33)	14 (70.00)	8 (80.00)	47 (78.33)
Personal monthly income (Rs.)	2500-5000	17 (56.67)	16 (80.00)	7 (70.00)	40 (66.67)
	5000-7500	11 (36.67)	3 (15.00)	2 (20.00)	16 (26.67)
	7500-10000	2 (6.67)	1(5.00)	1(10.00)	4 (6.67)

***(Multiple response)

(78.33%) of respondents worked in polyhouses on irregular basis followed by full day i.e. 8 hours (71.67%). This is due to the reason that polyhouses owners usually call their workers when need arises depending upon the type of crops to be grown in polyhouses.

2. Facilities provided at selected polyhouses

Facilities provided at workplace play a major role to motivate the workers to work efficiently as it increases the ease of working. This section covers all type of facilities that were provided to the workers by the owners. The results obtained about facilities provided by the owners are the presented in four categories viz. general facilities, medial facilities, gender specific facilities, Personal Protective Equipment (PPE).

General facilities: It was observed (Table 2) that approximately 80-100% of respondents were provided with few facilities like: drinking water, free tea and snacks and break for taking rest. According to Singh (2015) breaks during working hours reduces fatigue, monotony and increase work efficiency.

Medical facilities: Regarding the medical facilities provided at workplace, it was found that maximum number of respondents i.e.70.00 per cent were provided with first aid kit in case of emergency, followed by, free medical checkups if injured during work (10.00%). Whereas, 23.33 per cent of respondents were provided with paid medical leave by owners.

Gender specific facilities: Facilities were provided to gender specific workers by the polyhouses owners, which include bringing children at farm (26.70%), provision of separate toilets (18.30%) and separate place for taking meals (16.70%).

Personal protective equipment: Regarding Personal Protective Equipment (PPE), it was found that more than half of respondents i.e.(58.33%) were provided with face mask while performing polyhouses' activities, followed by hand gloves (31.66%) and protective shirts (16.66%). None of respondents were provided with protective caps while doing polyhouses' activities. Similar findings were reported by Singh (2016) that 78 per cent of workers were not wearing the PPEs while working. The main reason behindnot wearing the PPEs was that they feel uncomfortable after wearing the PPE. Lack of protective equipment directly affects the health and performance of workers. Similar findings from Jovita *et al.* (2011) showed that 74 polyhouse workers were not using safety practices while using pesticides. Study also suggested organizing training programmes regarding the safe use of pesticides for the polyhouse workers to improve their ability to handle dangerous chemicals.

3. To analyse the satisfaction level of various aspects

a) Satisfaction level of respondents regarding facilities provided at workplace: Figure 1 shows the mean scores with satisfaction level of respondents regarding provision of facilities at polyhouses. It was found that maximum mean score (4.56) was obtained with regards to general facilities, followed by medical facilities (2.30) and gender specific facilities (1.78). Low mean score was obtained for Personal Protective Equipment (PPE) (1.20).

b) Mode of payment and wage satisfaction of respondents: Table 3 depicted different mode of payment, fixing of wages and wage satisfaction of polyhouses' workers.

Payment mode: Maximum number of the respondents (60.00%) were getting wages on weekly

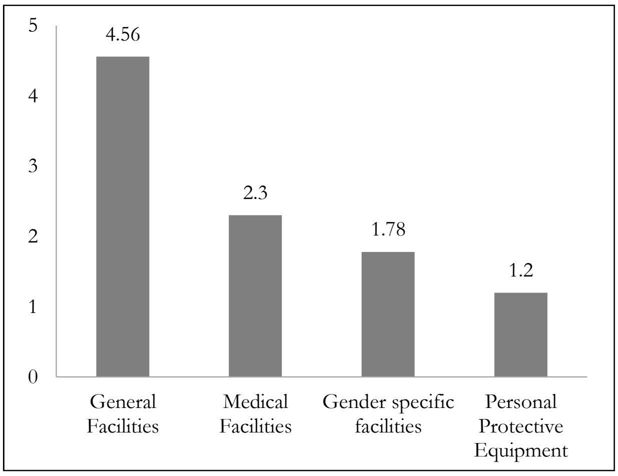
Table 2: Facilities provided at selected polyhouses

Physical facilities	Frequency (%)			Total
	NVPH (n=30)	AINSH (n=20)	Hi-Tech (n=10)	(n=60)
General facilities				
Free tea and snacks	25 (83.30)	14 (70.00)	10 (100.00)	49 (81.70)
Provision to entertain complaints	10 (33.30)	12 (60.00)	-	22 (36.70)
Drinking water	30 (100.0)	20 (100.0)	10 (100.0)	60 (100.0)
Rest interval during working hours	25 (83.30)	18 (90.00)	9 (90.00)	52 (86.70)
Medical facilities				
Provision of first aid	22 (73.30)	20 (100.0)	-	42 (70.00)
Free medical checkups	-	4 (20.00)	2 (20.00)	6 (10.00)
Medical leave	7 (23.30)	2 (10.00)	5 (50.00)	14 (23.30)
Gender specific facilities				
Allow to bring children at farm	11 (36.70)	3 (15.00)	2 (20.00)	16 (26.70)
Provided separate toilet	2 (6.70)	5 (25.00)	4 (40.00)	11 (18.30)
Separate place to have meal	10 (33.30)	-	-	10 (16.70)
Personal protective equipment				
Gloves	6 (20.00)	4 (20.00)	9 (90.00)	19 (31.70)
Face mask	15 (50.00)	10 (50.00)	10 (100.00)	35 (58.30)
Protective shirt	-	-	10 (100.00)	10 (16.70)
Cap	-	-	-	-

**Multiple response

Table 3: Mode of payment and wage satisfaction of respondents

Characteristics	Category	Frequency (%)			Total
		NVPH (n=30)	AINSH (n=20)	Hi-Tech (n=10)	(n=60)
	Weekly	22 (73.33)	14 (70.00)	-	36 (60.00)
	Monthly	8 (26.67)	6 (30.00)	4 (40.00)	18 (30.00)
	Lump sum	-	-	6 (60.00)	6 (10.00)
Wage satisfaction	Yes	12 (40.00)	5 (25.00)	2 (20.00)	19 (31.67)
	No	18 (60.00)	15 (75.00)	8 (80.00)	41 (68.33)
Mode of fixing wage	Time of work	15 (50.00)	3 (15.00)	4 (40.00)	22 (36.67)
	Quantum of work	15 (50.00)	17 (85.00)	6 (60.00)	38 (63.33)



Mean score: 1- Low, 2- Medium, 3- High

Figure 1: Satisfaction Level of respondents regarding provisions of facilities

basis, followed by monthly 30.00 per cent. Very few of respondents i.e. 10.00 per cent were getting lump sum wages in all polyhouses.

Mode of fixing wage: Findings of Table 3 enfolds that wages of more than half of the respondents (63.33%) were calculated on the basis of time spent on work, whereas, only 36.67 per cent of respondents' wages were fixed on the basis of quantum of work.

Wage satisfaction: Regarding wage satisfaction perceived by respondents, it was found that maximum number of the respondents (68.33%) were not satisfied with amount they got from owners as they found that amount of wages was quite less to fulfill their family needs.

CONCLUSION

As far as work profile of respondents is concerned, it was observed that maximum number of respondents were working on daily basis. More than half of respondents had work tenure of less than 1 year. All the respondents were getting only one holiday per week. Highest wages were given to the respondents (Rs.7500-10000) per month**.** Polyhouse farming was done in overall 10 months in a year except months of summer season (June and July). Study also depicts that most of the polyhouse workers were found to be engaged for 5-8 hours daily in polyhouse activities under high humidity and temperature. As far as satisfaction regarding wages of respondents is concerned, it was found that most of the workers were not satisfied with their wages. Regarding availability of various facilities provided at workplace, nearly 50 per cent of female respondents were not provided with separate toilet and separate place to have meal. It was further observed that medical facilities , general facilities and Personal Protective Equipment(PPE) like gloves and face masks were also provided to the respondents by their owners.

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Knowledge and Attitude of Trainees and Non-trainees Towards Different Activities of Krishi Vigyan Kendra

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ABSTRACT

The present paper investigates about knowledge and attitude of trainees and non-trainees towards different activities of KVK in Bareilly district, Uttar Pradesh. Data were collected from 300 farmers (150 trainees trained by KVK and 150 non-trainees). A pre-tested interview schedule was used for data collection. Findings revealed that 40.33 per cent of the trainees had high level of knowledge towards different activities of KVK followed by 48.23 per cent of trainees had medium level of knowledge. Considering attitude of trainee towards various activities of KVK a fair share of majority (58.67%) had favourable attitude whereas in case of non-trainees (47.33%) had favourable attitude towards different activities of KVK.

Keywords: Attitude, Knowledge, KVK

INTRODUCTION

Agriculture in India has expanded dramatically, with enormous increases in the production of staples such food grains, vegetables, fruits, milk, eggs, and fish. As a result, the per capita availability of vital food staples has increased despite expanding population. The ratio of agricultural land to agricultural people in India has dropped from 11.0 hectares per person in affluent countries to 0.3 hectares per person in India. Resources are increasingly marginalized as agricultural land and water are diverted to the industrial, urban, and non-agriculture sectors, putting enormous demand on natural resources. The idea of establishing a Farm Science Centre (Krishi Vigyan Kendra) was developed on the recommendation of the Education Commission (1964-66) and discussion by the Planning Commission and Inter-Ministerial Committee, as well as recommendation by the committee headed by Dr. Mohan Singh Mehta appointed by ICAR in 1973. KVK plays an important role in transmitting technology to increase crop yield and productivity. By operating as a two-way link between research and farmers, KVKs will play a critical role in the refinement of technologies to specific situations. According to Ajrawat and Kumar (2012), KVK has the ability to significantly alter socioeconomic position as well as the level of education. The instruction and direction offered to trainees play an important impact in the implementation of effective technological transformation orientation to management. Farmers with progressive attitude participate in income generating activities. Such farmers gain maximum information and benefits from KVK training (Bhatt, 2017).

MATERIALS AND METHODS

The present investigation was conducted in Bareilly district, Uttar Pradesh which was purposively selected for the study as this district has many farmers who have been trained by KVK and are well aware with its working. Out of 15 blocks in Bareilly district 2 blocks i.e. Fatehganj Pashchimi and Nawabganj block have been selected purposively. 30 villages were selected purposively. 10 respondents from each village were selected randomly from each village. Thus, total number of respondents were 300. The total sample size comprised of 150 trainees and 150 non - trainees. An interview schedule was developed for the study. Each respondent was interviewed about knowledge and attitude of respondents towards different activities

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of KVK in study area. The level of knowledge of the respondents about activities of KVK was measured by computing the knowledge score.

RESULTS AND DISCUSSION

The data in the Table 1 represents the knowledge level of trainees and non-trainees towards different activities of KVK trainings. 84 per cent of the trainees were fully aware about presence of KVK whereas 43.33 per cent of non-trainee were aware of KVK presence in their area.88 per cent of trainees were fully aware about services provided by KVK whereas only 39.33 per cent of non-trainees were aware about services provided by KVK. A majority share (73.33 %) were fully aware of major domains of KVK while only 36.67 per cent of non-trainees were aware of major domains.56 per cent of trainees were fully aware of the basic principle of training while only 22 per cent of non-trainee were fully aware.42.67 per cent of trainees were fully aware of adoption of villages by KVK and only few non trainees (18.00%) had knowledge of the same.36 per cent of respondents

Table 1: Knowledge of trainees and non-trainees towards different activities of KVK (N=150)

Statement	Trainee			Non-Trainee		
	Fully Aware	Partially Aware	Not Aware	Fully Aware	Partially Aware	Not Aware
Is there any Krishi Vigyan Kendra in Bareilly	84.00	14.67	1.33	43.33	31.34	25.33
What does Krishi Vigyan Kendra provide	88.00	9.33	2.67	39.33	34.67	26.00
Krishi Vigyan Kendra provides training and skill to the farmer in major domains	73.33	21.33	5.34	36.67	34.00	29.33
Which are the main criteria for the selection of farmers for Krishi Vigyan Kendra	56.00	24.67	19.33	22.00	46.00	32.00
KVK provides knowledge, training and skill to the farmer	51.33	28.67	20.00	28.67	37.33	34.00
What is the basic principle of training	40.67	31.33	28.00	27.33	42.00	30.67
Do you know Krishi Vigyan Kendra adopts some villages for development	42.67	32.66	24.67	18.00	50.67	31.33
Does whole area of the district Bareilly in the jurisdiction of KVK	36.00	42.00	22.00	21.33	41.33	37.34
Any farmer can obtain knowledge, training and skill from Krishi Vigyan Kendra	45.33	34.67	20.00	35.33	39.34	25.33
Can regular visit of KVK increase farm production	73.33	21.34	5.33	48.00	29.33	22.67
Scientists of Krishi Vigyan Kendra take follow-up of training and skill provided by them	36.00	32.67	31.33	27.33	45.34	27.33
Does Krishi Vigyan Kendra provide proper scientific information regarding management of chilli	64.67	22.67	12.66	34.67	44.67	20.66
Does KVK provide training on chilli cultivation and management	54.67	38.00	7.33	31.33	51.33	17.34
Vocational trainings are being provided by Krishi Vigyan Kendra	40.67	34.66	24.67	21.33	44.00	34.67
Krishi Vigyan Kendra is sponsored by Indian Council of Agriculture Research (ICAR), Government of India	62.00	22.67	15.33	19.33	48.67	32.00
Does Krishi Vigyan Kendra provides credit for field crops	38.00	42.00	20.00	15.34	57.33	27.33
KVK conducts demonstrations on the farmer's fields	46.00	38.00	16.00	20.67	50.67	28.66
Krishi Vigyan Kendra provides training to the rural women in Home science and Fruit preservation	34.67	44.66	20.67	18.00	58.67	23.33
Krishi Vigyan Kendra provides training to the farmers in Animal Husbandry also	31.33	51.33	17.34	15.33	56.00	28.67
Krishi Vigyan Kendra trains farmers in the field of Vegetable cultivation only	45.33	32.67	22.00	34.67	38.00	27.33

were fully aware of jurisdiction of Bareilly KVK while only 21.33 per cent of non-trainee had the knowledge of the same.36 per cent of trainees agreed to the follow up of training by scientists of KVK while only 27.33 per cent of non-trainees were aware of the same. A majority share (64.67%) had agreed to scientific information being provided regarding management of chilli while only 34.67 per cent agreed to the same.62 per cent of respondents were fully aware of sponsoring agency of KVK while a relatively only 19.33 per cent of non-trainees were aware of sponsoring agency of KVK.38 per cent of trainees were aware of KVK credit for field crops whereas only 15.33 per cent of respondents were fully aware of KVK credit for field crops.46 per cent of trainees were aware of KVK demonstration on farmers field whereas only 20.67 percent were fully aware of KVK demonstration on farmers field.31.33 per cent of trainees had awareness of KVK training in animal husbandry whereas only 15.34 per cent had awareness of KVK training in animal husbandry.45.33 per cent of trainee were fully aware of KVK training in field of vegetable cultivation whereas only 34.67 per cent of non-trainees were fully aware of KVK training in field of vegetable cultivation. The results are in consonance with findings of Bairolia (2008).

The overall knowledge of the trainees and non-trainees is stated in the Table 2. In case of trainee 48.23

Table 2: representing overall knowledge of respondents (trainee and non-trainee) towards various activities of KVK (N=150)

Overall Knowledge	Trainee	Non-trainee
Low	11.44	14.00
Medium	48.23	68.00
High	40.33	18.00

per cent of the trainees had medium level of overall knowledge, 40.33 per cent of trainee had high level of overall knowledge and 11.43 per cent of trainee had low level of knowledge regarding the activities of KVK. In case of Non-trainee 68.00 per cent of non-trainees had medium level of overall knowledge, 18.00 per cent of non-trainees had high level of overall knowledge regarding the activities of KVK.

The data in the Table 3 represents the attitude of trainees and non-trainees towards different activities of KVK trainings. A majority of respondents (57.33%) agreed to technical agricultural support to farmers being provided by KVK whereas only 28.00 of non-trainees had favorable attitude towards the same. 48.67 per cent of trainees agreed that KVK is must to learn recent agricultural knowledge and skill while only 30.67 per cent of non-trainees shared the view.29.33 per cent of trainees agreed KVK meets the needs of farmers for self-employment whereas 34.00 per cent of non-trainees agreed to it. In case of trainee 30.67 per cent

Table 3: Attitude of trainees and non-trainees towards different activities of KVK (N=150)

Statement	Trainee			Non-trainee		
	Agree	Undecided	Disagree	Agree	Undecided	Disagree
Krishi Vigyan Kendra (KVK) provides technical agricultural support to the farmers.	57.33	28.67	14.00	28.00	38.00	34.00
KVK is must to learn recent agricultural knowledge and skill.	48.67	29.33	22.00	30.67	26.00	43.33
KVK meets the needs of farmers for self-employment.	29.33	39.33	31.34	34.00	46.67	19.33
KVK helps only strong and influential farmers.	30.67	36.66	32.67	58.00	26.00	16.00
KVK is not providing practical training and skill to the farmers.	43.33	21.34	35.33	30.00	38.00	32.00
The scientists of the KVK are doing their job well.	37.33	33.33	29.34	26.00	37.33	36.67
Extension aids and methods used by the KVK are not effective.	27.33	21.33	51.34	21.33	42.67	36.00
KVK is doing a good work in catering to farmer's need.	54.67	25.33	20.00	31.33	39.34	29.33
KVK helps farmers to raise their standard of living.	34.00	28.67	37.33	19.33	44.67	36.00
The knowledge, training and skill of the KVK are only useful for resource available farmers.	38.00	28.00	34.00	42.00	31.33	26.67
There is no adequate follow up of the training of KVK.	52.00	26.67	21.33	28.67	41.33	30.00

Table 3 contd....

Statement	Trainee			Non-trainee		
	Agree	Unde-cided	Dis-agree	Agree	Unde-cided	Dis-agree
The knowledge, training and skill of the KVK is the wastage of the time and money.	16.67	35.33	48.00	32.67	39.33	28.00
Farmers should grow cash crop to increase profit in comparison to growing food crop for home consumption.	40.67	28.00	31.33	36.67	42.00	21.33
The knowledge, training and skill of the KVK are unrealistic and hence not useful.	24.67	30.00	45.33	34.00	34.67	31.33
New method of farming give better results than the old method.	43.33	26.67	30.00	38.67	31.33	30.00
Sufficient number and type of extension programme are being organized by KVK.	36.67	28.00	35.33	26.00	29.33	44.67
Concept of self-employment is being followed by KVK for organizing training programme.	41.33	27.33	31.34	28.67	47.33	24.00
KVK is conducting demonstration at farmer's field.	42.67	38.00	19.33	21.33	45.34	33.33
KVK is conducting on both on campus and off campus training.	30.67	26.00	43.33	15.33	52.67	32.00
Sufficient number of farmer's day are being organized by KVK.	30.00	31.33	38.67	26.67	42.66	30.67

of respondents felt KVK helps only strong and influential farmers whereas a high majority of non-trainee 58.00 per cent agreed to it.43.33 per cent of trainee had the attitude that KVK is not providing practical training and skill to the farmers.37.33 per cent of trainees agreed to that scientists of the KVK are doing their job well. A majority of trainees disagreed to the proposition that extension aids and methods used by the KVK are not effective.54.67 per cent of trainees agreed to KVK doing a good work in catering to farmer's need.38.00 per cent of trainees agreed that knowledge, training and skill of the KVK are only useful for resource available farmers while an increase in this attitude is noticed in case of non-trainee 42 per cent responded the same. In case of trainee 52.00 per cent of respondents felt there is no adequate follow up of the training of KVK. In case of trainee a small share of 16.67 per cent of respondents felt that knowledge, training and skill of the KVK is the wastage of the time and money. 41.33 per cent of trainees agreed that concept of self-employment is being followed by KVK for organizing training programme whereas 28.67 per cent of non-trainees agreed to it.42.67 per cent of trainees agreed that KVK is conducting demonstration at farmer's field and only 21.33 per cent of non-trainees agreed to it. 43.33 per cent of trainees disagreed that KVK is conducting on both on campus and off campus training, whereas 52.67 per cent of non-trainees had undecided attitude towards the same. 30.00 per cent of trainees agreed that sufficient number of farmer's day are being organized by KVK whereas 42.66 per cent of non-trainee had undecided attitude towards sufficient number of farmer's day being organized by KVK.

The overall attitude of the trainees and non-trainees is stated in the Table 4. In case of trainee 58.67 per cent of the trainees had medium level of attitude towards different activities of KVK, 22.00 per cent of trainee had low level of attitude and 19.33 per cent of trainee had high level of attitude regarding the activities of KVK. In case of non-trainee 47.33 per cent of non-trainees had medium level of overall attitude, 14.00 per cent of non-trainees had high level of overall attitude regarding the activities of KVK.

Table 4: representing overall attitude of respondents (trainee and non-trainee) towards various activities of KVK (N=150)

Overall Attitude	Trainee	Non-trainee
Less favourable	22.00	38.67
Favourable	58.67	47.33
More favourable	19.33	14.00

CONCLUSION

It is concluded that majority of the trainees had medium level of knowledge regarding various activities of KVK and in case of non-beneficiaries' medium level of knowledge was observed. The overall attitude of trainees and non-trainees towards different activities of KVK was found to be favorable with variations in share percentage.

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Reasons for Adoption and Non-adoption of Super Seeder Farm Technology and Factors Affecting Knowledge Level of Farmers in Haryana

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ABSTRACT

The rice-wheat cropping system (RWCS), which is the major cropping system in South Asia, includes residue burning. Rice and wheat are grown in rotation throughout the year in this method. Haryana, despite its modest size, has contributed significantly to India's highest food grain production. 80 per cent of the state's total geographical area of 4.42 million hectares is under agriculture, with irrigated land accounting for 84 per cent of the cultivated land. The state's cropping intensity is 181 per cent, with a total food grain production of 13.1 million tonnes. One of the most common crop rotations in the state is paddy-wheat (Haryana-ICAR). The rice-wheat crop rotation has been used by Haryana farmers. Farmers benefit more under this arrangement, but they deplete natural resources such as groundwater, soil fertility, soil fauna and flora, and so on. They also disrupted the agro-ecosystem by disrupting biogeochemical cycles, developing insect pest and disease resistance, and reducing soil organic matter, among other things. This crop rotation is supposed to produce about 40 million tone of crop waste every year.

Keywords: Adoption, Factors affecting, Knowledge level, Reasons, Super seeder farm technology

INTRODUCTION

Rice is traditionally introduced in the region by wet tillage (puddling) followed by seedling transplanting into the puddled soil, whereas wheat is established (in rice residue burned fields) by broadcasting/drilling seed following disking, tilling, and planking processes (Bhatt, 2016). Seed bed preparation processes oxidise previously hidden organic matter and split macro-aggregates into micro-aggregates, affecting soil characteristics negatively (Roper *et al*., 2013). Furthermore, soil disturbance caused by conventional tillage causes the soil to act as a source rather than a sink of pollutants in the atmosphere, making it non-sustainable and environmentally friendly (Busari, *et al*., 2015). Improved RWCS productivity should be a top priority in order to keep up with India's projected population expansion of 1.12 billion people by 2050. The population will have grown from 1.35 billion in 2008 to 1.35 billion in 2025 (UNEP, 2008). Traditional farmers' methods for growing wheat and rice, which are based on indigenous knowledge, are water, money, and energy intensive, and result in a plethora of issues that represent a serious threat to agriculture's long-term viability. Farmers generally burn paddy straw before wheat sowing as the cheap and easy option for residue management as spreading, removal and incorporation of paddy straw in the field are labour intensive and expensive tasks. Biomass burning of agricultural field residue (stalks and stubble) during wheat and rice harvesting periods in the Indo-Gangetic plains is an important source of atmospheric pollution in this region (Venkataraman *et al*., 2006). Consequently, regional climate, and in turn crop output and the health of the population are adversely affected. Alongside significant loss of soil fertility due to residue burning (Prasad *et al.,* 1999), the resulting air pollution impacts not only the farmers and their families, but the seasonal meteorological conditions facilitate smoke to blanket a wide area affecting millions of lives in cities and

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villages downwind (Mishra and Shibata, 2012; Vijayakumar *et al*., 2016). What are the alternatives to burning rice residue in the open field in India? The seeding of wheat is delayed while paddy straw continues to decompose. After November 15, delaying the seeding of timely wheat types resulted in daily output losses of 1% (Brar *et al.,* 2010). According to reports, paddy straw residue burning results in soil nutrient losses of 3.85 million tonnes of organic carbon, 59000 tonnes of nitrogen, 20000 tonnes of phosphorus, and 34000 tonnes of potassium, as well as a significant reduction in air quality. The carbon, nitrogen, and sulphur in straw are totally burned and lost to the atmosphere during the burning process. (Singh *et al*., 2012). To solve the problem of burning of paddy straw and late sowing of wheat, a machine called Super seeder has been developed for in-situ management of paddy straw. The super Seeder is a tractor-mounted machine that chops and lifts rice straw, sows wheat into bare soil, then mulches the sowed area with the straw. As a result, farmers can sow wheat immediately after harvesting rice without having to burn rice residue for land preparation. The wheat crop with super seeder can be sown in standing rice stubbles, avoiding field preparation tillage and allowing the crop to be sown 7-10 days earlier than with traditional sowing methods. The Super seeder is designed to save the environment while also increasing soil productivity without causing harm to the flora and animals. As a result, farmers may sow wheat right after their rice harvest without having to wait.

MATERIALS AND METHODS

Locale of the study: The research was designed to carried out in Kaithal district of Haryana state. From the selected district, three blocks namely Kaithal, Pundri and Guhla were undertaken to conduct the study. Out of these 3 selected blocks six villages from Kaithal block, two villages from Pundri block and five villages from Guhla block (total 13 villages) were undertaken where more number of super seeder adopter farmers were there. On the whole, a total of 60 Super Seeder adopter farmers and 60 non-adopter farmers were selected from the selected area.

Method of data collection: Interview schedule was prepared to collect the desired information as per objectives of the study. Data were collected with survey method and telephonically with the help of interview schedule.

Statistical analysis: Statistical techniques like frequency, chi square, weighted mean scores etc. were used as per the nature of data.

RESULTS AND DISCUSSION

Knowledge level of the farmers has been shown in Table 1. Almost fifty percent of the farmers (45.0%) had medium level while 35.00% had high and rest (20.00%) of the farmers had low level of the knowledge.

Table 1: Knowledge level of farmers regarding super seeder (n=60)

Knowledge level	Frequency	Percentage
Low (up to 33%)	12	20.00
Medium (34-66%)	27	45.00
High (more than 66%)	21	35.00

Data analysis on knowledge aspects regarding Super Seeder (Table 2) revealed that Seventy percent of the farmers had fully knowledge about the fields that should be laser levelled for direct drilling of crops so as to ensure uniformity in soil moisture across the field. Two third of the farmers had knowledge about the Residues should incorporated effectively into the soil across the field so that the residues load becomes uniform across the field and that optimal soil moisture content should be ensured at the time of sowing so as to have uniform crop establishment (66.67% each).

In regards to working of the machinery farmers reported having fully knowledge about aspects such as after the operation is completed all parts of machine should be cleaned and washed properly; selection of the proper row spacing, seed quantity, and depth according to the field and crop; Super Seeder can be used as a multi-crop planter (48.33%, 43.34% and 38.33%).

Regarding the knowledge aspect that tractor with double clutch of 60-75 HP should be used to operate the machine farmers (26.67%) had partial knowledge and 33.33 per cent had no knowledge about it.

More than fifty percent of the farmers had no knowledge about ensuring optimal depth of planting

Table 2: Knowledge statements regarding Super Seeder (n=60)

	Knowledge Aspects		
	Fully Knowledge	Partial Knowledge	No Knowledge
Residues incorporated effectively into the soil across the field so that the residues load becomes uniform across the field.	40(66.67)	15(25.00)	05(8.33)
Preferably the fields should be laser levelled for direct drilling of crops so as to ensure uniformity in soil moisture across the field.	42(70.00)	10(16.67)	08(13.33)
Optimal soil moisture content should be ensured at the time of sowing so as to have uniform crop establishment.	40(66.67)	14(23.33)	06(10.00)
Select the proper row spacing, seed quantity, and depth according to the field & crop (For e.g the optimum depth of seeding should be between 2.5 to 3.5 cm).	26(43.34)	14(23.33)	20(33.33)
Tractor with double clutch of 60-75 HP should be used to operate the machine.	24(40.00)	16(26.67)	20 (33.33)
Set rotor speed at 200-220 rmp and operate tractor in 1st straw load.	29(48.34)	14(23.33)	17(28.33)
Use recommended seed and fertilizer rate through calibrating the planter.	18(30.00)	15(25.00)	27(45.00)
Ensure optimal depth of planting through adjustment of depth control wheels.	13(21.67)	14(23.33)	33(55.00)
After the operation all parts of machine should be cleaned and washed properly.	29(48.33)	15(25.00)	16(26.67)
Super Seeder can be used as a multi-crop planter.	23(38.33)	19(31.67)	18(30.00)

Figures in Parentheses indicate percentage.

through adjustment of depth control wheels. 45.00 per cent farmers reported no knowledge regarding using recommended seed and fertilizer rate through calibrating the planter followed by setting engine at 200-220-240 rmp and operate tractor in 1st and 2nd gear depending upon straw load (28.33%). Malik *et al.* (2004) has also reported that earlier sowing improves the ability of wheat to compete against its major weed Phalaris, which was responsible for lower wheat yield and herbicide resistance. Increase in wheat as well as rice yield in next season due to residual effect of straw was also reported by the farmers.

The factors affecting knowledge level with socio economic status of the farmers have been shown in Table 3. Age was found significantly associated with knowledge level. In young age group high level of adoption (54.16%) while in old age low (50.00%) and medium level (30.00%) of adoption was found among farmers. Education association showed that illiterate farmers had low and medium level of knowledge (42.85%) each while senior secondary educated and graduates & above had medium (77.77%) and high (72.00%) level of adoption distributively. Significant association was found between education and adoption level of the farmers. Size of land holding was found significantly associated with adoption level. Marginal and small land holders had low and medium level of adoption while medium level i.e. 4-10 ha land holders had high level of adoption (44.45%). Annual family income, mass media exposure and socio economic status were found significantly associated.

Analysis of data regarding reasons for adoption of Super Seeder (Table 4) shows that more than 3/4th of the farmers were agreed that adoption of Super Seeder saves time and money as there is possibility of sowing wheat crop just after harvesting of rice crop (80%). Regarding other benefits near about 3/4th of the farmers were agreed that it reduces fuel and labour cost (76.66%) higher net returns by adoption of Super Seeder (75%), can be used as a multi crop planter (66.67%), possibility of sowing wheat crop just after rice harvesting i.e. option for ling duration wheat and rice varieties (63.33%) and it is a labour saving technology as less weedicides are reported (20%). Super seeder being a new technology was used by very few farmers but it has also helped in getting yields higher than zero till drill and rotavators/disc harrows (Devgan *et al.,* 2020). Regarding comparative advantages between Super Seeder adoption and conventional practices data revealed that Super Seeder takes 5h/ha while by conventional practices 14 h/ha is required means 64 per cent of time saving was reported by

Table 3: Association between socio-economic variables and knowledge level of super seeder adopter (n=60)

Socio-economic variables	Knowledge level			
	Low	Medium	High	Total
Age				
up to 35 yrs.	4(16.67)	7(29.17)	13(54.16)	24(40.00)
36-50 yrs.	3(11.50)	17(65.40)	6(23.10)	26(43.33)
above 50 yrs.	5(50.00)	3(30.00)	2(20.00)	10(16.67)
Total	12	27	21	60(100.0)
χ^2 *Cal*= 14.06*				
Caste				
General Castes	5(12.83)	18(46.15)	16(41.02)	39(65.00)
Backward Class	2(16.67)	6(50.00)	4(33.33)	12(20.00)
Scheduled Castes	5(55.56)	3(33.33)	1(11.11)	9(15.00)
χ^2 *Cal*= 9.43*				
Level of education				
Illiterate	3(42.85)	3(42.85)	1(14.30)	7(11.66)
Up to Middle	4(40.00)	5(50.00)	1(10.00)	10(16.67)
Senior Secondary and senior secondary level	3(16.67)	14(77.77)	1(5.56)	18(30.00)
Graduation and above	2(8.00)	5(20.00)	18(72.00)	25(41.67)
χ^2 *Cal*= 30.34*				
Subsidiary occupation of the family				
Nil	6(26.10)	13(56.50)	4(17.40)	23(38.33)
Business and services	3(14.28)	7(33.34)	11(52.38)	21(35.00)
Small scale enterprise	3(18.75)	7(43.75)	6(37.50)	16(26.67)
χ^2 *Cal*= 5.98*				
Size of land holdings				
Marginal (up to 1 ha)	5(23.80)	10(47.61)	6(28.59)	21(35.00)
Small (1-2 ha)	2(12.50)	9(56.25)	5(31.25)	16(26.67)
Semi-medium (2-4 ha)	3(21.42)	5(35.71)	6(42.87)	14(23.33)
Medium (4-10 ha)	2(22.22)	3(33.33)	4(44.45)	9(15.00)
χ^2 *Cal*= 14.08*				
Annual income				
Between Rs.75,000 - 1,50,000/-	5(45.45)	5(45.45)	1(9.10)	11(18.33)
Between Rs.1,50,000 - 3,00,000/-	4(14.28)	14(50.00)	10(35.72)	28(46.67)
Above Rs. 3,00,000/-	3(14.28)	8(38.09)	10(47.63)	21(35.00)
χ^2 *Cal*= 7.81*				
Mass media exposure				
Low (up to 9)	5(33.33)	8(53.33)	2(13.34)	15(25.00)
Medium (10-17)	3(12.50)	10(41.67)	11(45.83)	24(40.00)
High (above 17)	4(19.0)	9(42.9)	8(38.1)	21(35.00)
χ^2 *Cal*= 5.20*				
Social organization participation				
No membership	5(41.67)	3(25.00)	4(33.33)	12(20.00)
Member of one organization	4(16.67)	13(54.17)	7(29.16)	24(40.00)
>One organization	3(12.50)	11(45.80)	10(41.70)	24(40.00)
χ^2 *Cal*= 5.98*				
Socio-economic status				
Low (12-18)	5(33.33)	9(60.00)	1(6.67)	15(25.00)
Medium (19-24)	3(14.28)	8(38.09)	10(47.63)	21(35.00)
High (25-31)	4(16.66)	10(41.67)	10(41.67)	24(40.00)
χ^2 *Cal*= 7.83*				

*Significant at 5% level of significance; *Figures in parentheses indicate percentage

Table 4: Reasons for adoption of super seeder (n=60)

Aspects	Reasons for adoption		
	Agree	Neutral	Disagree
Super Seeder machine ploughs standing paddy stubble in soil and sow wheat seed simultaneously which saves time and money as there is possibility of sowing wheat crop just harvesting of rice crop.	48 (80.00)	6(10.00)	6(10.00)
Can be used as a multi-crop planter	40(66.67)	12(20.00)	8(13.33)
Higher net return by adoption of Super Seeder	45(75.00)	10(16.67)	5(8.33)
Reduce fuel and labour cost	46(76.66)	7(11.67)	7(11.67)
It helps in maintaining soil moisture thus reducing the need for at least one irrigation so it is a water saving technology.	30(50)	10(25.00)	10(25.00)
Possibility of sowing wheat crop just after rice harvesting i.e. option for long duration wheat and rice varieties.	38(63.33)	12(20.00)	10(16.67)
It is a labour saving technology as less weedicides are reported	12 (20.00)	12(20.00)	36(60.00)

Figures in Parentheses indicate percentage; Responses were multiple.

adopters. Saving in Fuel consumptions, labour requirement and cost of sowing were reported 42, 64 and 47 per cent, respectively. Other advantages with Super Seeder adoption reported were saving in gross return from grain (1.85%), cost of operation (3.32%), net return (11.59%) and total benefit over conventional practices were reported 5225 Rs /ha by the farmers (Kathpalia *et al.,* 2022).

From the Table 5 it is very clear that 3/4th of the farmers were agreed that Super Seeder requires high Horse power tractor and sometime extra weight is to be loaded for the proper working of the machine and 73.34%of the farmers were agreed that Super Seeder is expensive. About fifty percent of the farmers reported (46.67%) reported that technical knowledge of the farmers is poor and chocking of machine in high soil moisture condition (41.66%). The super seeder ploughs the standing paddy residue and sow seeds for the next wheat crop, in a single operation. This technology is although superior to Happy seeder and also more expensive. It requires a tractor of 65 hp to run the machine (Devgan *et al.*, 2020). The results of a study conducted in Punjab also revealed that ignoring the bad impact on environment, farmers burn paddy straw as it was economically advantageous to them. The farmers were engaged in mechanical farming for tillage operations and clearance of fields. Issues related to technical and mechanical aspects were found to be important (Roy *et al.,* 2018).

Analysis of study depicted (Table 6) the multiple cumulative socio economic impact of using Super Seeder as perceived by farmers. One-fourth of the small farmers performed social ceremonies by the benefit amount of Super Seeder (25.00%), investment on quality education of their children (31.25%) and increase in household assets (12.50%). Semi-medium farmers also invested on education of children (28.58%) on social ceremonies (14.28%) and household

Table 5: Reasons for non-adoption of Super Seeder (n=60)

Aspects	Reasons for adoption		
	Agree	Neutral	Disagree
High cost of machine	44(73.34)	10(16.66)	06(10)
Required high HP tractor	45(75.00)	10(16.67)	05(8.33)
Proper mixing of stubble in soil	16(26.66)	30(50.00)	14(23.34)
Difficulty in maintaining proper depth of sowing	18(30.00)	28(46.67)	14(23.33)
Technical knowledge of the farmers is poor	28(46.67)	12(20.00)	20(33.33)
Chocking of machine in high soil moisture condition	25(41.67)	12(20.00)	23(28.33)

Figures in Parentheses indicate percentage; Responses were multiple.

Table 6: Cumulative socio-economic impact of Super Seeder on farming families (n = 60)

Socio-economic impact	Marginal farmers (21) 35.00%	Small farmers (16) 26.67%	Semi-medium farmers (14) 23.33%	Medium farmers (09) 15.00%
Investment on quality education of their children	4(19.04)	5(31.25)	4 (28.58)	2(22.22)
Expenditure on Performance of social ceremonies like marriage, death etc. increased	3 (14.29)	4(25.00)	2(14.28)	2(22.22)
Increase in household assets	5 (23.80)	2 (12.50)	2 (14.28)	1 (11.12)
Increase in quality of medical treatment	3(14.29)	-	-	-
Increase in agricultural land on lease	-	1 (6.25)	4(28.58)	-
Increase in mass media exposure	3(14.29)	2 (12.50)	2(14.28)	2(22.22)
Increase in urban and extension contacts	-	2(12.50)	-	2(22.22)
Any others	3 (14.29)	-	-	-

Figures in Parentheses indicate percentage.

assets (14.28%) increase in agricultural land on lease (28.58%). About 1/10th of the medium land holders reported increase in household assets and 22.22 percent in mass media exposure. Analysis of study depicted the multiple cumulative socio economic impact of using Super Seeder as perceived by farmers. 19.04 percent marginal farmers performed social ceremonies by the benefit amount of Super Seeder, increase in mass media exposure (14.29%) and increase in household assets (23.80%). Small farmers also invested on education of children (31.25%) mass media exposure (12.50%) and household assets (12.50% each) increase in agricultural land on lease (6.25%)

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Socio-economic Features of Maize (*Zea mays* L.) Growers, Extension Support and Constraints in Maize Cultivation in Nagaland, India

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ABSTRACT

The present study was conducted in selected districts of Nagaland, India, to assess maize growers' socio-economic characteristics and adoption behaviour. In this study, 120 respondents were purposively selected from 8 villages of 4 blocks. An interview schedule was developed for data collection. The study revealed that the majority (66.67% and 90.00%) of the respondents were middle age group of 38 to 60 years and male. Most (97.50%) of the respondents were married with a medium-sized family of 4 to 7 members. Around 43.33% of the respondents had primary education. The majority (62.50%) of the respondents had small size land holding, whereas under maize cultivation majority (51.67%) of the respondents had medium landholding. The majority (80.00%) of the respondent's annual income was of medium level (Rs. 3,2000 - Rs. 145,000) and in terms of maize cultivation, 76.67 per cent of the respondents had also a medium level of income (Rs. 1,200 - Rs. 3,000). The majority (51.66%) of the respondents had contacted ATMA functionaries to acquire information related to maize farming. In contrast, 23.33 per cent of the respondents had accessed support from a government official. Access of information by maize farmers was in pitiable state and performance of formal extension system and mass communication sources were immensely inadequate in respect to support farming community and information dissemination. The findings also revealed that the majority (67.36%) of the respondents had less contact with technical experts, which is the major constraint in the study area.

Keywords*:* Socio-economic, Maize, Maize cultivation, Constraint in maize cultivation, Information sources

INTRODUCTION

Maize or corn (*Zea mays* L.) is the world's leading crop and is ranked third among the major food crops in India after rice and wheat in respect to area and production. It is also the second most important cereal crop, which belongs to the family Poaceae and genus *Zea*. "*Zea*" is an ancient Greek name for food grass. Maize is a C4 plant with chromosome number 2n = 20. The genus *Zea* comprises of four species, of which *Zea mays* is economically important. Globally, maize is regarded as the "Queen of cereals" and "Miracle crop" because of its high genetic yield potential. It is a cereal crop cultivated in Mesoamerica and later distributed to the remaining part of the world after European contacts (ICAR-IIMR, 2021). It is mainly a *kharif* season crop but is also cultivated in *rabi* season in some places. It is grown throughout the temperate, tropical and sub-tropical zones of the world. It is essentially a crop of warm countries with adequate moisture. The lowest seasonal rainfall in maize area is 200 mm. It cannot withstand frost at any stage of its growth (Reddy, 2004). Maize is getting popularity among growers due to its multipurpose use, like human food, animal feed and raw materials for different industries (Imran, 2015).

The world's area under maize is about 181 M ha with a production of around 1034 MT and productivity of 5.72 MT/ha. In India, the area under maize is 9.5 M ha, with a production of 25 MT and a productivity of 2.63MT/ha (USDA, 2017-18). Maize has ranked third in the world's cereals after wheat and rice. In the North Eastern Hill Region (NEHR), maize is grown primarily as a pure or mixed crop under *jhum*

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or shifting cultivation. However, large scale cultivation for a commercial purpose is becoming popular among farmers. In NEHR, maize is a component of mixed cropping under shifting cultivation, the yield varies from 0.30-1.70 qt/ha. In Nagaland, the area and production of maize were recorded as 69,130 ha and 1,37,160 MT, respectively (Govt. of Nagaland, 2020). Some of the major maize growing districts in Nagaland are Tuensang, Zunheboto, Peren, Phek, Kipheri and Dimapur. Dimapur and Peren are among the 12 districts of Nagaland that have been bestowed with rich fertile soil and favourable agro-climatic conditions for maize cultivation. The area and production of maize under Dimapur district is 6,770 ha and 13,473 MT and under Peren district is 3,100 ha and 6,149 MT, respectively (Govt. of Nagaland, 2020). This paper is an attempt to assess the socio-economic characteristics of maize growers and constraints in maize cultivation.

MATERIALS AND METHODS

The present study was carried out in the state of Nagaland. Around 70 per cent of the population in the state is engaged in the agriculture sector. Maize is the second most important and potential cereal crop in Nagaland (Govt. of Nagaland, 2020). There are 12 districts in Nagaland; Dimapur and Peren were purposively selected for the study because maize is one of the most important crops in these districts. There are 6 R.D. blocks in Dimapur and four blocks in the Peren district. In this study, four blocks, namely, Medziphema, Niuland, Peren and Jalukie, were purposively selected.

A list of all maize growing villages under the selected blocks was prepared. Out of these, two villages with a maximum number of growers were purposively selected from each block. Thus, a total of eight villages were selected for the present study. A list of all households engaged in maize cultivation was prepared from the villages chosen, and out of those, 120 farmers were selected as respondents based on the proportionate random sampling method. All the possible variables related to socio-economic characteristics of maize growers and issues related to constraints were taken into consideration.

RESULTS AND DISCUSSION

The results of the investigation have been discussed and presented using appropriate statistical tools under three sub-sections, namely, socio-economic characteristics of maize growers, access of information sources and constraints involved in maize cultivation.

Socio-economic characteristics of maize farmers: All the socio-economic variables, namely, age, gender, marital status, family size, family type, education, total land holding, total landholding under maize, annual income, income from maize, training exposure, social participation and experience in maize cultivation and considerations related to the socio-economic status of maize growers are presented and discussed.

The study reveals that the majority (66.67%) of the respondents were middle age group of 38 to 60 years, followed by 17.50 per cent of the respondents in the young age group (<38 years) and 15.83 per cent of respondents in the old age group (>60 years). The average age of the respondents was 49.96, with a standard deviation value of 11.42. Concerning the age of respondents, Singh *et al.* (2021) observed that young farmers had more willingness to take risks than other age groups. The majority (75.00%) of the respondents were male, while 25.00 per cent were female respondents. This indicates that male farmers are playing a major role in maize cultivation. Further, most (97.50%) of the respondents were married while 0.83 per cent were unmarried, divorced and widowed, respectively.

A majority (74.17%) of the respondents in the study area were from medium-size family. In contrast, 15.83 per cent of the respondents belong to a small family, followed by 10.00 per cent of respondents under a large family. Further, the majority (71.67%) of the respondents were from joint families, while the remaining 28.33 per cent were from nuclear type.

The study also reveals that about 43.33 per cent of the respondents acquired education till primary school, followed by 25.83 per cent of respondents up to middle school, 20.00 per cent up to matriculation, and 5.83 per cent up to higher secondary. On the other side, around 5.00 per cent of the respondents were illiterate and had not acquired any formal education. Thus, it is clear that the majority of the respondents in the study area had received a primary level of education. Benjongtoshi and Patra (2021) also reported a similar trend of educational status of French bean growers in Nagaland.

Table 1: Distribution of respondents according to their socio-economic characteristics (N=120)

Variable	Category	Frequency	Percentage	Range	Mean	SD
Age	Young (<38 years)	21	17.50	25-75	49.96	11.42
	Middle (38-60 years)	80	66.67			
	Old (>60 years)	19	15.83			
Gender	Male	90	75	-	-	-
	Female	30	25			
Marital status	Married	117	97.50	-	-	-
	Unmarried	1	0.83			
	Divorced	1	0.83			
	Widowed	1	0.83			
Family size	Small (< 4)	19	15.83	2-11	5.85	1.66
	Medium (4-7)	89	74.17			
	Large (>7)	12	10.00			
Family type	Joint	86	71.67	-	-	-
	Nuclear	34	28.33			
Education	Illiterate	6	5.00	0-12	6.07	3.12
	Primary	52	43.33			
	Middle	31	25.83			
	Matriculation	24	20.00			
	Higher secondary	7	5.83			
	Graduate & above	0	0.00			
Social participation	SHG	12	10.00	-	-	-
	Village council	27	22.50			
	Church member	20	16.67			
	Office bearer	8	6.67			
Experience	Low (<5.2)	25	20.83	3-18	10.23	4.93
	Medium (5.2-15)	79	65.83			
	High (>15)	16	13.33			
Training Exposure	Training attended	6	5.00	-	-	-
	Training not attended	116	95.00			

The distribution of respondents according to their social participation in different organization shows that 22.50 per cent of the respondents were active member of the village council while 16.67 per cent of the respondents were church member, 10.00 per cent of the respondents were SHG member, and 9.00 per cent of the respondents were office-bearer of any union or organization. Thus, it can be concluded that around 58.00% of the respondents were actively involved in social participation while 62.00% of the respondents were not involved in any organization. Table 1 reveals that the majority (65.83%) of the respondents had the farming experience of 5.2-15 years, followed by 20.83 per cent of respondents who had less than 5.2 years of farming experience, and the remaining 13.33 per cent of the respondents had more than 15 years of farming experience.

The study shows that 95.00 per cent of the respondents had not participated or attended any training, while 5.00 per cent of the respondents had participated in the training programme. Thus, it is clear from the table that most of the respondents had no exposure to training programmes related to maize farming.

Table 2: Distribution of respondents according to the size of landholding and land under maize cultivation (N=120)

Variable	Category	Frequency	Percentage
Total land holding	Marginal (<1 acre)	0	0.00
	Small (1-2 acre)	4	3.33
	Semi-medium (2-4 acres)	49	40.83
	Medium (4-10 acres)	64	53.33
	Large (>10 acres)	3	2.50
Area under maize cultivation	Small (<1.0 acre)	55	45.83
	Medium (1.0-2.0 acres)	62	51.67
	Large (>2.0 acres)	3	2.50

Table 2 reveals that the majority (53.33%) of the respondents had a medium size of landholding (4-10 acres), while 40.83 per cent had a semi-medium size of landholding (2-4 acres), followed by 3.33 per cent of the respondents had small landholding (1-2 acres), and 2.50 per cent of the respondents had large land holding (>10 acres). The study also shows that the majority (51.67%) of the respondents had medium landholding (1.0-2.0 acres) under maize cultivation, followed by 45.83 per cent of the respondents with small landholding (<1.0 acres) and 2.50 per cent of the respondents with large landholding (>2.0 acres) under maize cultivation.

Table 3 shows that the majority (80.00%) of the respondents had medium level (Rs. 32,000 - Rs. 1,45,000) annual income, followed by 15.83 per cent of the respondents with a high level of income (> Rs. 1,45,000) and the remaining 4.17 per cent of the respondents with a low level of income (< Rs. 32,000). It also reveals that 13.33 per cent of the respondents had a low level of income (< Rs. 1,100) from maize cultivation. In comparison, 76.67 per cent of the respondents had a medium level of income (Rs. 1,100 - Rs. 3,000), and 10.00 per cent of the respondents had a high level of income (> Rs. 3,000) from maize cultivation. It is important to mention that amount of rupees acquired after the sale of the maize was taken as income from maize, and the value of the consumed amount was not included in income from maize cultivation.

To assess the degree of access of information sources for acquiring information related to improved maize cultivation, three sources, namely, formal, informal and mass media sources with 19 alternatives were taken into account. Table 4 reveals that the majority (51.66%) of the respondents had sometimes contacted ATMA functionaries for acquiring information related to maize farming. On the other hand, 23.33 per cent of the respondents had accessed information from government officials, followed by 1.67 per cent each from ICAR and KVK. The study also revealed that 100 per cent of the respondents had not accessed information from NGOs.

The study reveals that the majority (97.50%) of the respondents had contacted neighbours for obtaining information while 95.00 per cent of the respondents had acquired information from friends and relatives, followed by 65.83 per cent of the respondents from neighbouring villages and 18.33 per cent of respondents from progressive farmers.

Table 3: Distribution of respondents according to income (N=120)

Variable	Category	Frequency	Percentage
Annual income	Low (<32,000)	5	4.17
	Medium (32,000-1,45,000)	96	80.00
	High (>1,45,000)	19	15.83
Income from maize cultivation	Low (<1,100)	16	13.33
	Medium (1,100-3,000)	92	76.67
	High (>3,000)	12	10.00

Table 4: Distribution of respondents based on access of information sources (N=120)

Information sources		Most often		Often		Sometimes		Never	
		F	%	F	%	F	%	F	%
Formal	Govt. officials	0	0.00	3	2.50	25	20.83	92	76.66
	ICAR	1	0.83	0	0.00	1	0.83	118	98.33
	NGO's	0	0.00	0	0.00	0	0.00	120	100.00
	ATMA	0	0.00	0	0.00	62	51.66	58	48.33
	KVK	0	0.00	0	0.00	2	1.67	118	98.33
Informal	Progressive farmers	0	0.00	0	0.00	22	18.33	98	81.67
	Neighbours	95	79.17	6	5.00	16	13.33	3	2.50
	Neighbouring village	2	1.67	10	8.33	67	55.83	41	34.17
	Friends & relatives	76	63.33	5	4.17	33	27.5	6	5.00
Mass media	Radio	21	17.5	5	4.17	29	24.17	65	54.17
	Television	4	3.33	1	0.83	89	74.17	26	21.67
	Exhibition	0	0.00	0	0.00	40	33.33	80	66.67
	Mobile	1	0.83	0	0.00	111	92.50	8	6.67
	Newspaper	1	0.83	2	1.67	21	17.5	96	80.00
	Whatsapp	0	0.00	0	0.00	14	11.67	106	88.33
	Facebook	0	0.00	0	0.00	6	5.00	114	95.00
	You tube	0	0.00	0	0.00	6	5.00	114	95.00
	SMS	0	0.00	0	0.00	4	3.33	116	96.67
	KCC	0	0.00	0	0.00	0	0.00	0	0.00

It was found that the majority (93.33%) of the respondents had used mobile phone for acquiring information. The study also shows that 78.33 per cent had accessed to TV, 45.84 per cent had accessed to radio, 33.33 per cent had participated to exhibition, while 20.00 per cent had accessed to newspaper, followed by 5.00 per cent each from Facebook and YouTube and 3.33 per cent through SMS. Therefore, it can be concluded that access of information by farmers was in pitiable state and performation of formal extension system and mass communication sources immensely inadequate in respect to support farming community and information dissemination.

Constraints faced by maize farmers: The sole purpose of selecting this objective was to identify and understand the various constraints faced by the maize farmers in the study area. The respondents were asked to highlight constraints faced by them in maize cultivation, concerning input availability, labour, financial, institutional, marketing and others/general, respectively. All the responses under different broad-head were included as an individual genre of response. The percentage of respondents who recognized the individual genre had also taken into account. The highest responses under the broad-heads of constraint were taken for ranking of the constraints.

Table 5 reveals that 100.00 per cent of the respondents had faced the problem in availing the benefits of Kishan Credit Card (KCC) due to lack of proper guidance and inadequate support from the banking sector. Around 84.17 per cent of the respondents highlighted the lack of subsidy for purchasing inputs as constraint. Simultaneously, 17.50 per cent recognized the inadequate guidance regarding credit availability to farmers as part of financial constraints, and 9.17 per cent of the respondents had recognized the difficulty in getting a loan as a financial constraint. In this regard, Verma *et al.* (2020) also reported that lack of availability of credit as constraint for entrepreneurial establishment by farmers. Altogether, 233 responses were recognized in respect of financial constraint with highest score of 100.00

Table 5: Delineation of constraints in maize cultivation (N=120)

Nature of constraints	Frequency	Percentage (*Maximum response obtained under the broad head)	Rank based on highest response obtained under the broad head
Input constraints			
High cost of hybrid seeds	7	5.83	46.67 IV
High cost of fertilizers & pesticides	21	17.50	
High cost of farm machinery	56	**46.67***	
irrigation channel and drainage facilities	50	41.67	
Total	134		
Labour constraints			
Scarcity of labour	30	25.00	25.00 VI
High cost of labour	30	25.00	
Total	60		
Technical constraints			
Lack of technical help/ less contact with technical expert	58	48.33	98.33 II
Lack of knowledge about recommended doses of manures & fertilizer	118	**98.33***	
Poor confidence in adoption of newly recommended technology	63	52.50	
Lack of knowledge about seed treatment	117	97.50	
Lack of knowledge about disease and pest management	115	95.83	
Lack of knowledge about the use of farm equipments	14	11.67	
Total	455		
Financial constraints			
Difficulty in borrowing loans	11	9.17	100.00 I
Inadequate guidance to credit availability farmers	21	17.50	
Lack of subsidy for inputs	101	84.17	
Difficulty to open Kisha Credit Card	120	**100.00***	
Total	233		
Institutional constraints			
Insufficient training programmes on improved practices	107	**89.17**	89.17 III
Non-availability of insurance	14	11.67	
lack of coordination with department, and maize growers	38	31.67	
less contact with extension workers	42	35.00	
Total	201		
Marketing constraints			
Poor transportation facilities	20	**16.67***	16.67 VII
Price fluctuation	2	1.67	
Total	22		
General constraints			
Incidence of insect pest and disease	2	1.67	33.33 V
Post-harvest loss due to rodents	2	1.67	
Lack of storage capacity	40	**33.33***	
Total	44		

per cent and financial constraint was recognized as most important constraint in maize cultivation. Further, these findings have strong agreement with the findings of Sarkar *et al.* (2021).

Altogether, 455 responses under six issues were recognized under technical constraint in maize cultivation in the study area. About 98.33 per cent of the respondents had recognized that the lack of knowledge on recommended doses of manure and fertilizers as a component of technical constraint. Simultaneously, 97.50 per cent of the respondents had faced the problem on seed treatment, and 95.83 per cent of the respondents had reported about problem of disease and disease management of maize. Around 52.50 per cent of the respondents had faced problem due to the lack of confidence to adopt newly recommended technology. Also, 48.33 per cent of the respondents had reported that lack of technical help and less contact with experts as another important technical constraint. Under technical constraint, highest score was 98.33 per cent and emerged as II most important constraint.

It was also found that 89.17 per cent of the respondents had reported about insufficient training programmes on improved practices as constraint, while 11.67 per cent of the respondents faced problem on non-availability of public sector institutional services for insurances, followed by 31.67 per cent of the respondents reported about lack of coordination with agricultural department and maize growers and 35.00 per cent of the respondents faced problem due to less contact with extension workers. The total score under institutional constraint was 201 with highest score of 89.17 per cent and ranked as III important constraint (Table 5).

Table 5 also shows that 46.67 per cent of the respondents had reported about high cost of machineries. Another 41.67 per cent of respondents had reported about inadequate irrigation channel and drainage facilities as constraint. While 17.50 per cent had highlighted about high cost of fertilizers and pesticides, and 5.83 per cent of the respondents had faced problems due to the high cost of hybrid seed. Concerning input constraint, 134 responses had recorded under 4 aspects with highest score of 46.67 per cent and ranked as IV important constraint.

The study further reveals that 25.00 per cent each of the respondents had highlighted the scarcity of labour, and high cost of labour, respectively as constraints in maize cultivation. The highest score in respect of constraints related to labour availability was 25.00 and ranked as V.

Marketing sector's reform is a prescribed measure to enhance the income of farmers (Dabbadi *et al.,* 2021). Table 5 also shows that in respect of marketing constraint, 16.67 per cent of the respondents had recognized the problem of transportation facilities due to bad road condition and poor road infrastructure. Under marketing constraint, the highest response was 16.67 per cent and ranked as VI.

From Table 5 it shows that 1.67 per cent of the respondents each had faced a problem on incidence of insect pest and disease, and post-harvest loss due to rodents, while 33.33 per cent of the respondents had highlighted the lack of storage capacity as constraint. Gamlin and Patra (2020) also reported that storage facility as a constraint in pineapple cultivation. The highest score on general constraint was 33.33 per cent and ranked as VII.

CONCLUSION

Based on the present investigation, it can be concluded that majority (66.67%) of the respondents engaged in maize cultivation were from middle aged, which formed the engagement of the largest productive part of human resources in agriculture and allied sector while majority of the respondents involved in maize cultivation were male. Therefore, efforts should be made by the state functionaries to provide technical knowledge on maize cultivation practices to their female counterpart to enhance their involvement and quality contribution to maize cultivation. The study shows that most of the respondents had acquired education up to primary school. Therefore, farmers should be trained according to their understanding and level of education. Majority of the respondents had a medium size of land holding with moderate income. Hence, the state government must encourage the farmers for intensive and integrated farming. The concerned authorities should facilitate to establish proper market structure and market linkage for doubling the farmer's income. Access of information by farmers was in pitiable state and performance of formal extension system and mass communication sources were immensely inadequate in respect to support farming community and information dissemination. Therefore, concerned authority should take the initiative to minimize the problem.

Majority of the respondents did not attend any training programmes on maize cultivation. Thus, the concerned departments should take the initiative to conduct a capacity development programme to boost the knowledge level and accelerate the rate of adoption in maize farming and reduce the technological gap. It was also recognized that the majority of the respondents had fewer contacts with technical experts, which is the major constraints in the study area. Therefore, to minimize the constraints, the technical experts may reach out and provide skills and training related to improved maize cultivation and also mitigate other constraints involved in maize farming.

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Evaluation of Chilli (*Capsicum annuum* L.) Genotypes for Growth and Yield Attributing Traits

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ABSTRACT

The present study was carried out to know the performance and evaluation of chilli genotypes for different traits attributing for growth and yield in chilli at the Division of Vegetable Science and Molecular biology, ICAR-Central Institute of Temperate Horticulture Srinagar (CITH) during *kharif* 2018. The analysis of variance revealed significant differences among the genotypes. Among the genotypes used for investigation Bhut Jolokia showed highest plant height (94.06 cm), maximum fruit diameter (2.60 cm) and maximum average fruit weight (2.83 g). The genotype Kashi Anmol showed highest plant spread (63.86 cm), highest fruit length (13.80 cm), maximum number of fruits per plants (100.50), maximum fruit yield per plant and per hectare i.e., (750.10g and 277.60 q) respectively. VOBC-0289 recorded the maximum average fruit weight (15.03 g) and maximum number of seeds per fruit (139.46). Maximum number of primary branches per plants was found in IC- 561635 (8.00), minimum number of days to 50% flowering was taken by genotype IC-561661 (44 days) and minimum days to first fruit set (38.36 days) was taken by genotype IC-561652, LVST- Red -1 recorded maximum pedicel length (5.00 cm).

Keywords: Chilli, Genotypes, Analysis of variance

INTRODUCTION

Chilli (*Capsicum annuum* L.) (2n=2x=24) belonging to genus *Capsicum* family Solanaceae is one of the major vegetable-cum-spice crop. It is also known as red pepper or chilli pepper. The Genus *Capsicum* consists of approximately 25 wild species and five domesticated species that include *Capsicum annuum, Capsicum frutescens, Capsicum chinense, Capsicum pubescens and Capsicum baccatum* (Perry *et al.,* 2007). The genus Capsicum originated in the American tropics. Five species of capsicum were cultivated in different parts of the World (Pickergill, 1997). Among these cultivated species, *Capsicum annuum* L. is most widely cultivated in India. The primary centre of origin of chilli is said to be Mexico with secondary centre in Guatemala and Bulgaria (Salvador, 2002). It was introduced in Europe by Columbus in 15th century and spread to the rest of the globe along the spice trading routes to Africa, India, China and Japan. Chilli was introduced in India by Portuguese from Brazil in the middle of 17th century.

Chilli has diverse uses as spice, condiment, culinary supplement, medicine, vegetable and ornamental plant. Chilli is an indispensable spice essentially used in every Indian cuisine due to its pungency, colour and aroma. It is a rich source of vitamins A, C and E along with mineral elements like molybdenium, manganese, folate, potassium and thiamine etc. (Bosland and Votava, 2003). Capsaicin (8-methyl- N-Vanillyl – trans -6-nonenamide), a crystalline acrid volatile alkaloid present in the placenta and pericarp of fruit is responsible for pungency in chilli and has high diverse prophylactic and therapeutic uses in Allopathic and Ayurvedic medicine value and can directly scavenge various free radicals (Bhattacharya *et al*., 2010). A large number of carotenoids provide high nutritional value and the colour to chilli. The capsanthin and capsorubin

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constitute more than 60 per cent of the total carotenoids present in the fruits. Chilli is also a good source of oleoresin. Oleoresin has varied uses in processed food and beverage industries and has highest export potential. The nutraceutical applications of capsaicinoid are widely exploited and identified its medicinal properties like antioxidant, anticancer, antiarthritic and analgesic (Prasad *et al.*, 2006). Chilli and its related species co-exist in India and have rich genetic resources, which are characterized by a considerable amount of variability for different qualitative and quantitative traits (Tanksley, 1984). Therefore, efforts should be made to collect and conserve the genetic resources of chilli in India. To enhance the utilization of such genetic resources they should also be evaluated for different qualitative and quantitative traits. Our objective was to determine the average performance of forty-eight chilli genotypes collected from different agro-ecological regions of India for different qualitative traits.

MATERIALS AND METHODS

The investigation was carried out at experimental field, Division of Vegetable Science and Molecular biology, ICAR-Central Institute of Temperate Horticulture Srinagar (CITH) during *kharif* 2018. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Forty-eight chilli genotypes collected from nine different states of India representing different agro-ecological regions were characterized and evaluated for different plant and fruit morphological and yield attributing traits. The mean annual rainfall and mean maximum temperatures were 63.61 mm and 25.76°C respectively. The sowing was carried out on 5th April 2018. Seedlings were transplanted in the field on first June 2018 at a spacing of 60 cm between row to row and 45cm between plant to plant. Ten plants of each genotype were transplanted in a randomized complete block design. Five randomly chosen plants from each genotypes of each replication were used for recording data.

The quantitative traits recorded were plant height (cm), plant spread (cm), number of primary branches, days to 50% flowering, days taken to first fruit set, fruit diameter (cm), fruit length (cm), pedicel length (cm), number of fruits per plant, fruit weight (g), fruit yield per plant (g), number of seeds per fruit, average dry fruit weight (g), fruit yield per hectare (q). Analysis of variance was carried out as per the procedure given by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed significant differences among the genotypes for all the sixteen characters studied indicating the presence of genetic variability in the genotypes and considerable scope for their improvement. These results are in conformity with earlier reports of Vani *et al.* (2007); Farhad *et al.* (2008); Gupta *et al.* (2009); Suryakumari *et al.* (2010); Kumar *et al.* (2012); Rajyalakshmi and Vijayapadma (2012); Janaki *et al.* (2015) in chilli.

Also in any crop breeding programme, it is essential to eliminate the undesirable types which can be achieved by studying the mean performance of genotypes. The mean performance of different growth and yield characters were presented in Table 2. The results on the performance of different chilli genotypes showed significant differences for all different characters.

Plant height: The genotypes under study possessed a large amount of variability for this character. Plant height ranged from 42.26 to 94.06 cm with an overall mean of 62.20 cm. The maximum plant height was attained by Bhut Jolokia (94.06 cm) and minimum height was attained by Goa-Sel-1 (42.26 cm). High variation in height of the chilli plants on their final performance was also noticed by Chopra *et al.* (2005); Jabeen *et al.* (2011); Jyothi *et al.* (2011); Amit *et al.* (2014); Kumari *et al.* (2017); Nagaraju *et al.* (2018); Purad *et al.* (2019); Kerketta *et al.* (2018).

Plant spread: In the present investigation plant spread shows the considerable variation. Plant spread ranged from 24.03 to 63.86 cm with an average value of 48.00 cm. The maximum plant spread was attained by Kashi Anmol (63.86 cm) and the minimum spread was attained by Goa-Sel-1 (24.03 cm). Similar results were also observed by Munshi *et al.* (2010); Nehru *et al.* (2012) and Nagaraju *et al.* (2018).

Number of primary branches: Number of primary branches is an important character which indicates the ideotype of plant. The results showed that sufficient variation existed for this character. Number of primary

Table 1: Analysis of variance for various quantitative characters in chilli (*Capsicum annuum* L.)

Source of variation	d.f	Mean sum of squares(MSS)													
		Plant height (cm)	Plant spread (cm)	No. of primary branches	Days to 50% flowering	Days to first fruit set	Fruit diameter (cm)	Fruit length (cm)	Pedicel length (cm)	No. of fruits per plant	Fruit weight (g)	Fruit yield per plant (g)	No. of seeds per fruit	Average dry fruit wt. (g)	Fruit yield/ ha (q)
Replication	2	9.16	12.15	0.59	21.57	22.18	0.01	0.51	0.43	4.97	0.017	78.90	9.73	0.38	10.43
Genotypes	47	287.29**	200.75**	4.02**	266.17**	153.59**	0.38**	22.96**	1.14**	533.87**	14.72**	36953.18**	1761.16**	0.704**	5068.38**
Error	94	0.63	0.86	0.05	3.65	3.30	0.002	0.03	0.009	2.73	0.08	19.10	0.57	0.05	16.37

*Significant at 0.05 probability level; **Significant at 0.01 probability level

branches ranged from 2.60 to 8.00 with an average mean of 4.98. The maximum number of primary branches was observed in IC-561635 (8.00) and minimum number of branches was observed in SKAU-089 (2.60). Such variation for number of branches were also noticed by Munshi *et al.* (2010); Nehru *et al.* (2012); Amit *et al.* (2014); Jamal *et al.* (2015); Karak *et al.* (2015); Srinivas *et al.* (2017); Kerketta *et al.* (2018); Purad *et al.* (2019)

Days to 50% flowering: There were significant differences among genotypes under study for days to 50% flowering Days to 50% flowering ranged from 44.00 to 80 days with an overall mean of 66.35 days. Earliest 50% flowering was recorded in IC-561661 (44 days) and delayed 50% flowering was recorded in Bhut Jolokia (80 days). Similar results on variability in days to flowering have also been reported by Farhad *et al*. (2008) from 61.17 DAS to 84.93 DAS, Tembhurne *et al.* (2008) 63.0 DAS to 82.0 DAS, days and Amit *et al.* (2014) from 70.53 DAS to 94.13 DAS, Kerketta *et al.* (2018); Kumari *et al.* (2017); Nagaraju *et al.* (2018) also showed similar results.

Days taken to first fruit set: Days to first fruit set showed considerable variation from 38.36 to 73.66 with an overall mean of 63.62. The maximum number of days to first fruit set was observed for Bhut Jolokia (73.66) and minimum days to first fruit set was found in IC-561652 (38.36). The results were in accordance with Srinivas *et al.* (2017); Nagaraju *et al.* (2018).

Fruit diameter: There were significant differences among all the genotypes for this character. Fruit diameter ranged 0.50 to 2.60 cm with an overall mean of 1.26 cm. Bhut Jolokia recorded the maximum fruits diameter (2.60 cm) and SKAU-0-92 recorded the minimum fruit diameter i.e., 0.50. Similar results were found by Kumar *et al.* (2017); Srinivas *et al.* (2017); Kerketta *et al.* (2018); Purad *et al.* (2019).

Fruit and pedicel length: The genotypes under study possessed a large amount of variability for this character. Fruit length of genotypes ranged from 2.60 to 13.80 cm with an average of 8.95 cm. The maximum value was recorded for Kashi Anmol (13.80 cm) and minimum value was recorded in IC-561635 (2.60 cm). The variation in chilli in fruit length was also reported by Kumari and Rajamony (2004); Chopra *et al.* (2005); Smitha and Basavaraja (2006); Dahal *et al.* (2008);

Table 2: Mean performance of chilli (*Capsicum annuum* L.) genotypes for various growth and yield attributing characters

S. No.	Genotypes	Plant height (cm)	Plant spread (cm)	No. of primary branches	Days to 50% flo-wering	Days to first fruit set	Fruit diameter (cm)	Fruit length (cm)	Pedicel length (cm)	No. of fruits per plant	Fruit weight (g)	Fruit yield per plant (g)	No. of seeds per fruit	Average dry fruit wt. (g)	Fruit yield/ ha (q)
1	LSVT-Red-1	73.10	44.20	5.40	62.00	58.00	1.60	12.00	5.00	34.00	10.26	348.26	74.53	2.16	128.96
2	LSVT-Red-2	74.26	47.03	5.50	62.03	58.26	1.50	12.03	4.60	32.16	9.90	318.13	73.43	2.13	117.73
3	LSVT-Red-3	74.06	42.10	5.60	62.06	57.83	1.56	12.03	4.80	36.00	9.26	332.40	74.26	2.16	123.03
4	Kashmiri Long -1	63.03	57.03	5.06	45.10	46.20	1.16	8.63	3.20	43.60	5.60	244.96	114.93	1.46	90.46
5	IC-561652	67.73	50.93	5.86	45.00	38.36	1.30	6.36	3.03	48.06	6.90	331.43	85.40	1.40	122.56
6	IC-561614	72.83	60.30	6.46	54.00	54.03	1.33	10.96	3.53	40.00	8.40	336.00	95.20	1.86	124.13
7	IC-561610	68.66	55.70	5.26	62.00	56.20	1.36	5.06	2.73	72.16	4.76	343.53	75.13	1.06	126.96
8	IC-561730	74.43	50.76	6.60	63.00	63.16	1.26	11.26	3.70	52.66	7.13	374.83	73.26	1.76	138.60
9	IC-561665	64.83	57.16	6.46	54.00	56.16	1.16	7.83	3.63	52.00	5.80	300.90	132.73	1.23	111.30
10	IC-572487	59.70	52.03	6.93	62.03	64.16	1.30	9.70	3.63	39.06	7.10	277.26	62.66	2.20	102.43
11	IC-561618	59.30	57.46	5.06	67.03	70.03	1.26	11.13	2.50	43.33	8.26	366.13	61.80	1.26	135.40
12	IC-561661	73.00	56.96	5.26	44.00	46.06	1.13	5.06	2.53	38.33	6.90	264.46	80.46	1.23	97.90
13	IC-561691	66.66	48.73	4.20	44.26	47.03	1.13	9.70	3.16	28.70	7.70	221.16	92.33	1.50	81.80
14	Kashi Anmol	66.20	63.86	5.73	66.00	72.06	1.20	13.80	4.06	100.50	7.46	750.10	96.93	1.86	277.60
15	IC-561657	49.30	49.53	3.66	56.00	63.16	1.23	5.90	3.00	40.06	3.40	136.46	62.86	0.86	50.33
16	CITH-HP-16	74.50	47.00	3.13	62.00	63.00	0.90	12.50	3.46	43.00	7.46	321.00	68.00	1.53	118.70
17	IC-561731	50.00	48.46	4.46	68.03	70.03	1.43	6.13	3.46	25.03	4.43	110.83	119.53	1.60	40.80
18	IC-561622	63.56	55.70	5.93	61.00	65.00	0.80	8.06	3.50	52.33	5.40	283.23	47.86	1.26	104.63
19	Sel-839-2	59.53	57.60	4.73	67.00	62.03	1.50	12.90	4.26	36.33	7.33	266.23	114.06	1.40	98.46
20	CITH-HP-111	67.46	52.30	4.06	56.03	62.06	1.10	10.83	3.56	26.03	7.83	203.60	70.26	1.20	75.50
21	Sel-917-111	69.63	54.06	4.73	64.03	70.00	1.00	12.00	3.16	37.03	6.20	229.46	101.26	1.96	84.76
22	CITH-HP-1154	53.00	51.46	5.33	70.00	66.00	1.20	9.83	2.76	34.10	6.86	233.70	74.53	1.83	86.23
23	IC-561635	57.60	49.00	4.13	57.20	60.83	1.10	7.13	2.53	30.03	4.73	141.06	87.86	1.10	52.06
24	IC-561635	51.90	52.66	8.00	52.00	54.00	1.40	2.60	2.66	40.00	3.66	143.96	54.20	0.86	53.16
25	IC-561639	56.96	33.50	5.66	68.00	65.03	1.20	7.43	3.66	31.20	7.00	219.03	22.93	0.76	80.93
26	Pusa Sadabahar	49.03	34.26	4.93	63.00	65.00	1.20	5.03	3.20	43.13	4.80	207.00	52.00	1.00	76.50
27	IC-561627	65.13	42.73	6.13	60.00	62.03	1.40	7.20	2.76	51.16	7.40	378.70	98.13	1.66	139.93

Table 2 contd....

S. No.	Genotypes	Plant height (cm)	Plant spread (cm)	No. of primary branches	Days to 50% flo-wering	Days to first fruit set	Fruit diameter (cm)	Fruit length (cm)	Pedicel length (cm)	No. of fruits per plant	Fruit weight (g)	Fruit yield per plant (g)	No. of seeds per fruit	Average dry fruit wt. (g)	Fruit yield/ ha (q)
28	SK-SC-1162	57.83	51.23	3.86	72.33	66.00	1.53	4.90	2.70	49.66	2.96	148.30	106.40	0.83	54.76
29	SKAU-078	74.20	54.13	5.40	74.00	65.16	1.20	10.43	3.86	61.46	4.50	276.60	120.40	1.90	102.30
30	VOBC-0289	58.20	46.13	4.73	74.26	67.16	2.56	9.26	3.53	29.70	15.03	445.86	139.46	2.70	165.03
31	Jawahar Mirch	58.66	54.00	5.00	73.26	69.83	1.20	4.56	3.23	35.20	4.33	152.26	58.20	1.00	56.10
32	Guchha Mirch	54.00	42.03	4.20	74.06	65.16	1.00	8.10	4.10	44.00	3.80	166.93	72.73	1.10	61.70
33	SK-SC-1161	67.53	50.60	4.46	75.00	65.00	1.80	6.26	2.90	46.86	5.50	257.70	104.80	1.56	95.13
34	Guchha Mirch-2	54.16	44.03	4.20	74.33	66.16	1.00	8.13	4.13	44.00	3.80	167.06	72.33	1.13	61.70
35	CITH-HP-17/13	60.63	52.73	6.06	75.00	62.16	1.00	10.53	3.00	56.03	4.16	229.66	83.80	1.50	84.86
36	ARCH-228	65.86	53.23	5.26	75.00	64.00	1.10	9.76	4.26	38.36	5.13	194.30	69.86	1.80	71.80
37	SKAU-084	64.20	47.03	5.60	65.00	62.16	1.13	12.53	3.26	54.00	7.20	388.26	69.26	2.06	143.66
38	G-4	54.33	46.13	3.80	77.00	67.00	1.23	7.80	3.60	51.50	5.60	288.23	81.20	1.06	106.63
39	CITH-HP-171/13	50.23	42.83	4.20	75.10	62.00	0.96	9.80	3.30	48.66	5.53	269.26	87.33	1.43	99.46
40	CITH-HP-22	61.56	37.33	3.33	78.03	72.00	1.33	11.86	3.23	34.13	6.40	218.13	116.86	1.73	80.56
41	Sel-680/11	61.83	39.93	3.06	74.00	70.16	1.33	12.73	3.46	43.73	7.43	325.06	93.80	1.60	120.06
42	CITH-HP-71/13	56.93	43.66	4.26	77.23	70.00	1.23	11.66	3.80	47.60	5.40	253.80	97.13	1.10	93.66
43	SKAU-089	44.26	28.26	3.60	76.00	72.83	0.83	13.06	3.40	45.60	3.76	171.83	92.23	1.40	63.40
44	CITH-HP-1154-1/13	55.70	45.80	6.53	75.03	67.00	1.10	7.00	3.86	42.60	5.06	214.40	98.66	1.66	79.33
45	SKAU-092	72.26	46.16	5.60	74.10	68.66	0.50	7.23	4.96	43.66	2.60	113.53	97.33	2.33	71.80
46	SKAU-096	52.40	34.00	2.80	78.20	70.00	1.26	6.93	3.83	39.93	4.56	181.06	107.66	1.60	66.86
47	Goa-sel-1	42.26	24.03	3.60	74.00	71.20	1.10	7.33	3.43	45.46	4.26	192.46	42.23	0.90	71.03
48	Bhut Jolokia	94.06	48.16	6.23	80.00	73.66	2.60	6.70	3.03	10.16	6.00	68.43	52.00	2.83	25.23
	CD ($P \leq 0.05$)	2.0728	1.507	0.378	3.09	2.94	0.088	0.320	0.1539	2.681	0.459	17.69	1.22	0.36	6.55

Chattopadhyay *et al.* (2011); Dhaliwal *et al.* (2014); Rohini and Lakshmanan (2014); Vijaya *et al.* (2014); Kumari *et al.* (2017); Srinivas *et al.* (2017); Kerketta *et al.* (2018); Purad *et al.* (2019).

Fruit pedicel length showed considerable variation from 2.50 to 5.00 cm with an average of 3.48 cm. LSVT-Red-1 recorded maximum value of (5.00 cm) and the lowest value was observed in IC-561618 (2.50 cm). The results were in accordance with Srinivas *et al.* (2017).

Number of fruits per plant: It is an important yield contributing character. Average number of fruits per plant ranged from 10.16 to 100.50 with an overall mean of 42.98. Maximum number of fruits per plant was recorded in Kashi Anmol (100.50) and minimum number of fruits were recorded in Bhut Jolokia (10.16). Such variation in chilli genotypes for number of fruits per plant was also noticed by Kumari and Rajamony (2004); Smitha and Basavaraja (2006); Sandeep *et al.* (2008); Tembhurne *et al.* (2008); Ajjapplavana and Goudra (2009); Pramila *et al.* (2009); Chattopadhyay *et al.* (2011); Kumari *et al.* (2017); Srinivas *et al.* (2017); Purad *et al.* (2019).

Average fruit weight: In present investigation average fruit weight showed the considerable variation from 2.60 to 15.03 g with an overall mean of 6.14 g. Maximum weight was recorded in VOBC-0289 (15.03 g) and SKAU-092 recorded minimum fruit weight (2.60 g). The results were in accordance with findings of Gupta *et al.* (2009); Amit *et al.* (2014); Kumari *et al.* (2017); Srinivas *et al.* (2017); Arya *et al.* (2018); Kerketta *et al.* (2018); Srinivas *et al.* (2017); Nagaraju *et al.* (2018); Purad *et al.* (2019).

Fruit yield per plant: Fruit yield per plant ranged from 68.43 to 550.10 g with an average mean of 258.48 g. The maximum fruit yield was recorded in Kashi Anmol (550.10 g) and Bhut Jolokia showed minimum fruit yield (68.43 g). Such variation in chilli genotypes for fruit yield per plant was observed by Tembhurne *et al.* (2008); Chaudhary *et al.* (2013); Chattopadhyay *et al.* (2011); Amit *et al.* (2014); Jaisankar *et al.* (2015); Srinivas *et al.* (2017); Kumari *et al.* (2017); Kerketta *et al.* (2018); Arya *et al.* (2018); Nagaraju *et al.* (2018); Purad *et al.* (2019).

Number of seeds per fruit: The maximum number of seeds was recorded in VOBC-0289 (139.46) followed by IC-561665 (132.73) and SKAU-078 (120.40). The minimum number of seeds were observed in IC-561639 (22.93). Similar results on variability in number of seeds per fruits have also been reported by Shirshat *et al.* (2007); Arup *et al.* (2011); Kumari *et al.* (2017); Kerketta *et al.* (2018); Natesh *et al.* (2005) from 78.3 to 85.7, Ravihunje *et al.* (2007) from 70.99 to 80.57, Farhad *et al.* (2008) from 37.97 to 114.00, Pandit and Adhikary (2014) from 32.51 to 110.84 and Amit *et al.* (2014) from 40.24 to 113.85 and Arya *et al.* (2018).

Average dry fruit weight: With over all mean of 83.96, the number of seeds per fruit ranged from 22.93 to 139.46. The maximum dry fruit weight was observed in Bhut Jolokia (2.83 g) and the minimum dry fruit weight was observed in IC-561639 (0.76 g). Similar results were also reported by Kumari *et al.* (2017).

Fruit yield per hectare (q/ha): Fruit yield per hectare ranged from 25.23 to 277.60 q/ha with an average mean of 95.54 q/ha. The maximum yield per hectare was observed in Kashi Anmol (277.60 q) and the lowest yield was found in Bhut Jolokia (25.23 q). Similar results were also reported by Kumari *et al.* (2017); Mishra *et al.* (2009) and Kerketta *et al.* (2018).

CONCLUSION

From the present study the analysis of variance showed significant amount of variability for all the characters. Also based on the overall performance certain genotypes exhibited superior performance for some economically important traits. Bhut Jolokia was superior for plant height, fruit diameter and average dry fruit weight. Kashi Anmol was found to be superior for plant spread, fruit length, number of fruits per plant, fruit yield per plant and fruit yield per hectare. VOBC-0289 was found to be superior for average fruit weight and number of seeds per fruit. The genotype with diverse characteristics could be used in a well-planned hybridization programme to select superior performing lines in the successive segregating lines.

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Development of Strategies for Effective Implementation of *Sansad Adarsh Gram Yojana*

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ABSTRACT

Sansad Adarsh Gram Yojana, the ambitious rural development program of Central Government of India was launched in 2014. Since its inception, there have been much hype about the unique characteristic of this program which involves adoption of villages by Members of Parliaments and transforming them into *Adarsh Gram* or Model Villages. It was a matter of interest to find out the status of implementation of the program and if any lacunae, developing strategies for its effective implementation. The strategies were grouped into four broad domains each having domain specific strategies under them. The four broad domains identified were convergence in identification of need, planning, technical expertise and funding. The broad domains were also ranked as well as the sub-domains within them based on average weight (W) calculated by adopting Alfares and Duffuaa method (2009). The strategy of convergence in funding (W=85.25) was ranked first as it obtained highest average weight thus suggesting its highest priority in the domain of convergence in identification of need. The strategy of convergence in planning (W=82.31) was deemed to be second most important. The strategy of convergence in technical expertise was third most important (W=81.04). The strategy of convergence in identification of was ranked fourth (W=75.99). This was because the main lacuna in effective implementation of SAGY at ground level was the shortage of fund because no separate funding was allotted to this program. It required convergence of existing development programs which was reported as the major constraint.

Keywords: Alfares and Duffaa method, Convergence, Effective implementation, Funding, *Sansad Adarsh Gram Yojana*, Strategies

INTRODUCTION

Villages have been the fundamental units of human civilization since time immemorial. Though development programs and technological advancements have brought about transformations in rural India but still 75 per cent of the poor reside in rural areas and struggle in a social setup of poor infrastructure, healthcare and economic system. In order to ameliorate such conditions, both government and non-government agencies undertake number of interventions to develop the villages. In India 68.84 per cent of the population lives in 640867 villages (Census of India, 2011) and rural development features as one of the top national development agendas. So, to take a step towards rural sustainability, Government of India on 11th October, 2014 rolled out an ambitious program named as *Sansad Adarsh Gram Yojana* (SAGY) for transforming villages into progressive or Model Villages. In this program, each Member of Parliament has to adopt a village and strive to transform it into a Model Village (http://saanjhi.gov.in/) by undertaking all interventions of health, education, infrastructure, sanitation, hygiene, livelihood and social aspects of human development in that village (Govt. of India, 2014). It was a matter of interest to find out the status of implementation of the program and if any lacunae,

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developing strategies for its effective implementation. Hence the following study was undertaken.

MATERIALS AND METHODS

Locale of study: The study was conducted in the purposively selected states of Maharashtra and Telangana. Maharashtra and Telangana share similar agro-ecological conditions. As according to the Indian Council of Agricultural Research agro-ecological zone classifications, Maharashtra is part of the semi-arid region of Deccan plateau while Telangana belongs to semi-arid region of Northern Telangana plateau (http://www.crida.in/cp-2012/). From each state two villages adopted under SAGY since 2014 were randomly selected from the list of SAGY villages. Malunja Budruk in Shrirampur block of Ahmednagar district and Tikekarwadi in Junnar block of Pune district were selected from Maharashtra. Likewise, Inovolu in Wardhannapet block of Warangal district and Dandepally in Kamalapuram block of Warangal Urban (earlier Karimnagar) district were selected from Telangana.

Sampling: Fifteen officials were randomly enquired from each of the two states. The officials were permanent employees of officer rank working in various development departments of the state and involved with implementation of government programs.

Methodology: The strategies to promote convergence amongst development departments involved in implementation of SAGY were identified through review of literature and experts' opinion. Then the identified strategies were ranked through interview schedule from 30 officials of various line departments of the two states using Alfares and Duffuaa (2009) methodology which is based on linear rank-weight linear function whose slope (Sn) depends on the number of criteria (n). This linear relationship specifies the average weight for each rank (r) for an individual judge (m), assuming a weight of 100 per cent for the first-ranked (most important) factor. To determine criteria weight even from single judge is difficult as it is difficult to assign relative weights to different decision criteria. Naturally, it becomes more tedious to obtain criteria weights from several decision makers. Quite often, judges are much more comfortable in simply assigning ordinal ranks to the different criteria under consideration. Thus, the beauty of Alfares and Duffuaa method is to convert the criteria rank given by judges into relative criteria weights, in addition, assigning 100 per cent to rank 1 and subsequently as the rank decreases the percentage will decrease.

In present study to determine aggregate criteria weights of each dimensions or statement, the 30officials ranked the statements within each dimension as well as each dimension. Thus, after obtaining aggregate weights, one can identify the important aspect of strategy development to promote value chain.

$$Sn = 3.19514 + \frac{37.75756}{n}$$

$$Wrn = 100 - Sn(r-1)$$

Where, n = number of criteria
R = rank assign to statement or criteria
Wrn = weight assign to criteria based on individual rank
W = aggregate weight of respondent

RESULTS AND DISCUSSION

As shown in Table 1, the convergence strategies were grouped into four broad domains each having domain specific strategies under them. The four broad domains identified were convergence in identification of need, planning, technical expertise and funding. The broad domains were also ranked as well as the sub-domains within them based on average weight (W) calculated by adopting Alfares and Duffuaa method (2009). The sub-domain weightages were calculated as follows.

As in Table 2, by Alfares method the strategies under the broad domain of convergence in identification of need were ranked according to their average weights. The aggregate weights (W) were calculated for each strategy assuming 100% weight for rank-1 (Wrn). The aggregate weights were reduced to average weights to rank the strategies. The strategy of all the development departments collaborating to identify specific needs in their rural area of operation (W=84.83) was ranked first as it obtained highest average weight thus suggesting its highest priority in the domain of convergence in identification of need. The strategy of block level extension functionaries, experts from KVK or nearby SAUs or research institutes facilitating the process of assessment of needs

Table 1: Devising strategy through Alfaresand Duffuaa (2009) method to promote convergence

S. No.	Strategies	Average Weight (W)	Rank
A.	***Convergence in Identification of Need***		
a)	All the development departments should collaborate to identify specific needs in their rural area of operation	84.83	I
b)	Identification of development needs should involve officials of all major development departments as well as villagers	81.04	III
c)	Block level officials and *Panchayat* members should facilitate the identification process	75.99	IV
d)	Block level extension functionaries, experts from KVK or nearby SAUs or research institutes should facilitate the process of assessment of needs in a scientific way through FGDs or PRA tools	82.31	II
B.	***Convergence in Planning***		
a)	Development of small scale convergence projects at block level is essential according to identified needs.	86.84	I
b)	BDO can facilitate chalking out plans for convergence projects	85.79	II
c)	Planning should be participatory, involving village leaders or villagers as a whole in area of operation	78.95	III
C.	***Convergence in Technical Expertise***		
a)	Technical knowledge exchange should be there among officials of major development departments	85.27	II
b)	Officials of each department should hold meetings to discuss the progress of convergence projects and solve the problems related to	79.48	III
c)	Conducting trainings at regular intervals for developing multidisciplinary capacities of development officials	87.90	I
D.	***Convergence in Funding***		
a)	Funds should be allotted to all the concerned departments for development work in their area of operation	88.9533	I
b)	All concerned agencies can contribute to the cost of convergence projects	86.32314	II
c)	Private welfare agencies and NGOs should come together to develop P-P-P Model of working	77.38058	III

Table 2: Ranking of strategies required for bringing about convergence in identification of need

Rank	a	b	c	d	Wrn
1	12	7	6	5	100
2	6	5	5	14	87.36547
3	6	14	5	5	74.73094
4	6	4	14	6	62.09641
f	30	30	30	30	
1/f	0.033333	0.033333	0.033333	0.033333	
Aggregate wt	2545.157	2431.446	2279.832	2469.35	
Average wt (W)	84.83856	81.04821	75.99439	82.31166	
Rank	1st	3rd	4th	2nd	

Wrn= Weight as per rank

Table 3: Ranking of strategies required for bringing about convergence in planning

Rank	a	b	c	Wrn
1	13	8	8	100
2	9	17	4	84.21901
3	8	5	18	68.43801
f	30	30	30	
1/f	0.033333	0.033333	0.033333	
Aggregate wt	2605.475	2573.913	2368.76	
Average wt (W)	86.84917	85.79711	78.95868	
Rank	1st	2nd	3rd	

Wrn= Weight as per rank

in a scientific way through FGDs or PRA tools (W=82.31) was deemed to be second most important. The strategy of involving officials of all major development departments as well as villagers in identification of development needs was third most important (W=81.04). The strategy of block level officials and *Panchayat* members facilitating the identification process was ranked fourth (W=75.99).

As in Table 3, by Alfares method the strategies under the broad domain of convergence in planning were ranked according to their average weights. The aggregate weights (W) were calculated for each strategy assuming 100% weight for rank-1 (Wrn). The aggregate weights were reduced to average weights to rank the strategies. The strategy of development of small scale convergence projects at block level according to identified needs (W=86.84) was ranked first as it obtained highest average weight thus suggesting its highest priority in the domain of convergence in planning. The strategy of BDO facilitating chalking out of plans for convergence projects (W=85.79) was deemed to be second most important. The strategy of participatory planning involving village leaders or villagers as a whole in area of operation (W=81.04) was ranked third.

As in Table 4, by Alfares method the strategies under the broad domain of convergence in identification of need were ranked according to their average weights. The aggregate weights (W) were calculated for each strategy assuming 100% weight for rank-1 (Wrn). The aggregate weights were reduced to average weights to rank the strategies. The strategy of conducting trainings at regular intervals for developing multidisciplinary capacities of development officials (W=87.90) was ranked first as it obtained highest average weight thus suggesting its highest priority in the domain of convergence in technical expertise. The strategy of exchanging technical knowledge among officials of major development departments (W=85.27) was deemed to be second most important. The strategy of officials of each department holding meetings to discuss the progress of convergence projects and solve related problems (W=79.48) as deemed to be the third most important strategy.

Table 4: Ranking of strategies required for bringing about convergence in technical expertise

Rank	a	b	c	Wrn
1	8	6	16	100
2	16	9	5	84.21901
3	6	15	9	68.43801
f	30	30	30	
1/f	0.033333	0.033333	0.033333	
Aggregate wt	2558.132	2384.541	2637.037	
Average wt (W)	85.27107	79.48471	87.90124	
Rank	2nd	3rd	1st	

Table 5: Ranking of strategies required for bringing about convergence in funding

Rank	a	b	c	Wrn
1	16	8	6	100
2	7	18	5	84.21901
3	7	4	19	68.43801
f	30	30	30	
1/f	0.033333	0.033333	0.033333	
Aggregate wt	2668.599	2589.694	2321.417	
Average wt (W)	88.9533	86.32314	77.38058	
Rank	1st	2nd	3rd	

Table 6: Ranking of strategies required for bringing about convergence in implementation of SAGY

Rank	CIN	CP	CT	CF	Wrn
1	5	5	5	15	100
2	6	16	4	4	87.36547
3	6	5	17	2	74.73094
4	13	4	4	9	62.09641
f	30	30	30	30	
Aggregate wt	2279.832	2519.888	2368.274	2557.791	
Average wt (W)	75.99439	83.99626	78.94245	85.25972	
Rank	4th	2nd	3rd	1st	

Wrn= Weight as per rank

As evident in Table 5, by Alfares method the strategies under the broad domain of convergence in identification of need were ranked according to their average weights. The aggregate weights (W) were calculated for each strategy assuming 100% weight for rank-1 (Wrn). The aggregate weights were reduced to average weights to rank the strategies. The strategy of allotting funds to all the concerned departments for development work in their area of operation (W=88.95) was ranked first as it obtained highest average weight thus suggesting its highest priority in the domain of convergence in identification of need. The strategy of all concerned agencies contributing to the cost of convergence projects (W=86.32) was deemed to be second most important. The strategy of private welfare agencies and NGOs coming together to develop P-P-P model of working was ranked as third most important strategy (W=81.04).

The broad domains of strategies for effective convergence were ranked as in Table 6, by Alfares method according to their average weights. The aggregate weights (W) were calculated for each strategy assuming 100% weight for rank-1 (Wrn). The aggregate weights were reduced to average weights to rank the strategies. The strategy of convergence in funding (W=85.25) was ranked first as it obtained highest average weight thus suggesting its highest priority in the domain of convergence in identification of need. The strategy of convergence in planning (W=82.31) was deemed to be second most important. The strategy of convergence in technical expertise was third most important (W=81.04). The strategy of convergence in identification of was ranked fourth (W=75.99). This was because the main lacuna in effective implementation of SAGY at ground level was the shortage of fund because no separate funding was allotted to this program. It required convergence of existing development programs which was reported as the major constraint. Hence officials felt that convergence in funding was utmost required followed by strategies needed for planning and technical expertise. As identification of need was already being done in this program hence its need was not that much felt by officials.

CONCLUSION

Proper implementation of any development program requires delineation of certain strategies which if are suggested by stakeholders of the program, then prove to be more useful to policymakers. For proper implementation of SAGY, convergence of all development departments is essential especially for funding.

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Resource Use Level and Yield Gap in Sugarcane Cultivation in Maharashtra: An Empirical Study

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ABSTRACT

This study has estimated the gaps in input use and yield of sugarcane in the state of Maharashtra. Different sugarcane types, viz. *ratoon*, *suru* and *adsali* which are grown in the states were considered and the shortfall in yield at demonstration plots from potential yield and at farmers' field from demonstration plots were considered as yield gap I & II. The per hectare yield gap I and II at the state level for the sugarcane ranged from 23.26 to 26.42 per cent and 12.42 to 25.42 per cent, while the total yield gap ranged from 32.79 to 45.12 per cent. The gaps in input use like excess use of nitrogen and manure, use of human labour and machineries, spacing practices, etc. were traced out to be the causes of yield gaps in different regions of Maharashtra. The paper suggested to adopt optimal practices and inputs usage at farmer's level to bridge the gaps in different regions of Maharashtra.

Keywords: *Adsali*, Jaggrey, *Ratoon*, *Suru*, Yield gap

INTRODUCTION

Sugarcane, the most prominent and ancient source of sugar used by mankind and one of the most important cash crops in the World and in Maharashtra economy as well. India is the largest producer of sugarcane in the world and stands next to Brazil in terms of production. In India Uttar Pradesh stands first followed by Maharashtra in terms of sugarcane production. In the 2019-20 crop year, global sugar production was approximately 166.18 million tons and approximately 80 per cent of the world's sugar is produced from sugar cane in tropical and subtropical climates (Statista, 2020). Sugar mills across India have produced 274 lakh tons of sugar during 2019-20 and Maharashtra alone produced 26 lakh tons, which is second after Uttar Pradesh with 44 lakh tons (The Indian Express, 2021). The sugarcane cultivation area is broadly classified into Tropical and Sub-tropical regions. The tropical region constitutes mainly the southern states of Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh. Despite having lesser area i.e. 42 per cent of the total area under sugarcane, the tropical region contributes higher i.e. 51 per cent of country's sugarcane production as the longer duration crop and favorable climatic condition causes higher productivity and better sugar recovery (GOI, 2016). In case of sugarcane cultivation, Maharashtra state has first position in terms of area (8.22 lakh hectare), second in production (69.31 million tonnes) and fifth in sugarcane productivity (84.28 t/ha) during the year 2019-20 (GoI, 2021). Contribution of sugarcane to the national GDP is 1.1 per cent which is significant considering that the crop is grown only in 2.57 per cent of the gross cropped area (Solomon, 2016). Therefore, sugarcane occupies a pivotal place on the economic map of the country and Maharashtra as well, efforts are needed to increase the productivity of sugarcane to develop the economy of the state. This can be achieved by adopting new sugarcane production technologies like balanced use of fertilizers, manures, micronutrients, weedicides, use of improved methods of irrigation and planting of sugarcane, etc.

Although, there is increase in the area and production of sugarcane, the productivity shows

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declining trend during the last two decades. The productivity of the crop primarily depends on the extent of levels of resource use and total management of the crop. The inputs such as labour, seed, manures, fertilizers, irrigation and inter-culturing operations are the major factors responsible for variation in yield of the crop. Most of the sugarcane growers are not using the recommended levels of the inputs, so, there exists a gap between the recommended and actual use levels of inputs. This leads to a gap between potential yield and actual yield level of sugarcane. Therefore, in order to bridge the gaps, it is necessary to quantify the gap and identify the factors influencing it.

MATERIALS AND METHODS

Sample and data: The study was based on the primary data collected from 570 farm families under the Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops from Western Maharashtra, Marathwada and Vidarbha regions of the State. On the basis of operational holdings, 31 *adsali* sugarcane growers, 76 pre-seasonal sugarcane growers and 54 *ratoon* sugarcane growers were selected by the three-stage stratified random sampling technique. The Konkan region of the State is not included in the study for both cash crops and Vidharba for sugarcane crop as these are having very negligible sample of cash crop growers. The number and size of plot of *suru* sugarcane growers is very less and negligible, so it was treated as pre-seasonal sugarcane. The data on entire cultivation practices along with input use and output, marketing, etc. were collected by primary survey from the selected respondents pertained to the agricultural year 2010-2011.

Analytical tools

1): Yield gap: The differentials between the recommended and actual use levels of important sources like seed, manure and fertilizers have been estimated. The two yield gaps (I & II) were calculated on the basis of per hectare potential yield, potential farm yield and actual yield obtained. The yield gaps were estimated by using the methodology developed by International Rice Research Institute (IRRI), Manila, Philippines (De Datta, 1981). The methodologies for estimation of different types of yield gaps are,

$$\text{Yield Gap-I} = Yp - Yd$$

Where, Yp = Potential yield (Yield realized at Research Station)

Yd = Potential farm yield (Yield realized on demonstration plots)

$$\text{Yield Gap-II} = Yd - Ya$$

Where, Yd = Potential farm yield (Yield realized on demonstration plots)

Ya = Actual yield (Yield realized on sample farms)

2) Production function analysis: The multiple linear regression equation used for estimating the numerical values of parameters of various independent variables influencing the yield gap as:

$$Yg = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + ut$$

Where, Yg = Yield gap (q/ha) (potential yield- actual yield)

a = Intercept

bi's = Regression coefficients of respective resource variables

X_1 = Human labour (man-days/ha),

X_2 = Bullock power (pair-days/ha),

X_3 = Machine power (hrs/ha),

X_4 = Nitrogen (kg/ha),

X_5 = Phosphorus (kg/ha),

X_6 = Potash (kg/ha)

X_7 = Manures (q/ha),

X_8 = Planting material / seed (kg/ha),

X_9 = Insecticide and pesticides charges (Rs./ha),

e_u = Error term

The significance of each of the co-efficient of the variables from the estimated functions were tested with the help of 't' statistics.

RESULTS AND DISCUSSION

The profitability of the farm business can be decided from relationship between costs incurred and returns obtained. The cost structure depends upon the type of resource employed, the resource mix and the extent of application. The resource use in sugarcane cultivation on per hectare basis is presented in Table 1.

Table 1: Resource use pattern of sugarcane (per ha)

Crop	Region	Human Labour (man-days)	Bullock Labour (pair -days)	Machine Labour (hrs)	Seed (kg)	Manure (q)	Fertilizers (kg)			Productivity (q)
							N	P	K	
Adsali sugarcane	Western Maharashtra	411.23	3.72	37.44	5604	67.86	456.65	346.98	239.10	1250.78
	Maharashtra	**411.23**	**3.72**	**37.44**	**5604**	**67.86**	**456.65**	**346.98**	**239.10**	**1250.78**
Pre-seasonal sugarcane	Western Maharashtra	344.48	15.67	28.26	5501	36.80	345.30	196.13	217.46	1004.23
	Marathwada	263.31	17.54	10.85	8967	8.99	243.56	170.07	89.04	636.55
	Maharashtra	**355.75**	**17.09**	**27.42**	**6463**	**34.85**	**353.25**	**205.66**	**211.90**	**1015.56**
Ratoon sugarcane	Western Maharashtra	324.60	5.39	14.93	000	2.94	305.71	180.15	227.72	876.12
	Marathwada	139.77	6.47	11.03	000	8.31	170.86	122.36	89.11	568.89
	Maharashtra	**304.46**	**5.50**	**14.50**	**000**	**3.52**	**291.02**	**173.85**	**212.62**	**842.64**

i) Adsali sugarcane: It is observed from table that the Western Maharashtra region of the state has more area under *Adsali* plantation. The per hectare use of human labour, bullock labour, machine labour, planting material (sugarcane sets), manure, nitrogen, phosphorus and potash was estimated to be 411.23-man days, 3.72 pair-days, 37.44 hrs, 56.04 q, 67.86 q, 456.65 kg, 346.98 kg and 239.10 kg, respectively.

ii) Pre-seasonal sugarcane: The average per hectare use of human labour was 344.48 and 263.31 man-days in Western Maharashtra and Marathwada region, respectively with an average use of 355.75 man-days at the state level. The average per hectare use of bullock and machine labour was maximum in Western Maharashtra as 15.67 pair-days and 28.26 hrs, respectively. The average per hectare use of planting material (sugarcane sets) was observed to be 64.63 q at the state level. The average use of manures in state was 34.85 q/ha and it was maximum to the extent of 36.80 q/ha in Western Maharashtra region. The per hectare average use of nitrogen, phosphorus and potash fertilizer were observed to be 353.25, 205.66 and 211.90 kg, respectively. It was also observed that few inputs used at greater level in case of pre-seasonal sugarcane types than other except human labour and fertilizer. The highest productivity (1004.23 q/ha) was observed in Western Maharashtra as compared to Marathwada (636.55 q/ha) with an average of 1015.56 q/ha at state level.

iii) Ratoon sugarcane: The average per hectare use of human labour and bullock labour at the state level was 304.46 man-days and 5.50 pair-days, respectively, while the maximum use of human labour and machine power were to the extent of 324.60 man-days and 14.93 hrs/ha in Western Maharashtra region. As regards to the per hectare use of nitrogen, phosphorus and potash were 291.02, 173.85 and 212.62 kg, respectively, with an average productivity of 842.64 q/ha, at the state level. It is important to note that, use of manure is not recommended for ratoon sugarcane in all regions, but the farmer still used it.

Input use gap: The per hectare gap between recommended and actual use levels of major inputs like seed, manures and fertilizers ingredients such as nitrogen, phosphorous and potash for sugarcane in different regions of the state is depicted in Table 2.

Table 2: Input use level and their gap from recommended dose in sugarcane (per ha)

Crop	Region	Particulars	Seed (kg)	Manure (q)	Fertilizers N (kg)	P (kg)	K (kg)
Adsali Sugarcane	Western Maharashtra	Recommended	5000	300	500	200	200
		Actual	5604	67.86	456.65	346.98	239.10
		Gap	-604	232.14	43.35	-146.98	-39.10
		Per cent gap	12.08	77.38	8.67	73.49	19.55
Pre-seasonal Sugarcane	Western Maharashtra	Recommended	5000	250	400	200	200
		Actual	5501	36.80	345.30	196.13	217.46
		Gap	-501	213.20	54.70	3.87	-17.46
		Per cent gap	10.02	84.08	13.63	1.94	8.73
	Marathwada	Recommended	5200	65.00	300.00	170.00	170.00
		Actual	8967	8.99	243.56	170.07	89.04
		Gap	-3967	56.01	56.44	-0.07	80.96
		Per cent gap	79.34	86.16	18.81	0.04	47.62
Ratoon Sugarcane	Western Maharashtra	Recommended	—	—	300	150	150
		Actual	—	2.94	305.71	180.15	227.72
		Gap	0.00	-2.94	-5.71	-30.15	-77.72
		Per cent gap	0.00	2.94	1.90	20.10	51.81
	Marathwada	Recommended	—	—	250	115	115
		Actual	—	8.31	170.86	122.36	89.11
		Gap	0.00	-8.31	79.14	-7.36	25.86
		Per cent gap	0.00	8.31	31.66	6.40	22.51

Note: Negative sign indicates excess use of inputs.

i) Adsali sugarcane: The excess use of planting material (sugarcane sets) was observed in Western Maharashtra (12.08%), while the gap in manure and nitrogen used was 77.38 and 8.67 per cent, respectively. However, the excess use of phosphorus (73.49%) and potash (19.55%) was observed in Western Maharashtra.

ii) Pre-seasonal sugarcane: It is revealed from the table that there was an excess use of planting material in Marathwada region (79.34%), which was due to traditional planting method. In case of manure use, gap in recommended and actual level was maximum in Marathwada (86.16%) as compared to Western Maharashtra region (84.08%). The gap in the use of nitrogen and phosphorus was observed to the extent of 13.63 and 1.94 per cent and the excess use of potash (8.73%) was observed in Western Maharashtra.

iii) Ratoon sugarcane: Though the use of manure is not recommended for ratoon sugarcane, farmers have used it to the tune of 2.94 and 8.31 q/ha. The excess use of nitrogen (1.90%), phosphorus (20.10%) and potash (51.81%) were observed in Western Maharashtra region. The gap in use of nitrogen (31.06%) and excess use of phosphorus (6.40%) fertilizer were observed in Marathwada region.

Estimated yield gaps in sugarcane: The information on yield performance of sugarcane and yield gaps in different regions of the state is presented in Table 3.

It can be observed from the table that the per hectare potential yield at state level for *adsali*, pre-seasonal and ratoon sugarcane were 2020, 1495 and 1075 q/ha, respectively, while the potential farm yields of these planting types were 1540, 1100 and 825 q/ha, respectively. However, per hectare actual farm yield for these planting types were 1250.78, 820.39 and 722.51 q/ha, respectively, at the state level. Therefore, in the case of *adsali* sugarcane, total yield gap of 42.54 per cent was estimated, out of which yield gap I & II were 23.76 and 18.78 per cent, respectively.

Table 3: Yield details and estimated yield gaps in sugarcane in different regions of Maharashtra

S.No.	Particulars	***Adsali* sugarcane**		**Pre-seasonal sugarcane**		**Ratoon sugarcane**	
		Qty. (q/ha)	**Per cent**	**Qty. (q/ha)**	**Per cent**	**Qty. (q/ha)**	**Per cent**
1	**Potential yield**						
	W. Maharashtra	2020.00	—	1740.00	—	1150.00	—
	Marathwada	—	—	1250.00	—	1000.00	—
	Vidarbha	—	—	—	—	—	—
	Maharashtra	2020.00	—	1495.00	—	1075.00	—
2	**Potential farm yield**						
	W. Maharashtra	1540.00	—	1050.00	—	1000.00	—
	Marathwada	—	—	1150.00	—	650.00	—
	Vidarbha	—	—	—	—	—	—
	Maharashtra	1540.00	—	1100.00	—	825.00	—
3	**Actual yield**						
	W. Maharashtra	1250.78	—	1004.23	—	876.12	—
	Marathwada	—	—	636.55	—	568.89	—
	Vidarbha	—	—	—	—	—	—
	Maharashtra	1250.78	—	820.39	—	722.51	—
4	**Yield Gap – I**						
	W. Maharashtra	480.00	23.76	690.00	39.66	150.00	13.04
	Marathwada	—	—	100.00	8.00	350.00	35.00
	Vidarbha	—	—	—	—	—	—
	Maharashtra	480.00	23.76	395.00	26.42	250.00	23.26
5	**Yield Gap – II**						
	W. Maharashtra	289.22	18.78	45.77	4.36	123.88	12.39
	Marathwada	—	—	513.45	44.65	81.11	12.48
	Vidarbha	—	—	—	—	—	—
	Maharashtra	289.22	18.78	279.61	25.42	102.5	12.42
6	**Total, Yield Gap**						
	W. Maharashtra	769.22	42.54	735.77	44.02	273.88	25.43
	Marathwada	—	—	613.45	45.65	431.11	47.47
	Vidarbha	—	—	—	—	—	—
	Maharashtra	769.22	42.54	674.61	45.12	352.50	32.79

The per hectare total yield difference in pre-seasonal sugarcane was observed to be 45.12 per cent at the state level, of which yield gap I was 26.42 per cent and yield gap II was 25.42 per cent. The region wise analysis shows that the highest gap in yield was 45.65 per cent in Marathwada followed by Maharashtra (44.02%). Among the regions, the yield gap I & II was maximum in Western Maharashtra (39.66%) and Marathwada (44.65%), respectively. The total yield gap in case of ratoon sugarcane was observed to be 32.79 per cent at the state level, out of which yield gap I was 23.26 per cent and yield gap II was 12.42 per cent. As regards to regionwise analysis, the maximum total yield gap was observed in Marathwada region (47.48%). The maximum yield gap I & II was observed in Marathwada region (35.00% and 12.48%).

Factors affecting yield gap of sugarcane: In order to find out the factors affecting the yield gap, it was regressed against the inputs. The estimated parameters of production functions fitted region wise for three planting types of sugarcane i.e. *adsali,* pre-seasonal and ratoon types are presented in Table 4.

Table 4: Results of estimated regression analysis of sugarcane

Particulars	*Variables*	*Adsali* sugarcane	Pre-seasonal sugarcane			Ratoon sugarcane		
		Western Maharashtra	Western Maharashtra	Marathwada	Maharashtra	Western Maharashtra	Marathwada	Maharashtra
Constant		1803.80	985.08	905.06	765.06	365.97	963.33	773.63
Human labour (days)	X_1	-1.71^{***} (0.55)	-0.27^{NS} (0.27)	-2.20^{NS} (1.36)	-0.48^{NS} (0.27)	-0.00^{NS} (0.03)	-3.96^{*} (2.05)	-1.67^{***} (0.25)
Bullock labour (pair days)	X_2	14.70^{NS} (18.49)	-0.02^{NS} (0.32)	4.06^{NS} (9.17)	-0.02^{NS} (0.33)	-8.37^{NS} (4.56)	-9.68^{NS} (15.81)	-6.08^{NS} (3.79)
Machine labour (hrs)	X_3	-18.81^{***} (3.3650)	-2.62^{**} (1.21)	-5.96^{NS} (3.79)	-3.22^{***} (1.21)	-7.25^{***} (1.23)	-3.31^{NS} (5.08)	-6.36^{***} (1.07)
Nitrogen (kg)	X_4	-0.27^{**} (0.13)	-0.28^{***} (0.10)	-1.02^{***} (0.19)	-0.35^{**} (0.1615)	0.08^{NS} (0.21)	-2.56^{**} (1.02)	0.12^{NS} (0.19)
Phosphorus (kg)	X_5	0.40^{NS} (0.45)	-0.23^{*} (0.12)	1.26^{NS} (1.23)	0.20^{NS} (0.27)	0.30^{NS} (0.28)	0.29^{NS} (1.64)	0.21^{NS} (0.24)
Potash (kg)	X_6	0.73^{NS} (0.47)	0.11^{NS} (0.20)	-1.29^{***} (0.32)	-0.22^{**} (0.10)	0.22^{NS} (0.19)	-2.88^{**} (1.36)	0.12^{NS} (0.17)
Manures (q)	X_7	-0.69^{***} (0.18)	0.46^{***} (0.15)	-4.25^{*} (2.17)	-0.42^{***} (0.16)	2.29^{NS} (1. 96)	2.72^{NS} (2.79)	1.60^{NS} (1.20)
Seed (kg)	X_8	1.65^{NS} (5.20)	1.07^{NS} (1.18)	3.34^{NS} (3.38)	1.23^{NS} (1.08)	..	..	—
R^2		0.66	0.70	0.55	0.68	0.68	0.71	0.76

***, **, * indicates the levels of significance at 1, 5 and 10 per cent respectively, NS = Non-significant
Figures in the parenthesis are the standard errors of respective regression coefficients.

i) Adsali sugarcane: The results of the estimated production function analysis at state level indicated that the selected eight independent variables have jointly explained 66 per cent variation in the yield gap of sugarcane. The regression coefficients of human labour (X_1), machine power (X_3) and manures (X_7) were highly negatively significant, while nitrogen fertilizer (X_4) was found negatively significant at 5 per cent level. These negative and significant coefficients indicated that one-unit increase in the use of human labour, machine power, manures and nitrogen fertilizers will minimize the per cent gap in yield. The coefficient of bullock power (X_2), phosphorus fertilizers (X_5), potash fertilizers (X_6) and seed (X_8) were found positive but non-significant, which indicate the excess use of these resources.

ii) Pre-seasonal sugarcane: The value of R^2 is 0.68 for the model fitted in respect of pre-seasonal sugarcane at state level, indicated that 68 per cent total variation in the yield gap have been jointly explained by the selected eight independent variables. The regression coefficients of machine power (X_3) and manures (X_7) were highly and negatively significant, while, nitrogen fertilizers (X_4) and potash fertilizers (X_6) were negatively significant at 5 per cent level. These negative and significant variables indicate that, there is scope to increase the use of these inputs for minimizing the yield gap. The magnitude of regression coefficient of human labour (X_1) and bullock labour (X_2) were negative and non-significant while, the magnitude of phosphorus fertilizer (X_5) and seed (X_8) were positive but non-significant.

iii) Ratoon sugarcane: The proportion of total variation explained jointly by the selected eight resource variables in the model of ratoon sugarcane was 76 per cent in Maharashtra state. The coefficients of human labour (X_1) and machine power (X_3) were highly and negatively significant, while, the coefficients associated with the variables like nitrogen fertilizer (X_4), phosphorus fertilizer (X_5), potassium fertilizer (X_6) and manure (X_7) were positive but non-significant.

From the above discussion, it is apparent that the use of inputs such as human labour, manures and chemical fertilizers are mainly responsible for the yield gap in the different sugarcane plantations and cotton cultivation. These findings confirm with the results of Inamke *et al.* (1996); Malik (2000) and Mathur *et al.* (2001), so the hypothesis that the labour, chemical fertilizers and manures are the important factors responsible for the yield gaps can be accepted.

CONCLUSION

The per hectare resource use of human labour for *adsali*, pre-seasonal and ratoon sugarcane at state level were 411.23, 355.75 and 304.46 man-days, respectively. However, their magnitudes for the use of bullock labour were 3.72, 17.9 and 5.50 pair-days, respectively. Maximum average use of machine labour (37.44 hrs) was observed in *adsali* sugarcane. The use of seeds (sets) for *adsali* and pre-seasonal sugarcane at state level were 56.04 q and 64.63 q, respectively. The per hectare average productivity of *adsali* sugarcane (1250.78 q), pre-seasonal sugarcane (1015.56 q) and ratoon sugarcane (842.64 q) at the state level and it was observed maximum in Western Maharashtra. The excess use of seed was observed in all the regions of Maharashtra. It is observed that farmers have used manure for ratoon sugarcane irrespective of its recommendation. The excess use of nitrogen was observed in Western Maharashtra for ratoon sugarcane. The gap in the use of nitrogen ranged from 1.90 to 31.66 per cent. In the case of phosphatic fertilizer excess use was observed for selected cash crops in all regions except pre-seasonal sugarcane in Western Maharashtra. The gap in use of potash was observed from 8.73 to 57.81 per cent and it was excess for ratoon, *adsali* and pre-seasonal sugarcane in Western Maharashtra. The per hectare yield gap I & II at the state level for sugarcane ranged from 23.26 to 26.42 per cent and 12.42 to 25.42 per cent, while the total yield gap ranged from 32.79 to 45.12 per cent. The regression coefficient showed that, the use of inputs such as human labour, manures and chemical fertilizers are mainly responsible factors for bridging the yield gap in sugarcane cultivations in Maharashtra.

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Knowledge and Constraints Faced by Exotic Vegetable Consumers: A Comparative Study of Dharwad and Hyderabad Cities of Karnataka and Telangana States of India

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ABSTRACT

Exotic veggies are those that have been imported in the previous few decades and are known as English vegetables. The present study was carried out to know the knowledge and constraints of exotic vegetable consumers. The sample taken for the study was 120 consumers. The results revealed that cent per cent of respondents had awareness about exotic vegetables and majority of consumers had knowledge about its forms of eating & also about importance in the diet. There was a significant difference in knowledge score between Dharwad and Hyderabad outliers. With regard to constraints faced, majority of the consumers said that its non availability in local markets, lack of knowledge about its recipes and lack of information about these vegetables as major problems faced while buying/eating of exotic vegetables.

Keywords: Exotic vegetables, Consumers, Knowledge, Outliers, Staff and Constraints

INTRODUCTION

Horticulture which deals with growing of vegetables, fruits and ornamental crops has become one of the most important sectors responsible for the growth of agriculture in India. India being a vast country with diversified agro-climatic conditions ranging from the tropical climates to the temperate zones, it is blessed with prolonged growing seasons and diverse soil types. It is to be noted that many non native vegetables when first introduced in the country were considered exotic. But over the years they became an integral part of our regular cuisine and got so popularized, that it is hard to believe that common vegetables like tomato and potato are not native to India but South America. The common exotic vegetables in India are Lettuce, Broccoli, Bok Choy, Brussels sprouts, Asparagus, Parsley, Leek, Zucchini, Kale, Cherry Tomato, Celery, Chinese cabbage, Red Cabbage, Coloured Capsicum, Chives etc.

These vegetables are primarily confined to elite restaurants and affluent Indian families. Since exotic vegetables are consumed by the upper classes of the society they have high market value, are one of the fastest growing industries with high profit margin when compared to traditional vegetables. There is very high demand for the imported varieties of exotic vegetables since India is not able to meet the demands within the country. The markets for these vegetables in India are still at a nascent stage when compared to international markets. The main objective of present study was to know about the knowledge and constraints faced by consumers consuming exotic vegetables.

MATERIALS AND METHODS

The study was undertaken during the year 2019-2020. The study was conducted in Dharwad and Hyderabad cities of Karnataka and Telangana states respectively. The total sample was 120 consumers. From each of the city's 30 university employees were selected purposively and 30 outliers i.e., citizens other than university staff were selected randomly.

A well-structured and pre-tested schedule was used to collect the information from the exotic vegetable

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consumers. In this study, an interview schedule, having 12 vegetables was taking. These vegetables had been categorized as Asian greens, flower vegetables, leafy and solanaceous vegetables. The responses observed from the different consumers were divided into two categories i.e. yes and no. The statement having “No” responses were given zero mark and the statement having “Yes” were given one mark. So, individual vegetable consumer can get maximum marks of 12 and thus a minimum mark was zero.

RESULTS AND DISCUSSION

The knowledge on vegetables refers to awareness about nutrients, vitamins and minerals present in each vegetables. It also refers to knowledge on ways of preparing, cooking and serving of the food. Knowledge is something that makes an individual to try new things that they learned. In the present study the consumer’s knowledge on exotic vegetables was studied by having seven statements where the consumer’s response to each statement will imply definite degree of knowledge about exotic vegetables. The seven statements were about availability, awareness, consumption form (i.e., raw or cooked), about storage and cultivation in garden which was shown in the Table 1. The knowledge indices for seven statement ranged from 100.00 to 03.33 with an overall knowledge index of 54.42 which indicates that majority of the consumers had fairly good knowledge to the extent of 54 per cent. The highest index was for awareness on exotic vegetables (100.00). It is due to increase in popularity to these vegetables in Indian cuisines by entry of multinational food chains like McDonalds, Pizza Hut, Dominos etc., in almost all the cities, which have made consumers aware of these vegetables. The knowledge of its availability was to the extent of 53 per cent due to increase in advertisements about these vegetables by various websites. The increase in online shopping websites for vegetables like Big Baskets, Natures basket etc., made people know about availability of these vegetables. About form of consumption of these vegetables, the consumers can consume either in raw (84.16) or cooked (56.00) form. It is based on individual preference and liking for particular form of consumption of these vegetables. Many of the internet websites now show different forms of consumption of each vegetable. So, consumers can know different forms of consumption of these vegetables. Most of them had thought that long storage of exotic vegetables in cold storage results in deterioration of quality and freshness of these vegetables. Cultivation of exotic vegetables in one’s own gardens had a low index (03.33). This is because most of the consumers lack knowledge on its cultivation which is different from traditional vegetables cultivation. Moreover it also requires specific growing conditions

Table 1: Knowledge of consumers about exotic vegetables (n=120)

Statements	Dharwad (n=60)				Hyderabad (n=60)				Know-ledge index
	UAS staff (n=30)		Outliers (n=30)		PJTSAU Staff (n=30)		Outliers (n=30)		
	F	%	F	%	F	%	F	%	
Awareness about exotic vegetables	30	100.0	30	100.0	30	100.0	30	100.0	100.0
Seasonally availability of exotic vegetables	20	66.67	12	40.00	18	60.00	14	46.67	53.35
Exotic vegetables need to be included to maintain diet	22	73.33	21	70.00	21	70.00	14	46.67	65.00
Some exotic vegetables need to cook for consumption purpose	15	50.00	23	76.67	17	56.67	13	43.33	56.66
Exotic vegetables are safe for consumption even it stored for long period in cold storage	08	26.66	05	16.67	03	10.00	07	23.33	19.16
Exotic vegetables can be eaten raw	25	83.33	23	76.67	26	86.67	27	90.00	84.16
Exotic vegetables can be grown in your own garden/farm.	02	6.67	01	03.33	01	3.33	-	-	03.33
Overall knowledge index	58.09		54.76		55.23		50.00		54.42
	56.42				52.61				

like light, temperature, water and green houses. This means it required high investment in maintenance and practice cultivation. So, they think that they cannot cultivate these vegetables in their own gardens. The results of the study are in line with Dipeolu *et al.* (2009); Khalied *et al.* (2011) and Adams *et al.* (2018).

When the overall knowledge index of consumers of Dharwad and Hyderabad were separately considered (Table 1), it could be seen that majority of UAS staff had high knowledge index of 58.09. This is because the climate of Dharwad is suitable to grow these vegetables where the staff sees practically these vegetables cultivation in Hi tech horticulture unit where they come to know about its importance and health benefits. The other probable reason is that location of Goa: one of the best tourist places of India nearer to Dharwad where there is a high demand for these vegetables. So, the exotic vegetables of Dharwad reach shores of the Goa. This results in high knowledge of Dharwad UAS staff when compared to other consumers.

The knowledge index of PJTSAU staff was 55.23. It is because the staff of agricultural universities gets more information about exotic vegetables from their fellow scientist from the department of horticulture. In comparison of knowledge index of UAS and PJTSAU staff, PJTSAU staff had slightly low knowledge than UAS. It is because the Hyderabad is having tropical climate and is not suitable to grow exotic vegetables result in low availability and less knowledge of exotic vegetables among Hyderabad staff.

Among Dharwad and Hyderabad outliers, the overall knowledge index of Dharwad is 54.76 which were higher than Hyderabad (50.00). It might be because Dharwad is a very small city where the influence of UAS was more on the Dharwad people. Moreover there were many growers who grow these vegetables in and around Dharwad because of favorable climatic condition for growing exotic vegetables. They supply these vegetables to consumers either by door delivery or through direct contact. This interaction of consumers with the growers results in gaining knowledge of these vegetables among Dharwad consumers.

When the knowledge indices of all consumers of Dharwad and Hyderabad is compared. The Dharwad consumers had knowledge index of 56.42 which is higher than Hyderabad consumers (52.61). The advantageous position of Dharwad in cultivating these exotic vegetables has been explained. Moreover the Agriculture University is situated in on the national highway where the passersby, buy these vegetables when they are displayed along the road side of the University. All this has created awareness about these vegetables among Dharwad citizens.

When the consumers were categorized based on their knowledge level (Figure 1). It could be seen that most of the consumers fall under medium knowledge level category which is a sign of good knowledge. This might be due to exposure of Indians to abroad culture where they gain knowledge about these vegetables. Moreover the data collected for the study was mostly

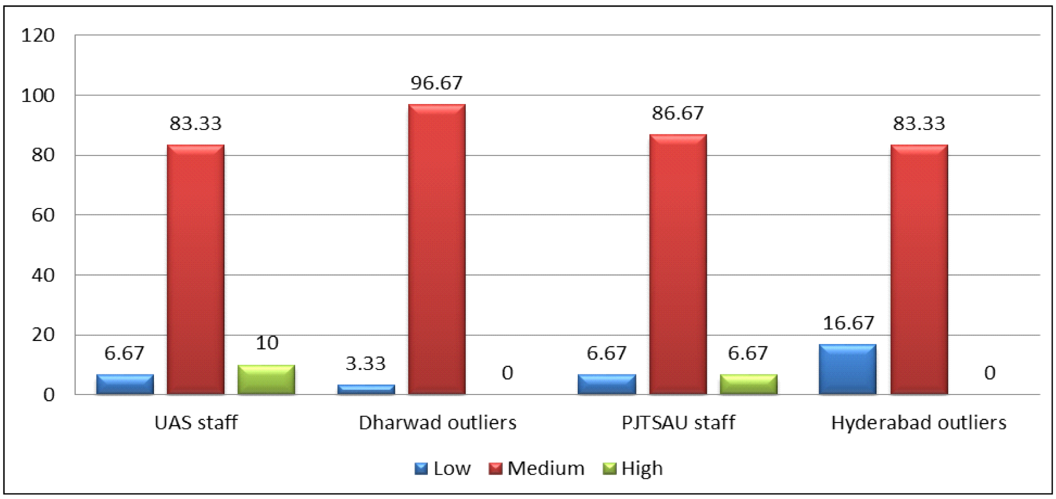

Figure 1: Knowledge level of consumers about exotic vegetables (n=120)

from consumers of these vegetables who had basic knowledge about these vegetables. This results in having the medium level of knowledge for majority of the consumers.

Comparison of the knowledge of exotic vegetable consumers: The 't' test values for the comparison of knowledge of staff and outliers of Dharwad and Hyderabad show a significant difference between outliers of Dharwad and Hyderabad (Table 2). Where it shows the Hyderabad outliers had low knowledge, it is because Hyderabad is a metropolitan city and one of the most populated cities of India. The agricultural university in Hyderabad is located at corner of the city. So, the influence of university on these vegetables on Hyderabad outliers was very less result in having low knowledge on exotic vegetables among Hyderabad outliers. Further the relationship between independent variable and the knowledge of consumers (Table 3) shows that none of the

Table 2: Comparison of mean knowledge score of Dharwad and Hyderabad consumers (n=120)

Knowledge	Mean	SD	't'
Dharwad UAS staff	4.0667	1.14269	0.66NS
Dharwad outliers	4.2333	0.77385	
Hyderabad PJTSAU staff	4.1000	1.12495	1.58NS
Hyderabad outliers	3.6667	0.99424	
Dharwad UAS staff	4.0667	1.14269	0.11NS
Hyderabad PJTSAU staff	4.1000	1.12495	
Dharwad outliers	4.2333	0.77385	2.46*
Hyderabad outliers	3.6667	0.99424	

*Significant at 95% level ($p<0.05$)

Table 3: Relationship between independent variables with knowledge of consumers of exotic vegetables (n=120)

Independent variables	Pearson correlation coefficient "r value" Dependent variable Knowledge(n=120)
Age	0.001NS
Education	0.076NS
Family income	0.085NS
Family size	-0.072NS
Family occupation	-0.015NS
Social media	-0.009NS
Innovativeness	0.098NS
Source of information	-0.019NS
Source of motivation	0.036NS

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

independent variables correlated with the knowledge of consumers. This means irrespective of consumers age, education, family income, family size, social media participation, innovativeness, source of information and motivation they have similar knowledge because buyers and consumers of these vegetables have a similar socio-personal background. The results are in line with the findings Christina *et al.* (2011).

Constraints faced by exotic vegetables consumers: Constraints faced by consumers differ from individual to individual depending upon their social status, livelihood requirement, consumption form and method of cooking. The constraint of consumers was studied

Table 4: Constraints of consumers in buying/eating of exotic vegetables (n=120)

Constraints	Dharwad (n=60)				Hyderabad (n=60)			
	UAS Staff (n=30)		Outliers (n=30)		PJTSAU staff (n=30)		Outliers (n=30)	
	F	%	F	%	F	%	F	%
Inadequate supply/irregular supply of exotic vegetables	16	53.33	23	76.67	19	63.33	27	90.00
Do not know where they are available	11	36.67	16	53.33	11	36.67	07	23.33
Preferences of the family for traditional food	14	46.67	11	36.67	17	56.67	11	36.67
Not available in the nearby markets	26	86.67	26	86.67	18	60.00	29	96.67
Price of exotic vegetables is too high	14	46.67	10	33.33	15	50.00	16	53.33
Lack of information on exotic vegetables	16	53.33	24	80.00	15	50.00	24	80.00
High perishable so difficult to store	10	33.33	10	33.33	07	23.33	05	16.67
Lack of knowledge about exotic vegetable recipe	15	50.00	23	76.67	17	56.67	23	76.67

*Multiple responses are possible

and is presented in Table 4. Constraints were listed, which are related to purchase and consumption of these vegetables. It could be seen that most of the consumers felt these vegetables are not available in the nearby markets. This is because these vegetables are not much in demand so the growers send them to outside markets. They are also seasonal and costly. They are available only in specialized markets like retail outlets (i.e., More, Reliance, Big Baskets etc.). The consumers also say irregular supply of these vegetables was problem in purchasing. The reason could be that these vegetables are mostly seasonal based and available in the winter season. So, there is a lack of continuous supply. Lack of knowledge on how to cook these vegetables was also a problem because consumers who have no exposure to these vegetables by way of travel abroad or visit to multinational food chains had no proper information on cooking methods for these vegetables. Exotic vegetables' cooking was quite different from traditional cooking method. The other constraints were high price, preference for traditional vegetables and perishability. This could be due to traditional bound food habits of Indians. The results are in line with the findings of Oyedela *et al.* (2014).

CONCLUSION

It can be concluded from the study that cent per cent of respondents had awareness about exotic vegetables and majority of the consumers had knowledge about its eaten forms i.e., raw and cooked forms and its importance in diet. Very few respondents had knowledge about its cultivation in garden/farms. Among staff and outliers of Dharwad and Hyderabad, Dharwad had little high knowledge than Hyderabad. The study also showed that there was a significant difference in knowledge score between Dharwad outliers and Hyderabad outliers. None of the independent variables were significantly correlated with the knowledge of exotic vegetable consumers. Majority of the consumers said that its non availability in local markets, lack of knowledge about vegetables recipes and lack of information about these vegetables were major problems faced in buying/eating of these vegetables.

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Constraint Analysis of Pluralistic Fisheries Extension Service Providers of Rajasthan

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ABSTRACT

Rajasthan state has a vast amount of water resources, but fish production from these water resources is said to be half of its potential. Total inland water resources area including reservoirs, ponds and tanks is 4.23 lakh ha. Fish production was reported to be 1.16 lakh tons in 2019-20. A number of fisheries development programmes are in progress in the state. Extension service providers from Government, Non Government and Private organisations are involved in the development of fisheries. However, not many studies have been reported about the constraints faced by these pluaralistic extension service providers, which was the objective of this study. Through the review of literature and focus group discussion with key informants a list of 53 constraints was prepared and classified under nine heads. A five point scale was used to measure the severity of constraints and its reliability was tested by test re-test method and Cronbach's alpha. Information was collected form forty extension service providers and using weights for each constraint, maximum score that could be achieved was 200. The study revealed that administrative constraints ranked first with an average score of 168.6 followed by social constraints (129.25), management related constraints (123.42), and extension and training constraints (120.62). Among administrative constraints burden of additional duties/charges on the officials was highest. In social constraints effect on children's education due to postings in remote places/frequent shifting due to transfers ranked first. Highest management related constraint was more span of control and extension and training constraints were less availability of transport facilities for field visits. To address these constraints, interventions are needed to deal with all of its dimensions so that an effective fisheries extension service can be developed.

Keywords*:* Constraints, Fisheries extension service providers, DoF, Fisheries, Rajasthan

INTRODUCTION

The role of pluralistic extension service eproviders is very important in formulating and implementing different schemes and policies suitable for the development of agriculture/fisheries in respective states in India. The success of any agricultural or fisheries extension services largely depends on the extension skills of extension workers (Kashem *et al.*, 2001). India's agri-extension services has been evolving but the real question lies in building capacities of the personnel involved in extension so that technologies are transferred to the bottom of the pyramid equitably and efficiently. Indias agriculture extension system is well developed and now number of sub disciplines have emerged. Among these, fisheries extension is one which is promising and is evolving. Fisheries extension is important and caters to marine capture/culture and inland culture/capture etc. Each state in India is blessed with diverse water resources so fisheries extension play a very important role in the development of the sector. States play a major role in executing the extension programs at field levels through their respective Department of Fisheries (DoF).

One state which is important with respect to fisheries is Rajasthan. In Rajasthan, the total inland water resources area, including reservoirs, ponds, tanks are 4.23 lakh ha and the fish production was 1.16 lakh tons in 2019-20, (DoF, India 2019-20), Yadav *et al.*

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(2021). Several fisheries development programmes are in progress in the state. Extension service providers from pluralistic organizations like Government, Non-Government and Private are involved in fisheries development. Pluralistic here refers to multiple or plural, and extension consists of a system of actors/groups. Even with vast amount of water resources and pluaralistic organisations involved as fisheries extension service providers fish production from these water resources as per Saini (2017); Yadav *et al.* (2019) is half of its potential. It is necessary to explore why full potential has not been tapped.

One of the potential reason can be that extension service providers face a number of constraints. Constraint based studies have been done in other states and Union Territories like Angral *et al.* (2017) in their study in Jammu & Kashmir region have reported that fisheries extension service provider faces a number of constraints like lack of cooperation, illiteracy, lack of institutional credit, low level of fish farmer's participation, lack of adequate co-operation and coordination from the line departments and lack of seriousness which become a hurdle in development.

Panday (2009) reported the constraints faced by officials of DoF, Tripura in the transfer of improved aquaculture technologies. Constraints reported were lack of communication and transportation facilities, lack of infrastructural facilities, delay in communication of messages at the right time which act as barrier to successful implementation of the programmes, In addition lack of mobility, non aquaculture extension duties, a high target set by the organization, the bureaucratic pattern of district administration, top-level officials failing to provide adequate leadership to staff, poor co-ordination with various development agencies, lack of infrastructural facilities, inadequate budget provided by the Government for technology transfer programmes, inadequate availability of raw material/inputs, vast jurisdiction of coordinators were also some constraints.

Pathak *et al.* (2014) studied problems perceived by Fisheries Extension Officers (FEOs) of Assam and West Bengal (W.B.), which were classified under heads administration, finance, infrastructure, psycho-social, extension, and psychological. Study reported that finance related problems ranked first followed by administrative and infrastructure related constraints. Finance related problems included issues like late salaries, irregular payment of travel and dearness allowances, the disparity in pay scale, etc. For, FEOs of W.B. administration related problems like late promotion and transfer problems were high. There are a few studies done with reference to the constraints faced by the fisheries extension providers in context of Rajasthan. The existing studies have focused on constraints faced by fishermen like Sharma *et al.* (2018) reported about irregular supply of feed, lack of preservation and curing facilities, poor economic condition of fishers, ignorance of rules and regulation, lack of updated information about price.

However, constraints faced by extension service providers are few. Nevertheless, it seems from the few studies that the pluralistic fisheries extension service providers face constraints and these can differ as per water body and the type of fisheries being practiced there. Thus this present study was done with the objective of assessing the constraints faced by the fisheries extension service providers in the state of Rajasthan.

MATERIALS AND METHODS

Pluralistic fisheries extension service providers were identified through review of literature, discussions with the officials of the DoF, Rajasthan, Tribal Area Development Cooperative Federation Ltd. (RTADCF Ltd.) Rajasthan, College of Fisheries, Maharana Pratap University of Agriculture and Technology (COF, MPUAT), Udaipur, NGO, Private organizations and official websites of different institutes working in the area of fisheries development.

From this information, a list of organizations that are involved in providing fisheries extension services in Rajasthan was prepared and the same is presented in Table 1 along with number of men and women officials in each organization and the officials selected for the study.

Out of total of 47 fisheries extension service providers 40 were selected in a way that from each organization representation was ensured. Constraints faced by pluralistic fisheries extension service providers available in review of literature were listed and thereafter an expert group consisting of 2 social

Table 1: Pluralistic fisheries extension service providers in Rajasthan

Pluralistic fisheries extension service providers				
Government Organizations (GO)		Non-Government Organization (NGO)	Private Organizations	
Central Government	Rajasthan State Government			
Ministry of Fisheries, Animal Husbandry and Dairying, Government of India	Department of Fisheries (DoF) Rajasthan Total Officials: 30 Women: 6 Men: 24 Selected: 24	Seva Mandir, Udaipur Total Officials: 2 Women: 1 Men: 1 Selected: 2	Ornamental Fisheries Training and Research Institute, Udaipur Total Officials: 2 Women: 0 Men: 2 Selected: 2	West Coast, Mumbai and Niva Aero Solutions, Chennai Total Officials: 2 Women: 0 Men: 2 Selected: 2
National Fisheries Development Board (NFDB) Officials of the Department of Fisheries, Rajasthan, who were implementing Central schemes.	Rajasthan Tribal Area Development Co-operative Federation Ltd. Total Officials: 6 Women: 0 Men: 6 Selected: 6	Institute for Ecology and Livelihood Action, Udaipur Total Officials: 1 Women: 0 Men: 1 Selected: 1		
	College of Fisheries, Maharana Pratap University of Agriculture and Technology, Udaipur Total Officials: 4 Men: 4 Women: 0 Selected: 3			

scientists, 2 fisheries professionals, 1 official from DoF, 1 official from NGO and 1 from private organization was formed. This expert group added more constraints in this list which made a total of 53 constraints and these were further classified under 9 heads. These heads were i.) extension & training constraints, ii.) management-related constraints, iii.) technical constraints, iv.) input supply constraints, v.) administrative constraints, vi.) financial constraints, vii.) communication and human relation constraints, viii.) feedback constraints, ix.) social constraints which are presented below.

Administrative constraints: Burden of additional duties, large number of vacant posts, delay in sanction of programmes/activities, diversified duties and assignments and no separate facility of office.

Social constraints: Disturbance in children's education due to stay in remote places/frequent shifting due to transfers, less availability of residential quarters, less time to participate in domestic/religious programmes and less time to participate in social programmes.

Management-related constraints: More span of control, pressure of meeting targets, pressure from higher officers, less cooperation from linked departments, inadequate allowances, interference of local leaders and less contact of farmers on the day of visit.

Extension and training constraints: Less availability of transport facilities for field visits, less number of problem oriented works, less practical skill during training, fewer training literature, less training related to job, untimely schedule of field visits, less duration of training programmes and less funds for training.

Communication and human relation constraints: Less expertise in ICT tools, incomplete information about innovations, less time to communicate with farmers, less audio and visual aids, less communication with local leaders, reluctance from fishers to communicate and less expertise in communication skills.

Technical constraints: Less information on improved technologies, less availability of latest fisheries literature, less availability of fisheries field equipment, less technical skills to operate audio-visual aids, less computer literacy & slow internet connection in the office.

Feedback constraints: Less response from fishers, less recognition for good work from fishers, unable to evaluate feedback and shyness of fishers.

Input supply constraints: Higher cost of seeds, fertilizers & pesticides, difficulty in distribution of inputs to fishers, inadequate input supply, risks in input supply, untimely input supply and increased demand for inputs.

Financial constraints: Less compensation or incentives for additional work, fewer grants for programmes/activities, untimely grants for programmes/activities, insufficient pay, less salary compared to nature of work and untimely salary.

RESULTS AND DISCUSSION

Table 2 presents the C.I. and it is observed that administrative constraints were very high. Social, management, and extension constraints were categorized as high as per the C.I. Other constraints had a medium C.I.

Table 2: Constraint faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Administrative	168.6	Very high	I
Social	129.25	High	II
Management	123.42	High	III
Extension and training	120.62	High	IV
Communication and human relation	111.57	Medium	V
Technical	105.83	Medium	VI
Feedback	92.25	Medium	VII
Input supply	87.5	Medium	VIII
Financial	85.33	Medium	IX

Friedman test results revealed that there was a significant difference in C.I. ($P < 0.05$) as the P-value was 0.0001.

Table 3: Administrative constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Additional duties	193	Very high	I
Vacant posts	193	Very high	II
Delay in sanction of programmes/activities	191	Very high	III
Diversified duties and assignments	185	Very high	IV
No separate facility of office	81	Medium	V
Average score	168.6		

It is clear from Table 3 that all administrative constraints except one had a very high C.I. Additional duties was cited as the foremost constraint with a C.I. of 193. Further inquiry into this revealed that officials were often allotted additional duties like election duty, attending court cases, meetings, office paperwork's etc. Due to this, they do not get sufficient time to work in the field to interact with fishers.

A large number of vacant posts were also reported as administrative constraints and had a similar C.I. Discussion with the officials revealed that only ten fisheries officials have been recruited after the DoF separated from the Animal Husbandry Department in 1982. In RTADCF Udaipur, it was reported that there has been no recruitment since 1976. Due to non recruitment most of the fisheries posts are vacant in DoF, Rajasthan, RTADCF, Udaipur, College of fisheries, MPUAT, Udaipur and officials have to look after the charge of more than one district or water bodies. Delay in sanctioning of programmes/activities ranked second with a C.I. of 191. Delay in sanction of programmes/activities was mostly due to lengthy administrative processes and also due to non-availability or less staff. In addition to extension related work, diversified duties and assignments were also given to the officials and this ranked as third constraint. It was reported that officials had more than one district or large operation area under single supervision. They were involved in production and administrative both kinds of work. The findings of the present study are similar to Jadoun *et al.* (2017) who reported constraints of animal husbandry officials in Haryana. They also reported administrative constraints like heavy workload during peak season followed by the inadequacy of staff. Similarly, Patil *et al.* (2017) also reported that extension personnel of the fisheries department in Maharashtra faced administrative constraints like diversified duties and assignments, no compensation or incentives for additional work. Patel *et al.* (2016) reported similar results about inadequate staff strength in agriculture department as foremost administrative constraint faced by extension personnel of Karnataka. Pathak *et al.* (2014) reported constraints of fisheries extension officers in Assam and W.B. and reported administrative constraints like late promotion and transfer problems, and additional duties like census work and election duties. Findings of the present study are similar to other studies.

Table 4: Social constriants faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Children's education suffered due to stay in remote places/ frequent shifting due to transfers	170	Very high	I
Limited residential quarters	137	High	II
Less time to participate in domestic/religious programmes	117	Medium	III
Less time to participate in social programmes	93	Medium	IV
Average score	129.25		

It is clear from Table 4 that education of children usually suffers due to stay at remote places or frequent shifting due to transfers and this was ranked first as per the C.I. of 170. Discussion with extension officials revealed that due to less staff in the organization, they have to work for more than one district, also they are frequently transferred to other districts which affects the children's education. Limited facility of residential quarters also had a C.I. of 137, which was classified as a very severe constraint. The officials reported that a number of the residential quarters were less and residential quarters were away from the city or town, due to that officials felt separated from the social life. Less time to participate in domestic, religious, and social programmes due to heavy workloads was also reported as a constraint. Similar results have been reported by Patil *et al.* (2017) who reported extension personnel of agriculture department Maharashtra found non-availability of residential quarters as a constraint.

Table 5: Management constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
More span of control	170	Very high	I
Pressure of meeting Target oriented approach	169	Very high	II
Pressure from higher officers	156	High	III
Less cooperation from linked departments	111	Medium	IV
Inadequate allowances	99	Medium	V
Interference of local leaders	85	Medium	VI
Less contact of farmers on the day of visit	74	Low	VII
Average score	123.42		

It is clear from Table 5 that more span of control was ranked as first management constraint as there were more people under control of one manager/officer. The pressure of meeting the targets ranked second as the officials had to achieve targets in their area like, seed production, fishers training, skill development programs, etc. Panday (2009) had also reported that the DoF officials in Tripura also faced constraints like high targets set by the organization, bureaucratic pattern of district administration and poor coordination with various development agencies. Patil *et al.* (2017) also reported this as a constraint for agriculture extension personnel in Maharashtra. The DoF officials reported less co-operation from the other departments like irrigation department, Water supply department, and Gram panchayats. The officials of RTADCF, NGOs, and private organizations reported inadequate allowances for work. Constraints like local leaders' interference and less contact of farmers/fishers on the day of the visit were also reported. In a study by Agrial *et al.* (2017) in Jammu and Kashmir it has been reported that DoF officials were not getting full co-operation from the respondents thus had low participations during trainings and technology transfer.

Table 6: Extension and training constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Less availability of transport facilities for field visits	166	Very high	I
Less number of problems oriented work	149	High	II
Less practical skill during training	147	High	III
Few training literatures	124	High	IV
Less training related to Job	116	Medium	V
Untimely schedule of field visits	102	Medium	VI
Less duration of training programmes	99	Medium	VII
Fewer funds for training	62	Low	VIII
Average score	120.62		

It is clear from Table 6 that transport facilities were not proper which are the basic requirement for field visits. Some reported that they do not have a vehicle in the organization. When vehicles are present some are not in working condition or used for another purpose, so they have to rent a taxi. Jadon *et al.* (2017) also reported lack of transportation facilities was a constraint perceived by officials of the Department of animal husbandry in Haryana. All officials reported that they had undergone few trainings but less emphasis was given on practical skills during training programmes. The officials stated that the training programmes were more theoretical, lacking practical skills regarding fisheries/aquaculture and less training literature. Extension service providers reported less training related to the job while starting the job/on-job training to improve work efficiency. The training program's duration was three days for officials but they suggested 5-7 days training was appropriate. Officials of DoF, RTADCF, and CoF, MPUAT stated that during training practical information on control of disease, production, seed supply, seed quality should be included. Studies by Patil *et al.* (2017) and Misha *et al.* (2016) in Maharashtra also reported lack of training and non-availability of training literature as major constraints faced by extension personnel. Jadon *et al.,* (2017) reported inadequate extension services and training programmes for Haryana officials. Poor response from farmers, lack of equipment's like soil, water testing, and lack of training material were also major problems. Pathak *et al.* (2014) reported poor response from farmers, lack of equipment's like soil, water testing, and lack of training material as major problems in Assam and W.B.

It is observed from Table 7 that less expertise in ICT tools was the first constraint in communications

Table 7: Communication and human relation constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Less expertise in ICT tools	155	High	I
Incomplete information about innovations	143	High	II
Less time to communicate with farmers	132	High	III
Less audio and visual aids	122	High	IV
Less communication with local leaders	99	Medium	V
Reluctance from fishers in communication	70	Low	VI
Less expertise in communication skills	60	Low	VII
Average score	111.57		

with a C.I. of 155. The second rank was given to inadequate information about innovations with a score of 143. Less time to establish communication with farmers was ranked the third constraint with a score of 132. Similarly Patil *et al.* (2017) in their study have also reported that, inadequate audio-video aids as a constraint faced by the agricultural extension personnel of Maharashtra. Whereas Jodan *et al.* (2017) reported less technical expertise in the field of extension by the animal husbandry department officials in Haryana. Panday (2009) also reported lack of audio-visual aids as a constraint by DoF, officials in Tripura.

Table 8: Technical constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Less information on improved technologies within time	150	High	I
Less availability of latest fisheries literature	144	High	II
Less availability of fisheries field equipment's	127	High	III
Less technical skills to operate audio-visual aids	106	Medium	IV
Less computer literacy	64	Low	V
Slow internet connection in office	44	Low	VI
Average score	105.83		

It is clear from Table 8 that technical constraints faced were less information on improved technologies with a C.I. of 150. Officials reported that they do not get complete information on improved technologies on time and due to this the same cannot be transferred to the fishers. Less availability of the latest fisheries literature had a C.I. of 144 followed by less availability of fisheries field equipment's. DoF and RTADCF officials stated that they do not have a fisheries laboratory and sufficient fisheries field equipment like equipment for water quality and soil quality tests. Other researchers like Majhi (2001); Patil *et al.* (2017); Misha *et al.* (2016) and Pathak *et al.* (2014) have also reported that poor infrastructure, non-availability of training literature, and non-availability of equipment's as major constraints faced by fisheries extension personnel. Patil *et al.* (2018) noted technical constraints like no training facilities, no timely information about the fish catch, inadequate resources and infrastructural facilities, and

Table 9: Feedback constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Less response from fishers	113	Medium	I
Less recognition for good work from fishers	104	Medium	II
Unable to evaluate feedback	65	Low	III
Shyness of fishers	87	Low	IV
Average score	92.25		

lack of modern equipment in the coastal Konkan region of Maharashtra.

It is clear from Table 9 that the feedback constraints faced were less responses from fishers with a C.I. of 113. Patil and Sharma (2020) also reported this constraint as there was less response due to busy schedules from farmers of Maharashtra. Second rank was given to less recognition for good work from fishers with a C.I. of 104. Angral *et al.* (2017) in theirs study reported that major constraints faced by implementing agency were low level of people participation as farmers did not attend and participate in training programmes. Jadon *et al.* (2017) also reported inadequate co-operation from the animal husbandry farmers in Haryana.

Table 10: Input supply constraints faced by pluralistic fisheries extension service providers

Constraints	C.I.	Severity	Rank
Higher cost of seeds, fertilizers and pesticides	111	Medium	I
Difficulty in the distribution of inputs to fishers	89	Medium	II
Inadequate input supply	89	Medium	III
Risk in input supply	87	Medium	IV
Untimely input supply	82	Medium	V
Increased demand for inputs	67	Low	VI
Average score	87.5		

It is clear from Table 8 that the high cost of seeds, fertilizers and pesticides ranked as first constraint with a C.I. of 111. The second rank was given to inadequate input supply with a C.I. of 89, and the third rank was given to difficulty in the distribution of inputs to fishers. The officials reported about higher cost of seeds, fertilizers and pesticides. Further enquiry into this revealed that 40% of fish seed supply of state was fulfilled by the government, private seed hatcheries from other states like West Bengal, U.P. M.P and Andhra Pradesh. However, many fishers/farmers were not getting fish seed on time and the quality and quantity of seed also not good. Due to non availability of input suppliers in the state, the distribution of inputs to fishers was difficult and increased the product's transportation cost. In a study Sharma *et al.* (2018) also reported irregular supply of seeds, lack of quality feed, high cost of supplementary feed, and irregular/inadequate supply of inputs in Rajasthan. Similar results have been reported by other researchers like Patil *et al.* (2017) who reported that input supply as the most severe constraint perceived by the extension personnel of the agriculture department of Maharashtra. Panday (2006) reported constraints in the transfer of improved aquaculture technologies by DoF, Uttar Pradesh.

Table 11: Financial constraints faced by pluralistic fisheries extension providers

Constraints	C.I.	Severity	Rank
Less compensation or incentives for additional work	131	High	I
Less grants for programmes/ activities	119	Medium	II
Untimely grants for programmes / activities	113	Medium	III
Insufficient pay	52	Low	IV
Salary is less as compared to nature of work	50	Low	V
Untimely salary	47	Low	VI
Average score	85.33		

It is clear from Table 8 that the officials expressed that less compensation or incentives for additional work as the major constraint with a C.I. of 131. Inadequate and untimely grants for programmes/activities was reported to be a major constraint. Further discussions with the extension service providers revealed that no compensation or incentives for additional work was provided in Private organizations and NGOs. These officials stated that fewer grants for programmes/ activities were there and the grants were untimely. Similar results have been reported by Jadoun *et al.* (2017) in Haryana. Patil *et al.* (2017) reported extension personnel of the agriculture department in Maharashtra faced financial constraints like no compensation or incentives for additional work. Pathak *et al.* (2014) also reported finance-related problems faced by FEOs of Assam and W.B. including issues like late salaries, irregular payment of travel allowance/dearness allowance disparity in pay scales. Kendall's coefficient of concordance (W) was computed to measure if there was an agreement among the responses of different fisheries extension service providers. The value of W was 0.629, which indicated that there was a good level of agreement.

Friedman rank test which is a non-parametric test was used to test if there was a significant difference between scores achieved for each constraint and the results are presented in Table 12.

Table 12: Friedman rank test result

Test Statistics	
N	40
Chi-Square	347.242
df	10
Asymp. Sig.	.000

It is clear form Table 12 that there was a significant difference among the index of the constraint ($P< 0.05$) as the P-value was 0.0001.

CONCLUSION

It could be concluded from the study that the constraints perceived by fisheries extension service providers were many and this can reduce their work efficiency. With a separate Ministry of Fisheries, Animal Husbandry and Dairying, which has been established in 2019 and a dedicated 'Matsya Sampada Yojana', efforts are needed to address the constraints faced by Extension service providers. To address this constraint, interventions are needed to deal with all of its dimensions. Thus, there is a need for integrated approaches for finding solutions to constraints.

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Community Attitude Towards Rural Tourism: A Study in Meghalaya

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ABSTRACT

Rural tourism as an agri-business enterprise provides substantial income to farmers and yield benefits that strengthen culture, antiquity and technological outlook of rural households. For a sustainable and profitable rural tourism venture, integration of the community members in the core tourism plan and their active participation is a necessary pre-requisite. The present study was taken up in Meghalaya state that has heavy tourist traffic and huge potential for rural tourism. Two popular rural tourism centers viz., Mawlynnong (cleanest village of Asia) and Sohliya (strawberry village) were the locale of the study. To study the attitude of community members towards rural tourism, 60 residents (30 from each village) were randomly sampled. Tourism Impact Attitude Scale (TIAS) modified to suit the local context was utilized to measure residents' attitude. Findings confirmed 66.67 per cent of total respondents held favorable attitude towards rural tourism. However there is a significant difference of attitudes between two tourism centers. Education, land holding, annual income and role in rural tourism are found important determinant factors effecting individuals attitude. Harnessing the favorable attitude of the residents to aware them about the entrepreneurial opportunities of rural tourism so that the covert attitude can be converted into overt benefits is recommendable.

Keywords: Agri-business, Attitude, Community members, Meghalaya, Rural tourism

INTRODUCTION

With increasing rate of population to feed, farm income downturns are a potential threat for agrarian economy. Revolutionary technologies developed so far with specific target approach overlooked rural development as whole. Communities with modest components like village, farm and farmer can generate returns from non-farm activity like rural tourism as an alternate livelihood source to bridge this revenue gap (Krishna *et al.*, 2020). Likewise, with urban population seeking detachment from city life and willing to experience rural lifestyle, closer to nature, rural tourism is an evolving enterprise (Singh *et al.*, 2016). Rural tourism as small-scale solution for community checks migration effect, showcases rural heritage and provides trade platform to unique arts and crafts practitioners. Rural tourism goes beyond simply traditional activities such as agriculture, and can act as a catalyst for new entrepreneurial activities, partnerships and networks (Butler and Clarke, 1992). With abundant natural and human resources available for tourism promotion within the villages, rural tourism industry has the capacity to generate employment to locals. Conducive settings of Meghalaya bestowed with rich tribal culture, natural landscapes and resources has emerged few noteworthy rural tourism centers. Establishment of tourism industry in rural areas yields numerous beneficiary effects for local community. Services like homestays, catering and recreational activities for tourist-customers create employment opportunities for locals. Apart from government interventions, community involvement in

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terms of community based tourism activities that provides ownership and management also develops sustainability of rural tourism (Singh *et al.*, 2017). Community participation is in turn affected by various perceptions held by community on rural tourism as it forms the crucial aspect for integrated tourism planning. Hence, to measure community's attitude towards rural tourism present study was contemplated in Meghalaya state of India.

MATERIALS AND METHODS

The study was conducted in two popular tourism destinations in the Khasi Hills of Meghalaya viz., Mawlynnong and Sohliya. Mawlynnong in East Khasi Hills district has earned the distinction of being the cleanest village in Asia and it also offers attractive sights like living root bridge and balance boulder rock. Sohliya in Ri-Bhoi district is known for its strawberry farms and strawberry festival conducted in February. From each of tourism destinations, 30 residents were randomly selected as respondents. Socio-economic profile containing ten independent variables and one dependent variable, community's attitude towards rural tourism were used in this study. The dependent variable is operationally defined as the positive or negative feeling or opinion of community members about rural tourism in their village expressed through certain behavioral aspects. For assessing the attitude, Tourism Impact Attitude Scale (TIAS) developed by Lankford and Howard (1994) containing pre-designed item statements slightly modified under 4 factors (Petrovic *et al.*, 2015) *viz.,* Factor 1: Community and personal benefits derived from tourism (F1); Factor 2: Negative impacts of tourism (F2); Factor 3: Individual's support or concern for the tourism development in the area (F3) and Factor 4: Opinion about development of tourism (F4); was employed. 20 item statements that were suitable to the locale context were adopted from the scale. Respondents were to rate the statements on a five point Likert scale representing strongly agree, agree, undecided, disagree and strongly disagree with scores of 5, 4, 3, 2 and 1 for positive statements and vice-versa for negative statements. The range of 20 – 100 is the total possible score for the attitude scale used in this study. From each of tourism destinations, 30 residents were randomly selected as respondents. Mean value of summated scores obtained from each individual was used to categorize respondents' attitude level into 'favorable attitude' and 'unfavorable attitude' (Adesoji *et al.*, 2019). Non parametric Mann-Whitney U test with no difference null hypothesis was used to compare the difference between the dependent variables of two tourism centers. To further measure the degree of association among variables Spearman's rank correlation analysis was executed. Statistical analysis was performed using analytical software namely SPSS 20 and Microsoft excel 2007.

RESULTS AND DISCUSSION

Description of the profile of the community member respondents of the selected tourism destinations are provided in Table 1. Majority of respondents were young (38.34%) falling under the age of 35 years. In both the villages the number of female respondents (58.34%) was roughly more than male (41.66%). Most of the respondents in Mawlynlong (63.34%) were educated up to secondary level (Marbaniang, 2017); however half of Sohliya village respondents (50.00%) were illiterate. In both the villages, 60.00 per cent and 66.67 per cent respectively were marginal farmers with less than 1 hectare of land. Mean annual income was Rs. 1,45,616.70, with slightly higher average for Mawlynlong than in Sohliya. Overall, maximum number of the resident respondents of both villages possessed medium levels of cosmopolitanism (76.67%) and social participation (75.00%) which serve as an important characteristic of respondents that influences participation in agri-tourism that favor change locals' perceptions (Pinky, 2014). However, 71.66 per cent were unaware of the concept of rural tourism or agri-tourism. Nearly 40 per cent of total were actively involved in tourism activities with tourism related enterprise as livelihood means and involved in direct service provision to tourist consumers in the form of restaurant, home-stays, recreational activities, etc., and 25 per cent respondents play passive role in the form of indirect service provision to tourists (eg. fruits & vegetable supply to restaurants, etc.). Average mean rural residency of respondents along with their family stood at 38.93 years.

The opinion of respondents to item statements regarding their attitude towards rural tourism obtained in the form of mean score is presented in Table 2. On a whole, the attitude statements that ranked higher than

Table 1: Distribution of respondents according to personal characteristics

Variable	Categories	Frequency (%)		
		Mawlynnong (n=30)	Sohliya (n=30)	Total (n=60)
Age (years)	Young (<35)	15 (50.00)	8(26.67)	23(38.34)
	Middle (35–50)	9(30.00)	12(40.00)	21(35.00)
	Old (>50)	6(20.00)	10(33.33)	16(26.66)
	Mean age	37.43	42.10	39.76
Gender	Male	13(43.33)	12(40.00)	25(41.66)
	Female	17(56.67)	8(60.00)	35(58.34)
Education level	Illiterate	1(3.33)	15(50.00)	16(26.67)
	Primary	3(10.00)	5(16.66)	8(13.33)
	Secondary	19(63.34)	7(23.34)	26(43.34)
	Undergraduate	7(23.33)	3(10.00)	10(16.66)
Land holding	Marginal (< 1 ha)	18 (60.00)	20 (66.67)	38(63.34)
	Small (1 – 2 ha)	5 (16.67)	4 (13.34)	9(15.00)
	Semi-medium (2 – 4 ha)	2 (6.67)	3 (10.00)	5(8.33)
	Medium (4 – 10 ha)	3 (10.00)	2 (6.66)	5(8.33)
	Large (>10 ha)	2 (6.66)	1 (3.33)	3(5.00)
Annual income	Low (<33,750)	3 (10.00)	6 (20.00)	9(15.00)
	Medium (33,751-1,44,000)	8 (26.66)	19 (53.34)	27(45.00)
	High (>1,44,000)	19 (63.34)	5 (16.66)	24(40.00)
	Mean	1,76,633.30	1,22,100.00	1,45,616.70
Cosmopolitanism	Low	6 (20.00)	2 (6.67)	8(13.33)
	Medium	19 (63.34)	27 (90.00)	46(76.67)
	High	5 (16.66)	1 (3.33)	6(10.00)
Social participation	Low	1 (3.33)	5 (16.66)	6(10.00)
	Medium	23 (76.67)	22 (73.34)	45(75.00)
	High	6 (20.00)	3 (10.00)	9(15.00)
Rural tourism awareness	Aware	11 (36.67)	6 (20.00)	17(28.34)
	Unaware	19 (63.33)	24 (80.00)	43(71.66)
Role in tourism	Active	17 (56.67)	7 (23.33)	24(40.00)
	Passive	11 (36.67)	4 (13.33)	15(25.00)
	No role	2 (6.66)	19 (63.34)	21(35.00)
Rural residency (years)	Mean	57.80	40.06	38.93

grand mean score (4.35 for Mawlynnong; 4.01 for Sohliya and 4.27 for overall), directly contributed for respondents in showing positive attitude towards rural tourism. Of all the 20 statements, the statement 'My village has better roads and pavements thanks to tourism development' received highest mean score ($\bar{x}$ = 4.76) while the statement 'I support charging tax or fee for tourism development' had least mean ($\bar{x}$ = 3.10).

The Mawlynlong respondents have rated the statement 'The community should encourage more intensive development of tourist facilities' with highest mean score of 4.73 implying a strong support and positive consent of the residents for the tourism expansion. Also, the statement 'I am against new tourism facilities, which will attract more tourists to my community' had lowest mean of 3.56, complementing the finding that

Table 2: Attitude scores of community members towards rural tourism

S.No.	Item statements	Mean score*		
		Mawlynnong (n=30)	Sohliya (n=30)	Total (n=60)
F1	***Community and personal benefits derived from tourism***			
1	My village has better roads and pavements thanks to tourism development.	4.60	4.73	4.67
2	The quality of public services (health care, cleanness, water supply, protection from fire, etc.) in my place has been improved.	4.56	4.33	4.45
3	Tourism has an impact on the improvement of my life standard.	4.43	4.06	4.25
4	The number of shops in my place has risen as a result of tourism development.	4.50	3.93	4.22
F2	***Negative impacts of tourism***			
5	Settlements in this municipality should not initiate the attraction of a great number of visitors.	3.90	3.43	3.67
6	Tourism has a negative impact on the environment preservation.	4.30	3.86	4.08
7	The noise from the existing tourist activities has a negative impact on the life in my place.	4.40	3.93	4.07
8	The amount of rubbish has risen in my place due to a larger number of visitors.	4.13	4.06	4.10
9	Tourism reduces possibilities for recreation outdoors in my place.	4.23	3.70	3.97
10	Tourism has influenced the rise of crime rate in my place.	4.20	4.26	4.33
11	Visitors have a negative impact in my place.	4.16	4.13	4.15
F3	***Individual's support or concern for the tourism development in the area***			
12	Tourism development should be actively supported.	4.70	4.20	4.45
13	My place has resources to become an attractive tourist destination.	4.46	4.36	4.42
14	Tourism development in my place will provide more opportunities for employment of local population	4.60	4.10	4.35
15	I am against new tourism facilities, which will attract more tourists to my community	3.56	3.86	3.98
16	Tourism plays an important role in the economy of the community.	4.70	4.03	4.37
17	I support charging tax or fee for tourism development.	4.10	2.53	3.05
F4	***Opinion about development of tourism***			
18	Municipal authorities are right if they support tourism development.	4.53	4.13	4.33
19	The benefits of tourism outweigh the negative consequences of tourism development.	4.36	4.10	4.23
20	The community should encourage more intensive development of tourist facilities.	4.73	4.60	4.67
	Grand mean of all item statements	**4.35**	**4.01**	**4.27**

* Maximum obtainable score is 5.

residents will not oppose tourism development and will welcome a greater number of tourists to visit their village. In case of Sohliya the highest scoring statement was 'My village has better roads and pavements thanks to tourism development' received highest mean score ($\bar{x}$ = 4.73) while the statement 'I support charging tax or fee for tourism development' had least mean ($\bar{x}$ = 2.53). This indicates that the residents were happy that rural tourism improved infrastructure of village. The residents' were of the belief that charging tax on tourists will reduce the number of tourists' arrivals into village.

Factor wise attitude scores from the Table 3 showed that overall, F4 had the highest mean score of 4.41, followed closely by F1 with a mean score of

Table 3: Factor-wise attitude scores of community members towards rural tourism

Factors	Mawlynnong		Sohliya		Total	
	Mean	Rank	Mean	Rank	Mean	Rank
Community and personal benefits derived from tourism	4.52	II	4.26	II	4.39	II
Negative impacts of tourism	4.18	IV	3.91	III	4.05	IV
Individual's support or concern for the tourism development in the area	4.35	III	3.84	IV	4.10	III
Opinion about development of tourism	4.54	I	4.27	I	4.41	I

4.39 (Ivana *et al.,* 2014). The fact that higher mean scores of Mawlynnong respondents, can be due to involvement of residents in tourism activities for livelihood. However, lack of tourism infrastructure facilities in Sohliya can be improved for better tourism management. F3 and F2 had relatively low score of 4.10 and 4.05 respectively. The result implies that villagers have accepted rural tourism as they realized there were benefits of tourism and had strong encouraging opinion for tourism development.

The mean attitude score of the overall respondents 4.18 was used to categorize the respondents into two categories viz., favorable attitude on rural tourism (≥ 4.18) and unfavorable attitude on rural tourism (< 4.18). Results are presented in Table 4, it reveals that in Mawlynnong only 20.00 percent of respondents had unfavorable attitude for rural tourism and 80.00 percent of the residents had favorable attitude (Muresan *et al.,* 2015; Yahya and Fang, 2019). On other hand, 46.66 percent of respondent residents had unfavorable attitude and more than half (53.34%) of them had favorable attitude towards rural tourism in Sohliya. The fact that high favorable percentage of Mawlynnong respondents, can be due to involvement of residents in tourism activities for livelihood. More unfavorable percentage in Sohliya was due to lack of infrastructure facilities. On a whole, 66.67 percent have favorable attitude towards rural tourism.

The comparison of mean attitude scores of the two said villages, Mawlynnong and Sohliya was done using non parametric test statistic independent samples Mann-Whitney U. The results confirmed that there is significant difference of attitude towards rural tourism (dependent variable) between the two villages. It is evident from Table 5 that mean ranks of Mawlynnong are significantly higher than those of Sohliya and can be probably associated to long time tourism history of former village compared to recent agri-tourism innovations in later village. This is because of the fact both the villages operate tourism in one kind or other indicating suggestion to improvise and campaign for tourism benefits in later village in order to better the attitude outlook of residents.

To test the association of independent variables with respondents' attitude, non-parametric Spearman's rank correlation was utilized for analysis and the results are presented in the Table 6. The correlation analysis indicated that education, land holding, annual income and role in rural tourism of respondents are positive and significantly associated with their attitude towards rural tourism. This implies that residents with high

Table 4: Distribution of respondents according to their attitude towards rural tourism

Level	Score	Frequency (%)		
		Mawlynnong (n=30)	Sohliya (n=30)	Total (n=60)
Unfavourable	< 4.18	6 (20.00)	14 (46.66)	20 (33.33)
Favourable	≥ 4.18	24 (80.00)	16 (53.34)	40 (66.67)

Table 5: Comparison of mean attitude scores of two villages

	Mean Ranks	Mann-Whitney U	p value	Z statistic	Decision
Mawlynnong (n=30)	36.68	264.500	0.006**	-2.752	Reject null hypothesis
Sohliya (n=30)	24.32				

**Significant at the 0.01 level

Table 6: Association of attitude towards rural tourism with independent variables

Variable	Mawlynnong (n=30)		Sohliya (n=30)		Total (n=60)	
	r_s value	p value	r_s value	p value	r_s value	p value
Age	.246	.190	-.133	.483	-.031	.812
Gender	-.110	.585	-.024	.901	-.054	.683
Education	-.074	.697	**.313***	.092	**.303***	.019
Land Holding	.234	.214	**.579****	.001	**.436****	.001
Annual Income	-.110	.564	**.695****	.000	**.362****	.004
Role in rural tourism	.210	.265	**.547****	.002	**.474****	.000
Rural residency	.114	.548	-.048	.801	.029	.828
Awareness on rural tourism	.274	.144	.005	.980	.184	.159
Cosmopolitanism	**-.332***	.073	.305	.101	-.016	.902
Social Participation	**.350***	.058	-.123	.516	-.027	.836

**Significant at the 0.01 level * Significant at the 0.1 level

education (Brayley *et al.,* 1990), more possession of land, receiving high annual income (Milman and Pizam, 1988), having active role in rural tourism (Ivana *et al.,* 2014) hold more positive attitude towards rural tourism. Slathia *et al.* (2015) also reported that education was found to be positively correlated with degree of women empowerment under rural tourism. Other variables like age, rural residency, cosmopolitanism and social participation had non-significant association with the residents' attitude. These findings of study support that gender has no influence on attitude towards tourism as reported by Davis *et al.* (1988). However, the findings were contradictory with previous studies (Harrill, 2004; Alrwajfah *et al.,* 2019) that showed age and gender of residents affects attitudes. If seen tourism center wise, in Mawlynnong, the variable cosmopolitanism had negative but significant association (r_s = -0.332, p = 0.073), while the social participation (r_s= 0.350, p = 0.058) had positive significant associations with respondents' attitude towards rural tourism. In Sohliya, the strawberry farms are major source of tourists' attraction as well as income for the residents. Thus, the more land a farmer has for strawberry cultivation (r_s =0.579, p = 0.001), the better his/her attitude towards tourism.

CONCLUSION

Local community's view of rural tourism is important for proper tourism planning and development. Their favourable attitude promotes growth and sustainability of the tourism venture. The study provided the assessment of attitude of community members from two famous tourism centers of Meghalaya viz., Mawlynlong and Sohliya. Overall attitude score of majority of the residents of both the centers were found favorable which imply the acceptance of tourism enterprise by villagers. The attitude score of community members towards rural tourism was relatively more favorable in Mawlynnong than that of Sohliya. Empirical findings of the study confirmed that education, land holding, annual income and role in rural tourism had positive and significant association with community members' attitude towards rural tourism. This favorable attitude should act as foundation for creation of awareness regarding the concept of agri-tourism and its entrepreneurial opportunities so that covert attitude can be converted into overt benefits. Community members partaking in tourism development activities helps to mainstream rural tourism as an empowering income generative activity.

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Assessing the Sustainability of on-site Sanitation System in Rural Households of Punjab, North-Western India

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ABSTRACT

The present study was conducted to access the sustainability of on-site sanitation system in rural households of Punjab, north-western India. A total of 150 households, 50 from each village i.e., village Killianwali (District Shri Muktsar Sahib), village Talwandi Khurd (District Ludhiana) and village Rode (District Moga), were selected for the study. An interview schedule was prepared to collect general and specific information from the village respondents. Results revealed that majority of the village respondents were illiterate and their monthly family income was Rs. 11,000-30,000 per month. The maximum rainfall infiltration was reported in Killianwali village followed by Rode and Talwandi Khurd, respectively. Majority of village respondents were residing in single story buildings. Out of the total respondents, 82.0 per cent of the families from the village Talwandi Khurd use submersible pump (200 to 350 feet) in their home whereas most of the families from village Killianwali uses rural water supply for the household activities. Majority of the respondents (62.0%) have only one toilet which was self-constructed. They cleaned their toilets on regular basis, do not use Use any chemicals and detergent to clean the pan and wash hands regularly. Majority of the respondents constructed their toilets way back during 16-20 years ago. Construction design of toilets, distance between the toilet and drinking water source was not found adequate; hence, it is suggested to build guidelines to minimize the risk of waterborne diseases.

Keywords: Groundwater, Onsite sanitation system, Rural households, Social and economic characteristics, Toilet

INTRODUCTION

Sanitation facilities are one of the management efforts to prevent and reduces environment pollution. It also contributes for human health care. However, majority of people living in the rural areas and on the urban fringes in developing countries still lack satisfactory sanitation. This might be due to the requirement of enormous investment in capital costs, high operation and maintenance cost for the construction of proper sewerage system to solve the problem of human waste management in India.

Septic tank and pit latrine modes of on-site sanitation systems are commonly used in India. However, onsite sanitation system employs unimproved sanitation facilities with unsafe management practices resulting into negative impact on the public health and the environment (Shivendra and Ramaraju, 2015). The effect of on-site sanitation systems on groundwater is a major worry, as urbanization makes it increasingly impossible to connect the entire rural area to the government's water supply and sanitation infrastructure.

It is critical to provide sanitation to all, as well as to make sure that this facility is hygienic and does not contribute to pollution. From the Census (2001), it was found that 74 per cent of urban India had access to sanitation and 46 per cent of urban Indians had water closets. However, it was unclear whether the flush toilets were connected to septic tanks, underground networks, or open drains. It's worth noting that only 32.7 per cent of urban Indians were connected to a piped sewer

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system, and 12.6 per cent around 50 million people still defecate in the open (Census, 2011). The problem is massive, and immediate action is required to ensure both sanitation and disposal. Rising population and subsequent division of dwelling units in rural areas has led to more congested living. The required distances between the source of underground water and the toilet pits are being overloaded due to paucity of space. Moreover under 'Swacchh Bharat Abhiyaan' launched by Government of India about 18.8 million toilets are to be constructed in the country by 2019. This has further reduced the distance between source of water and toilet pits also increasing the load of fecal waste. Thus, leading to pollution of underground water due to seepage and hampering of the natural filtration process due to shortage of space (Sharma, 2014). So, there is a need to collect the information regarding socio cultural, economic characteristics, construction and structure of toilets in rural households of Punjab, north-western India so that suitable strategies and remedial measures may be put in place well in time.

MATERIALS AND METHODS

Study sites and selection of households: From thickly populated villages i.e., village Killianwali (District Shri Muktsar Sahib), village Talwandi Khurd (District Ludhiana) and village Rode (District Moga), falling in respective ground water depth region were selected. A total of 150 households, 50 from each village were selected for the study.

Data collection: An interview schedule was prepared to collect relevant information from the village respondents.

a) General information: The first part of the interview schedule focused on collecting the socio-cultural characteristics of the respondents like education, family size and monthly family income of the respondents.

b) Specific information: A structured interview schedule was also developed to obtain specific information about the status of onsite sanitation system in the rural households, villages profile in terms of onsite sanitation system, existing practices while using toilet and information regarding construction and structure of toilets in rural households.

Statistical analysis: The collected data were coded, tabulated, analyzed and interpretated by using SAS software (SAS Institute, 2013). The descriptive statistical tools such as frequency and percentages were calculated to draw the inference from the study.

RESULTS AND DISCUSSION

The personal information of the respondents (Figure 1) revealed that 25 per cent of the respondents were illiterate followed by 29 per cent were primary passed, 19 per cent were high school passed, 12 per cent graduate and 8 per cent were post graduated. Only 7 per cent had passed intermediate level. The results showed that most of the respondents were not well educated. Among all the three villages most of the respondents were not well educated in Killianwali village than other two compared villages.

It was evident from the data (Table 1) that majority (62.6%) number of the respondents were having 5-9 members in their families, followed by less than 5 members (31.3%) and only 6.0 per cent of the respondents were having 10-14 members in their families.

As we know, income plays an important role in shaping the economic condition of family. Data in Table 1 revealed the monthly income of family. More than half of the respondent families (53.3%) had monthly family income between Rs. 11,000-30,000 per month. Near about 20.0 per cent of the respondent families had monthly family income between Rs. 31,000-50,000 per month. Nearly, 18.0 per cent of the

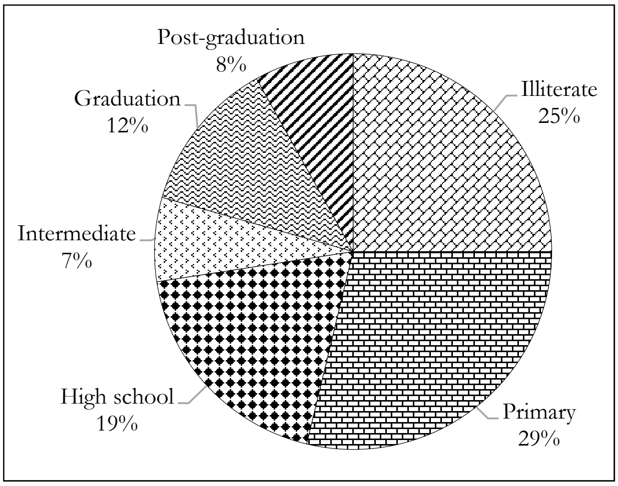

Figure 1: Education qualification of respondents (*Data pooled for three villages*) (n=150)

Table 1: Personal profile of the respondents (n=150)

Personal Profile	Killiawali (n_1=50)	Talwandi Khurd (n_2=50)	Rode (n_3=50)	Total (n=150)
Size of family				
Less than 5 members	13 (26.0)	8 (16.0)	26 (52.0)	47 (31.3)
5-9 members	34 (68.0)	38 (76.0)	22 (44.0)	94 (62.6)
10-14 members	3 (6.0)	4 (8.0)	2 (4.0)	9 (6.0)
Monthly family income (Rs.)				
<10,000	18 (36.0)	4 (8.0)	5 (10.0)	27 (18.0)
11,000-30,000	19 (38.0)	34 (68.0)	27 (54.0)	80 (53.3)
31,000-50,000	10 (20.0)	11 (22.0)	9 (18.0)	28 (20.0)
> 50,000	3 (6.0)	1 (2.0)	9 (18.0)	13 (8.6)

'f' Indicates frequency; '*' Indicates percentages

respondents have monthly family income less than Rs. 10,000 per month. Only 8.6 per cent of the respondents have family income more than Rs. 50,000 per month. All the three villages were having monthly income between 11,000-30,000 respectively.

General information of three villages of Punjab: The data in the Table 2 depicts the village profile with general information in terms of on-site sanitation system. From the data, it was found that all the three villages had only effluent (waste water) disposal system instead of onsite disposal and full sewerage systems. Common water supply was available either through submersible pumps or government rural water supply in all the three villages. The maximum depth of the ground water was found in Rode village (200-700 feet) followed by Talwandi Khurd village (200-300 feet). However, village Killianwali had minimum depth of ground water i.e., 40-100 feet.

Moreover, it was found that the soil is fertile in all the three villages and the type of soil found in Killianwali village was desert soil followed by sandy loam soil in Talwandi Khurd (Table 2). While, both type of soils was found in Rode village. In addition to this, the maximum rainfall infiltration was reported in Killianwali village (24%) followed by Rode (23%) and Talwandi Khurd (22%), respectively.

Status of on-site sanitation system in rural households of Punjab: Data in Table 3 revealed the

Table 2: Villages profile in terms of onsite sanitation system of Punjab (n=3)

Parameters	Killianwali	Talwandi Khurd	Rode
Method of sewage disposal in the village			
On-site disposal system	-	-	-
Effluent (waste water) disposal system	√	√	√
Full sewerage system	-	-	-
Common water supply in the village			
Yes	√	√	√
Depth of ground water in area	40’ – 100’	200’ – 300’	200’ – 700’
Soil profile of the area			
Fertile	√	√	√
Soil type			
Sandy loam soil	-	√	√
Desert soil	√	-	√
Rainfall infiltration factor (%)	24	22	23

Table 3: Status of on-site sanitation system in rural households of Punjab (n=150)

Parameters	**Frequency (%)**			
	Killianwali (n_1=50)	**Talwandi Khurd (n_2=50)**	**Rode (n_3=50)**	**Total (n=150)**
Type of building				
Single story	31 (62.0)	27 (54.0)	21 (42.0)	79 (52.6)
Double story	17 (34.0)	17 (34.0)	20 (40.0)	54 (36.0)
More than two story's	2 (4.0)	6 (12.0)	9 (18.0)	17 (11.3)
Source of water supply				
Rural water supply	31 (62.0)	9 (18.0)	11 (22.0)	51 (34.00)
Submersible pump	13 (26.0)	41 (82.0)	35 (70.0)	89 (59.33)
Both	6 (12.0)	0 (0.0)	4 (8.0)	10 (6.66)
Depth of specific water source				
50'-200'	15 (30.0)	7 (14.0)	0 (0.0)	22 (14.66)
201'-350'	4 (8.0)	34 (68.0)	13 (26.0)	51 (34.00)
351'-500'	0 (0.0)	0 (0.0)	15 (0.0)	15 (10.00)
>500'	0 (0.0)	0 (0.0)	7 (14.0)	7 (4.66)
No. of toilets in home				
0-1	28 (56.0)	31 (62.0)	34 (68.0)	93 (62.0)
1-2	17 (34.0)	15 (30.0)	9 (18.0)	41 (27.3)
>2	5 (10.0)	4 (8.0)	7 (14.0)	16 (10.6)
Type of toilet				
Bathroom-cum-toilet	12 (24.0)	6 (24.0)	5 (10.0)	23 (15.33)
Separate toilet	38 (76.0)	44 (88.0)	45 (90.0)	127 (84.66)
Construction details				
Self-constructed	50 (100.0)	50 (100.0)	50 (100.0)	150 (100)
Location of toilet				
Attached	7 (14.0)	6 (12.0)	4 (8.0)	17 (11.33)
Separate	43 (86.0)	44 (88.0)	46 (92.0)	133 (88.66)

'f' Indicates frequency; '*' Indicates percentages

status of onsite sanitation system in rural households of Punjab. It was found that more than half of the respondent families (52.6%) were residing in single story buildings, followed by double story (36.0%) and around 11.30 per cent of the respondents resided in more than two story building (Table 3). Among the three villages, Killianwali village had maximum number of the respondents i.e., 62.0 per cent, living in single story building compared to other two villages.

The data (Table 3) on source of water supply in rural households revealed that more than half of the respondents (59.33%) use submersible pumps and 34.00 per cent of the respondents use government rural water supply, whereas, 6.6 per cent of them using both the source of water supply in their home. Out of the total respondents, 82.0 per cent of the families of Talwandi Khurd village use submersible pump in their home whereas, most of the families (62.0%) of Killianwali village uses rural water supply for the household activities. Around 34.0 per cent of the respondents have 201-350 feet depth of specific water source at their home. Least 4.66 per cent of the respondents have more than 500 feet depth of water source.

Majority of the respondents (62.0%) had only one toilet and 10.6 per cent of them had more than two toilets in their home (Table 3). Majority of the respondents (84.6%) had separate toilets in their home and only 15.3 per cent uses bathroom-cum-toilet in their home. All the respondents (100.0%) had self-constructed toilets in their home. Around 88.6 per cent of the respondents had separate toilet location in their home whereas, 11.3 per cent of the respondents had attached location.

Existing practices while using toilet: The Table 4 gives an overview of existing practices while using the toilet. It was found that respondents from Rode village were more in number and they use to pour little quantity of water on the pan before using it, followed by Killianwali and Talwandi Khurd respondents. Hence, in total only 12.7 per cent of the respondents use to pour the water on pan before using it.

Further, respondents from village Talwandi Khurd were found to be more in number in practicing the sweeping of floor and picking trash (Table 4). In total 14.0 per cent of respondents were reported to practice the sweeping and trash picking activity. It was clearly seen that majority of the respondents (85.0%) cleaned their toilets on regular basis and 66.0 per cent of the respondents clean their toilet brushes after use. Majority (98.0%) ventilate their toilet by switching on exhaust fan or opening the window and door. Nearly, 90.0 per cent of the respondents use any chemicals and detergents to clean the pan. Form the point of hygiene, it was reported that all the respondents stated that they use to wash their hands regularly after using the toilet.

Specific information regarding construction and structure of toilets in rural households of Punjab: Data in Table 5 gives an overview about the information regarding construction and structure of toilets. To begin with, the year of construction of toilet, it was found that about 31.30 per cent of the respondents constructed their toilets way back during 16-20 years ago. Only 2.0 per cent of the respondents have constructed their toilets which was more than 20 years ago.

Regarding, the horizontal distance of toilet from the source of water, it was found (Table 5) that majority of the respondents (68.6%) toilets have less than 5meter distance whereas, only 4.0 per cent of them have 11–15 meter distance from source of water. Subsequently, the super structure of toilet, it was observed that majority of the respondents (79.3%) have 4'*6' to 6'*8' size for their toilet. Likewise, the majority of the respondents (78.0%) stated that they use Indian toilet over western style. In the majority of the respondents (755.3%) home, the diameter of trap and water seal zone was found to be 1-1.5 inches.

More than half of the respondents (54.0%) use running water supply in their toilet compare to 46.0 per cent of the respondents using stored water. Regarding, the requirement of water it was observed that more than half of the respondents (51.3%) use 1-5 litre and only 9.3 per cent of the respondents use 11-15 litre. In view with the sub- structure detailing of toilet construction.

In view with the sub- structure detailing of toilet construction, it was seen from Table 4.7 that 78.0 per cent of the respondents have sufficient volume of pit to store sludge. Subsequently, for design of onsite system 71.3 per cent of the respondents use septic tank. In addition to alteration of the pit design as per the

Table 4: Existing practices while using toilet (n=150)

Statements	Killianwali (n_1=50)	Talwandi Khurd (n_2=50)	Rode (n_3=50)	Total (n=150)
Pour little quantity of water on the pan before it is used	6[†] (12.0[*])	5 (10.0)	8 (16.0)	19 (12.7)
Sweep the floor and pick up and trash	3 (6.0)	10 (20.0)	8 (16.0)	21 (14.0)
Regular cleaning of toilets	41 (82.0)	42 (84.0)	45 (90.0)	128 (85.3)
Clean your toilet brushes	15 (30.0)	44 (88.0)	40 (80.0)	99 (66.0)
Ventilate your toilet	48 (80.0)	50 (100.0)	50 (100.0)	148 (98.7)
Use any chemicals and detergent to clean the pan	44 (88.0)	42 (84.0)	45 (90.0)	131 (87.3)
Wash your hands regularly	50 (100.0)	50 (100.0)	50 (100.0)	150 (100.0)

'†' Indicates frequency; '*' Indicates percentages

Table 5: Information regarding construction and structure of toilets in rural households (n=150)

Specific information	Killianwali (n_1=50)	Talwandi Khurd (n_2=50)	Rode (n_3=50)	Total (n=150)
Year of construction of toilet				
1-5 years	10[f] (20.0[*])	8 (16.0)	4 (8.0)	22 (14.6)
6-10 years	12 (24.0)	15 (30.0)	15 (30.0)	42 (28.0)
11-15 years	10 (20.0)	12 (24.0)	14 (28.0)	36 (24.0)
16-20 years	18 (36.0)	12 (24.0)	17 (34.0)	47 (31.3)
> 20 years	0 (0.0)	3 (6.0)	0 (0.0)	3 (2.0)
Horizontal distance of toilet from source of water				
<5 meters	29 (58.0)	41 (82.0)	33 (66.0)	103 (68.6)
6-10 meters	17 (34.0)	13 (26.0)	11 (22.0)	41 (27.3)
11-15 meters	1 (2.0)	2 (4.0)	3 (6.0)	6 (4.0)
Super structure				
Size of toilet room				
4'x 6' to 6'x 8'	37 (74.0)	43 (86.0)	39 (78.0)	119 (79.3)
8' x 10' to 10' x 12'	15 (30.0)	9 (18.0)	7 (14.0)	31 (20.6)
Type of WC seat				
Indian	41 (82.0)	36 (72.0)	40 (80.0)	117 (78.0)
Western	9 (18.0)	14 (28.0)	10 (20.0)	33 (22.0)
Diameter of trap and water seal zone				
1"-1.5"	38 (76.0)	35 (70.0)	40 (80.0)	113 (75.3)
1.5" -2"	12 (24.0)	15 (30.0)	10 (20.0)	37 (24.6)
Source of water supply in the toilet				
Running supply	12 (24.0)	35 (70.0)	34 (68.0)	81 (54.0)
Stored water	38 (76.0)	15 (30.0)	16 (32.0)	69 (46.0)
Requirement of water per use of toilet				
1-5 litres	37 (74.0)	21 (42.0)	19 (38.0)	77 (51.3)
6-10 litres	5 (10.0)	25 (50.0)	29 (58.0)	59 (39.3)
11-15 litres	8 (16.0)	4 (8.0)	2 (4.0)	14 (9.3)
Sub structure detail				
Sufficient volume of pit to store sludge				
Yes	37 (74.0)	39 (78.0)	41 (82.0)	117 (78.0)
Design of onsite system				
Soak pit	23 (46.0)	11 (22.0)	9 (18.0)	43 (28.6)
Septic tank	27 (54.0)	39 (78.0)	41 (82.0)	107 (71.3)
Alteration of the pit design as per local soil conditions				
Yes	33 (66.0)	29 (58.0)	37 (74.0)	99 (66.0)
Common pit for two or more individual toilets				
Yes	46 (92.0)	48 (96.0)	47 (94.0)	141 (94.0)
Problem of rodents and insect				
Yes	11 (22.0)	9 (18.0)	15 (30.0)	35 (23.3)

'f' Indicates frequency; '*' Indicates percentages local soil condition, it was found that the majority of the respondents (66.0%) have done the alterations. Around 34.0 per cent of the respondents have not done any alteration. While majority of the respondents (94.0%) have made the common pit for two or more individual toilets. Further, 76.6 per cent of the respondents faced no problem of rodents and insects in their toilets or nearby area.

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Performance of Integrated Watershed Management Programme (IWMP): A Study from Nagaland, India

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ABSTRACT

A critical issue in development scenario is how to achieve the exact implementation of development plan to get the maximum outcome from the implementation of developmental initiative. This paper is an attempt to assess the performance of IWMP in Nagaland, India. Altogether, 120 beneficiaries of IWMP were included as study community. Physical and financial performances were taken into consideration. It had significantly contributed through the adoption of rubber cultivation, horticultural crops cultivation, agroforestry and forest trees cultivation. The area under shifting cultivation had shown a significant decline. The overall cropping intensity also had significantly increased under IWMP. Various soil and moisture conservation activities, namely, 'contour bund', 'water harvesting structure' and 'half-moon' terrace were adopted by the beneficiaries under IWMP. Further, it had remarkably contributed to the livestock sector and increased the income of the beneficiaries from different occupational activities and monthly expenditure of beneficiaries. Owing to the implementation of the project, the possession of the bank account of beneficiaries had reached up to 72.00 per cent. Considering the sources of credit of the beneficiaries, the most common source of credit was the local moneylenders with a higher rate of interest, which remarkably switched to SHGs with a relatively lower rate of interest. The overall (physical and financial) performance of IWMP in Nagaland, India was satisfactory and policy process should take the issues into consideration for socio-economic up-scaling of rural people through watershed approach.

Keywords: Cropping intensity, Cropping pattern, Financial performance, IWMP, Performance of IWMP, Physical performance

INTRODUCTION

The concept and history of watershed development in India started way back in 1880 with the Famine Commission and then in the Royal Commission of Agriculture in 1928. Both Commissions laid the foundation for organized research in a watershed framework. Later, a number of watershed development programmes were organized as multidisciplinary and multi-agency and functionally participatory with the active involvement of farmers of the watershed (Joshi *et al.,* 2004). The present participatory approach incorporates all the elements of soil and water conservation along with improvement in agricultural and social infrastructure, market and credit access as well as introduction of new agricultural technologies all bundled together under the generic name of watershed development (NABARD, 2006).

The Indian economy is agrarian and vulnerable to climatic factors (Patra and Babu, 2017). Water is the most important input for agriculture and crop production. The plant needs it continuously with optimum quantity. Proper management of available water can bring a remarkable change in the production, the productivity of crops (Patra, 2004). In 2008, based on the government's decision to condense the Centrally-sponsored schemes, the "Integrated Watershed Management Programme" was designed and implemented as a government's flagship programme. The former area development programmes of the Department of Land Resources, *viz.* Drought Prone Areas Programme (DPAP), Desert Development

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Programme (DDP) and Integrated Wastelands Development Programme (IWDP) have been integrated into a single modified programme called "Integrated Watershed Management Programme (IWMP)" which was launched in 2009-10. IWMP was launched with the objectives of restoring the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water. IWMP was implemented based on Common Guidelines 2008, issued by the Department of Land Resources, GOI revised in 2011.

In Nagaland, IWMP was launched during 2009-2010 and has been implemented successfully by the Department of Land Resources in all the 11 districts of the state. IWMP is being implemented in the state to increase the overall agricultural production and improve the farmers' livelihood. It has become the main intervention for natural resource management in terms of soil and moisture conservation measures in agricultural lands, water resource management, plantation and afforestation, which directly or indirectly contribute to enhancing the livelihood of the participants. In the development sector, the contribution of all stakeholders is key to the successful implementation of the programme (Patra *et al.,* 2012).

In recent years, Integrated Watershed Management (IWM) has been identified as a key for planning and management of natural resources in mountain ecosystems. It provides an ecologically sound economic base for the watersheds and their people. In any developmental activity, the watershed approach is more scientific because the inherent potential of soil, water and forest recourses in a particular area is controlled by various factors such as physiography, geological base, soil characteristic, climate, present land use, socio-economic aspects etc. (Rawat, 1997). The watershed approach to natural resource management connects all the components–economy, society, environment and forms a comprehensive approach to the management of agriculture, forestry and allied activities in the proposed watershed (Rao, 2000).

A number of researches have been undertaken to ascertain the benefits of different watershed projects, taking into account various domains/interventions. The evaluation and impact assessment of watershed development programmes helps in ascertaining the response of the project beneficiaries to the inputs, services and other assistance and the effects of project on water resources, agricultural production, and fodder and fuel production in the watershed area. It has been pointed out that the watershed development activities have made significant positive impacts on various biophysical aspects such as soil and water conservation, soil fertility, cropping patterns, cropping intensity, production and productivity of crops (Singh, 2000). The watershed project significantly affects the agricultural and non-agricultural incomes, employment, forestry, cropping pattern, and production and productivity of different crops. It addresses the issues of generating natural resources and enhancing of rural livelihoods, especially in rainfed areas (Shah *et al.,* 2009).

Another study by Pathak *et al.* (2013) on Gokulpura-Goverdhanpura watershed reported that with the watershed interventions, there was a significant increase in the cultivation of high-value crops, *viz.* vegetables and horticulture. Kulshrestha *et al.* (2014) studied the impact of the watershed programme in Budhara watershed of Morena district of Madhya Pradesh and reported a positive change in the agricultural area, irrigated area, cropping intensity and area of horticultural crops. Based on the review made by Joshi *et al.* (2004), the introduction of the watershed programmes resulted in increased crop productivity, increased employment, better crops and cropping systems, which ensure higher and regular cash flow, the additional area under sustained irrigation and cropping, and reduced production risks. Further, Ao and Patra (2018) reported from Nagaland, India, that IWMP had significantly influenced in social up-scaling of beneficiaries.

MATERIALS AND METHODS

The present study was conducted in the Wokha district of Nagaland, India. Wokha is situated in the mid-west of the State of Nagaland and adjoins the Golaghat plain of Assam on the west and is mostly inhabited by the Lotha tribe. It is situated at a latitude of 26′8" North and a longitude of 94′18" East. The altitude ranges from 230M – 2200M (MSL). The district covers an area of 1,628 sq. km and represents 9.82 per cent of the total area of the State of Nagaland (16,579 sq.km.). In terms of area, the district ranks the fifth position among the eleven districts. The district has 5 rural development blocks (Census of India, 2011). Wokha District enjoys three Agro-climatic zones -Sub-Temperate climate, Mid-Tropical and Sub-tropical climate with further sub-classification of three distinct soil types - High Hills Areas with lateritic soils and non-lateritic red soils, Lower Hills ranges of brown forest soils and podzolic soils, and Foothills Valleys with recent alluvium, old alluvium and mountains soils. As the district is characterized by hilly, undulating terrain, with Jhum cultivation as the main livelihood activity, sustainable economic activity has slow progress. Hill agriculture is vehemently different from plains agriculture (Mukherjee *et al.,* 2019). As a result of excessive *jhumming* activity, there is the rapid degradation of forest land, soil erosion and decreased water table. With the decreasing *jhum* cycle to 4-5 years, which earlier was a cycle of 6-8 years, and increasing rural population leading to larger utilization of *jhum* land, the once fertile land has been exhausted, leading to low productivity of *jhum* paddy and other agricultural produces (DoLR, Wokha, 2009). With a view to addressing the stated problems faced by the farming community, the introduction of a planned watershed management programme was considered much needed. This came to fruition with the implementation of IWMP in the District. The first batch of the project under the Wokha district consisted of IWMP-I and IWMP-II. These projects were implemented in 2009 and completed in the year 2014. IWMP-I and IWMP-II were purposively selected for the study as the other projects were still on-going. For the study, the selection of villages from the completed batch was done in consultation with the watershed development teams (WDT) of the project area. Altogether, 12 villages were selected from IWMP-I and IWMP-II, and a total of 120 beneficiaries were included as respondents and interviewed. To assess the performance of IWMP, the study was concentrated on physical and financial performance and carried out. In order to assess the physical and financial performance more accurately, a comparative method of data collection was applied, i.e., the status of the study area 'before' and 'after' IWMP. For assessing the physical performance in the sampled area, various indicators like change in cropping pattern, changes in cropping intensity, adoption of alternate land use system and changes in livestock composition were selected. Similarly, for financial assessment, indicators like income from different sources, savings behaviour and sources of credit were taken into account. The data were collected through personal interviews using an interview schedule. Important statistical analyses, namely, frequency, percentage and z test were used to bring the valid conclusion.

RESULTS AND DISCUSSION

The findings of the research are presented and discussed in this section. The performance of the development programme immensely depends on the active participation of beneficiaries in the programme (Ao *et al.,* 2019), and IWMP is not an exception.

***Change in cropping pattern*:** Crop based activities with different components remain a source of income and livelihood (Gamlin and Patra, 2019). In the North Eastern Region of India, shifting cultivation is predominant (Patra *et al.,* 2019). It was found that the total area under shifting cultivation among the beneficiary respondents BP was 396.5 acres, and AP declined to 230.5 acres (Table 1). The mean cultivated area BP and AP were 3.30 acres and 1.81 acres, respectively, with a mean difference of -1.50 acres. The study shows that there has been a massive decline in the area under shifting cultivation after IWMP, which may be because, after implementation of IWMP, the beneficiaries diverted their interest of farming from

Table 1: Change in cropping pattern of the beneficiaries of IWMP- before project (BP) & after project (AP) (N=120)

Area under different crops	Total cultivated area (Acre)		Mean cultivated area (Acre)		Mean difference	*z* value	*z*-critical (two tailed)	*p*-value
	BP*	AP#	BP*	AP#				
Shifting cultivation	396.5	230.5	3.30	1.81	-1.50	-6.46**	1.96	1.07738E-10
Rubber cultivation	21.5	306.3	0.18	2.55	2.37	13.94**	1.96	0
Horticultural crops	31.2	99.85	0.26	0.85	0.59	5.53**	1.96	3.19605E-08
Forest trees	15.75	41.9	0.13	0.35	0.22	3.03**	1.96	0.00243

*= Before project; #= After project; **Significant at 1 per cent level

shifting cultivation to settled cultivation of high-value crops under the project. The mean change in area under shifting cultivation BP and AP was negatively significant with a z value of -6.46.

With respect to the area under rubber cultivation, only 21.5 acres was under rubber cultivation prior to the implementation of IWMP, but with the intervention of IWMP, the area increased to 306.3 acres. The mean cultivated area increased from 0.18 BP to 2.55 AP with a mean difference of 2.37. Thus, the area under rubber cultivation showed a tremendous increase in AP implementation. Also, the z test result showed that the change in area under rubber cultivation BP and AP was highly and positively significant with a z value of 13.94. Patra *et al.* (2020) reported from another part of Nagaland, India, that rubber cultivation had contributed around 87.00 per cent to annual income.

In the case of horticultural crops, there was a tremendous increase in the total area from 31.2 acres BP to 99.85 acres AP implementation. The mean of cultivated area BP was 0.26, and it increased to 0.85 AP with a mean difference of 0.59. The z test result showed that the change in the cultivation area under horticultural crops was highly significant, with a z value of 5.53. Despite that, need-based government intervention and policy support are needed to capitalize on the potential of horticulture (Verma *et al.,* 2021).

Table 1 also clearly shows the influence of IWMP in respect of change in area under forest trees. The total area under forest increased to 41.9 acres from 15.75 acres within the period of implementation of IWMP. The mean area under forest was 0.13 BP and 0.35 AP, with a mean difference of 0.22. The z test result showed that the change in the area of cultivation under horticultural crops was highly significant, with a z value of 3.03. From Table 1, it can be observed that shifting cultivation which occupied the dominant area under cultivation prior to the implementation of IWMP had been taken over by rubber cultivation and other commercial crops. Except for the decline in the area under shifting cultivation, there had been a gradual increase in the areas under rubber cultivation, horticultural crops and forest trees, which leads to conclude that IWMP had influenced the beneficiaries to a great extent in terms of cropping pattern. Adequate capacity strengthening of functionaries and beneficiaries has a direct influence on the development process (Patra and Mondal, 2007), and intervention of IWMP has contributed accordingly.

***Change in cropping intensity*:** Table 2 represents the information of the beneficiaries regarding the influence of IWMP on change in cropping intensity and their distribution into low, medium and high cropping intensity BP and AP implementation along with the calculated value of z test.

After the implementation of IWMP, Table 2 indicates that there had been a significant increase in the cropping intensity of the beneficiaries. It can be inferred from the table that the percentage of beneficiaries falling under medium cropping intensity (116-125%) increased from 37.50 per cent BP to 50.83 per cent AP. Under high cropping intensity (126% and above), the percentage of beneficiaries increased from 9.17 per cent BP to 47.00 per cent AP. As such, there had been a tremendous decline in the percentage of beneficiaries under low cropping intensity from 53.33 per cent BP to 10.00 per cent AP implementation which signified that the beneficiaries were taking up a greater number of crops in a year in a particular plot of land, thus contributing to increase in cropping intensity. The

Table 2: Influence of IWMP on change in cropping intensity of beneficiaries (N=120)

Category	**BP***		**AP#**		**Overall cropping intensity**		***z*-value**	***z*-critical (two tailed)**	***p*-value**
	F	**%**	**F**	**%**	**BP**	**AP**			
Low (up to 115)	64	53.33	12	10					
Medium (116-125)	45	37.5	61	50.83	107	126	6.103**	1.96	1.04037E-09
High (126 and above)	11	9.17	47	39.17					
Total	120	100	120	100					

*= Before project; #= After project; **Significant at 1 per cent level

z test result showed that the change in cropping intensity BP and AP was highly and positively significant with a z value of 6.103.

From the above results, it can be concluded that the majority of the beneficiaries were in the medium category followed by the high category after the project implementation, which might be the result of various soil and water conservation activities carried out by IWMP, which led to the increase in ground water table, enabling the beneficiaries to take up multiple crops in the same piece of land during the same agricultural year.

Adoption of the alternate land-use system: Adoption of improved technologies is meant for sustainable development (Patra and Kense, 2020). Various studies proved that the adoption behaviour of farmers has a direct influence on the socio-economic condition of the farmers (Patra *et al.,* 2018 and 2019). The information in table 3 indicates the changes that took place in the alternate land-use system of the beneficiaries BP and AP implementation. The table shows that the percentage of beneficiaries engaged in agro-horticultural activities had increased significantly from 22.00 per cent BP to 53.00 per cent AP. Also, there was a considerable increase of beneficiaries engaged in agroforestry from 9.00 per cent BP to 18.00 per cent AP.

Table 3: Influence of IWMP on beneficiaries to adopt alternate land-use system (N=120)

Category	BP*		AP#	
	F	%	F	%
Agro-horticulture	26	22	64	53
Agro-forestry	11	9	22	18
Not adopted	83	69	34	29
Total	120	100	120	100

*= Before project; #= After project

Horticulture has immense potential for the economic development of the country (Sahu *et al.,* 2021). The findings from the above table showed that the farmers had taken up agro-horticulture and agro-forestry on a much larger scale after the implementation of IWMP. The reason might be that the project had imparted knowledge on how to convert fallow and wastelands into income-generating land-use systems by taking up agro-horticulture and agro-forestry.

***Change in livestock population*:** The difference in possession of livestock by beneficiaries of IWMP of the study area and pattern of change in possession of these, BP and AP is presented in Table 4. In Nagaland, India livestock sector is playing an important role in livelihood and nutrition security (Benjongtoshi and Patra, 2020 and 2021). It depicts that the poultry population was found to be the highest and most commonly reared livestock with a mean of 6.92 BP, which had increased to 8.43 AP. The difference in the mean BP and AP was 1.51. The z analysis showed that the difference was not significant (z= 0.75, p=0.454). Pig rearing was the second most reared livestock, as observed from the table with a mean of 1.22 BP and 1.33 AP. The table showed a slight increase in the population of pigs with a mean difference of 0.11. The z test showed no significant difference (z=1.603, p=0.109) BP and AP in terms of pig rearing. Other categories of livestock, *i.e.* cattle and duck, showed a considerable decline in the growth AP implementation as compared to BP and were found to be of little importance among the beneficiaries. In the case of cattle, the mean decreased from 0.23 BP to 0.06 AP with a mean difference of -0.17 and the z test showed no significant difference (z=-0.990, p=0.322). The mean

Table 4: Influence of IWMP in pattern and growth of livestock population

Livestock status	Total number		Mean		Mean difference (BP-AP)	z-value	z-critical (two tailed)	p-value
	BP*	AP#	BP	AP				
Pig	146	159	1.22	1.33	0.11	0.75^{NS}	1.96	0.454
Poultry	830	1011	6.92	8.43	1.51	1.603^{NS}	1.96	0.109
Cattle	28	7	0.23	0.06	-0.17	-0.990^{NS}	1.96	0.322
Duck	19	13	0.16	0.11	-0.05	-0.461^{NS}	1.96	0.645

*= Before project; #= After project; NS=non-significant

of duck population was 0.16 BP, and it decreased to 0.11 AP, with a mean difference of -0.05 and showed no significant difference between BP and AP (z=-0.461, p=0.645).

Overall, it can be observed that there had been no remarkable improvement with regard to livestock population, which may be due to the reason that the farmers, in general, reared livestock only for meeting the meat requirement of the family and did not put much effort to consider livestock as a means of generating income for the family even after the intervention of IWMP. Another reason might be that there had been no animal health workers in the project villages to attend during the disease occurrence.

Based on the size of the livestock population, the beneficiaries were classified into low, medium and high categories and have been presented in Table 5. The table shows that the percentage of beneficiaries belonging to the low category decreased from 53.00 per cent BP to 33.00 per cent AP, which can be stated as a huge improvement. It can also be observed that the beneficiaries belonging to the medium category increased from 23.00 per cent BP to 40.00 per cent AP and, in the case of beneficiaries belonging to a high category, it can be seen that the per cent increase was from 24.00 per cent BP to 27.00 per cent AP.

Table 5: Categorization of beneficiaries of IWMP based on the change in possession of livestock population N=120

Category	BP*		AP#	
	F	%	F	%
Low (up to 7)	63	53	40	33
Medium (8-14)	28	23	48	40
High (15 and above)	29	24	32	27
Total	120	100	120	100

*= Before project; #= After project

Financial aspects: Financial performances of the beneficiaries had been assessed under different aspects viz., monthly income from different activities, monthly household expenditure, and pattern of savings and credit.

***Monthly Income from different activities*:** Table 6 represents the monthly income of the beneficiaries from different activities in which they are associated i.e., agriculture, livestock, service, earnings from daily wages, migration, and others. It could be seen from the table that the mean income from agriculture achieved a significant increase from Rs. 686 BP to Rs. 1,695 AP and a mean difference of Rs. 1,009 with a z value of 4.974 and p-value of 6.56E-07. The z test showed that the difference was highly significant. In the case of income from livestock, it can be seen from the table that the mean monthly income BP was Rs. 830 whereas AP the mean monthly income had increased to Rs. 1,240 and showed a mean difference of Rs. 410. The z test shows that the difference was highly significant (z= 3.968, p= 7.25E-05). The mean income from service increased from Rs. 3,038 BP to Rs. 3,929 AP with a mean difference of Rs. 891. The z test shows that there was no significant difference between BP and AP (z=1.002, p=0.3166). The earning from daily wage had shown a slight increase with a mean income of Rs. 344 BP to Rs. 447 AP and had a mean difference of Rs. 103. The z test did not show any significant difference (z=1.844, p=0.0652). Monthly income earned through migration to nearby towns had also shown a slight increase with a mean monthly income of Rs. 135 to Rs. 219, with a mean difference of Rs. 84. The z test did not show a significant

Table 6: Influence of IWMP in respect of monthly income from different activities (in Rs.) (N=120)

Category	Monthly mean income (BP)*	Monthly mean income (AP)#	Mean Difference	*z*-test	*z*-critical (two tailed)	*p*-value
Agriculture	686	1695	1009	4.974**	1.96	6.56E-07
Livestock	830	1240	410	3.968**	1.96	7.25E-05
Service	3038	3929	891	1.002^{NS}	1.96	0.31661
Daily wages	344	447	103	1.844^{NS}	1.96	0.065188
Migration	135	219	84	0.797^{NS}	1.96	0.425483
Others	798	1440	642	2.664**	1.96	0.007732

*= Before project; #= After project; **Significant at 1 per cent level

difference (z=0.797, p=0.4255). Income from other miscellaneous sources of occupation had increased from Rs. 798 to Rs. 1,440 and showed a mean difference of Rs. 642 with z value of 2.664 and p-value of 0.0077, which showed that the difference BP and AP were highly significant.

Monthly expenditure: Another means of assessing the financial performance of the beneficiaries under IWMP was analysed by taking into account the number of beneficiaries shifted to higher monthly expenditure groups. The beneficiaries were classified on the basis of their monthly expenditures incurred before and after project implementation, and the information so obtained have been presented in Table 7. The information given in Table 7 shows that after the implementation of IWMP, there had been a decline in the number of beneficiaries from 63.00 per cent to 28.00 per cent under the monthly expenditure group of < Rs. 5,000. Whereas, in case of monthly expenditure groups ranging from Rs. 5,000 - Rs. 10,000, Rs. 10,001 - Rs. 15,000, and Rs. 15,001 - Rs. 20,000, the number of beneficiaries increased from 23.00 per cent to 45.00 per cent, 8.00 per cent to 13.00 per cent and 3.00 per cent to 8.00 per cent, respectively. It was also observed from the table that there was no beneficiary in the monthly expenditure group of Rs. 20,001 - Rs. 25,000 and Rs. 25,001 - Rs. 30,000 BP but increased to 3.00 per cent and 1.00 per cent, respectively AP implementation. Beneficiaries with monthly expenditure > Rs. 30,000 had shown a negligible decrease from 3.00 per cent to 2.00 per cent AP.

Table 7: Distribution of beneficiaries of IWMP based on pattern of change in monthly expenditure (N=120)

Expenditure groups (Rs.)	BP*		AP#	
	F	%	F	%
<5,000	76	63	33	28
5,000-10,000	27	23	54	45
10,001-15,000	10	8	16	13
15,001-20,000	4	3	10	8
20,001-25,000	0	0	4	3
25,001-30,000	0	0	1	1
>30,000	3	3	2	2
Total	120	100	120	100

*= Before project; #= After project

Savings and credit: The information in Table 8 shows the pattern of savings and credit of the beneficiaries before and during the project period. It could be observed that in the case of a savings account, only 43.00 per cent of the beneficiaries had a savings account in various banks, whereas 57.00 per cent did not have any savings account BP. It could also be observed that with the implementation of IWMP, the number of beneficiaries with savings accounts increased to 72.00 per cent and by then, only 28.00 per cent did not have a savings account.

The table also depicted the financial status of the beneficiaries in terms of annual savings patterns. It

Table 8: Influence of IWMP in savings and credit pattern of beneficiaries (N=120)

Savings account	BP*		AP#	
	F	%	F	%
Savings account holder	51	43	87	72
No savings account	69	57	33	28
Savings (annually in Rs.)				
No savings	81	67	54	45
Low savings (up to 1,500)	21	18	11	9
Medium savings (1,501-3,000)	12	10	34	28
High (above 3,000)	6	5	21	18
Credit source				
Money lender (8%-10% interest/month)	26	22	15	13
Bank (7%-9% interest/annum)	3	3	5	4
SHG (4%-5% interest/month)	5	4	23	19
Family/friends (3%-4% interest/month)	12	10	20	17

*= Before project; #= After project

could be observed that the percentage of beneficiaries who did not make any savings was reduced from 67.00 per cent to 45.00 per cent after IWMP. In the category of low savings (up to Rs. 1,500), the percentage of beneficiaries declined from 18.00 per cent to 9.00 per cent. On the contrary, it was observed that there had been a tremendous increase in the percentage of beneficiaries under the medium savings category (Rs.1,501-3,000) from 10.00 per cent to 28.00 per cent There was also an increase of beneficiaries from 5.00 per cent to 18.00 per cent under high saving category (>Rs. 3,000).

The table also gives information on the various sources through which the beneficiaries obtain their credit requirements before and after the implementation of IWMP. It can be seen that the percentage of beneficiaries who took credit from money lenders decreased from 22.00 per cent to 13.00 per cent after IWMP. The interest rate of money lenders varies from 8.00 per cent to 10.00 per cent per month. Credit acquired through the bank with an interest rate of 7.00 per cent to 9.00 per cent per annum showed a slight increase from 3.00 per cent to 4.00 per cent whereas in the case of credits through SHG with an interest rate of 4.00 per cent to 5.00 per cent per month, there was a significant increase from 4.00 per cent to 19.00 per cent. Credit taken from family/friends with an interest rate of 3.00 per cent to 4.00 per cent also showed a significant increase from 10.00 per cent to 17.00 per cent.

From the findings, it could be observed that the formation of the SHGs with the assistance of IWMP, which gave out credit/loan at a very reasonable rate of interest, had enabled the beneficiaries to ease off from the high rate of interest from the money lenders. Patra, Odyuo and Mondal (2015) also reported that the group approach impacted rural development. At the same time, a very negligible per cent of the beneficiaries and non-beneficiaries availed credit from the banks, which might be due to the difficult procedure of the bank loans.

CONCLUSION

To assess the performance of IWMP, this paper examines physical and financial performance. Concerning physical performance, the study shows that IWMP had significantly contributed to the adoption of rubber cultivation, horticultural crops cultivation, agroforestry and forest trees cultivation under the scheme. The area under shifting cultivation had shown a significant decline during the project period. The overall cropping intensity also had significantly increased after the implementation of IWMP. Various soil and moisture conservation activities were adopted by the beneficiaries under IWMP. Namely, adoption of 'Contour bund' by 62.00 per cent, adoption of 'water harvesting structure' by 38.00 per cent and 'half-moon' terrace was adopted by 18.00 per cent of the beneficiaries due to the intervention of the project. Further, it had remarkably contributed to the livestock sector and increased in possession of livestock by beneficiaries.

In respect of the financial performance of IWMP, there was an overall increase in the income of the beneficiaries from different occupational activities. The monthly expenditure of beneficiaries was also increased. Owing to the implementation of the project, the possession of the bank account of beneficiaries had reached up to 72.00 per cent as compared to 43.00 per cent before the project. Considering the sources of credit of the beneficiaries, the most common source of credit was the local moneylenders with a higher rate of interest, which remarkably switched to SHGs with a relatively lower rate of interest. Therefore, the overall (physical and financial) performance of IWMP in Nagaland was satisfactory and concerned authorities should take the initiative for large scale implementation and socio-economic up-scaling of beneficiaries.

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Economics of Capsicum Crop Under Protected Cultivation

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ABSTRACT

In the present study an attempt has been made to study the economic benefits derived by respondents (150) growing capsicum under poly house in six district of Punjab. In main season, glut of vegetable arises in the market which lowers down the price. Due to shortage of processing industry and storage infrastructure, off season vegetable is the viable option to enhance the income and quality of produce. The findings of the study revealed that maximum number of respondents (63.15%) obtained the capsicum yield between 236 to 304 quintals per acre. About 27 per cent of respondents obtained capsicum yield of 150-236 quintals per acre and about ten per cent of the respondents obtained capsicum yield between 304 to 370 quintals per acre by cultivating capsicum in poly house. About the net returns under poly houses it could be seen that maximum number of respondents (36.84%) had earned net income of Rs. 4.33 to 5 lakh from capsicum cultivation in poly house while about 32 per cent of respondents obtained net income between Rs. 3.25 to 4.33 lakh per acre and 2.5 to 3.25 lakh per acre respectively from capsicum cultivation under poly house as compared to 51.72 per cent of the respondents had gained net income between Rs. 2.42 to 3.02 lakh per acre and 31.04 per cent of the respondents had earned net income between Rs. 1.5 to 2.42 lakh per acre while 17.24 per cent of the respondents obtained net income of Rs. 3.02 to 4 lakh per acre of capsicum cultivation in net house technology and Rs. 1.40 to 1.53 lakh per acre from low tunnel technology.

Keywords: Capsicum crop, Cultivation, Economics, Protected

INTRODUCTION

In the 21st century, for off season production of vegetables to avoid glut in main season and for superior quality of vegetables with high production, protected cultivation is the best choice for efficient utilization of natural resources (Chandra *et al.,* 2000). In main season, glut of vegetable arises in the market which lowers down the price. Due to shortage of processing industry and storage infrastructure, off season vegetable is the viable option to enhance the income and quality of produce. In off season, vegetables can be cultivated under protected structures like net house, poly house, green house, low tunnel, shade house and row covers etc. (Sirohi and Bahera, 2000). Tomato, capsicum, brinjal and cucumber are the major vegetable crops that can be grown under protected conditions in Punjab with high productivity and yield as compare to open field conditions. Bitter gourd and some other cucurbits can also be grown under these protected structures. Throughout year cultivation of these vegetables is possible through these technologies. To ascertain the yield and net profit obtained by the farmers in cultivation of capsicum crop under protected vegetable cultivation technologies, this study has been planned.

MATERIALS AND METHODS

The present study was conducted in six districts i.e. Amritsar, Gurdaspur, Sangrur, Moga, Jalandhar and Kapurthala of Punjab state. A list of total vegetable growers in selected districts was prepared with the help of department of horticulture. From this list 150 farmers who have adopted protected vegetable cultivation were selected according to probability proportion of number of farmers doing protected vegetable cultivation in different districts. An interview schedule was designed by consulting relevant literature for data collection. It dealt with the statements to know

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the yield and net profit obtained by the farmers in adoption of protected vegetable cultivation. The data were collected personally by the researcher by visiting the study area and interviewing the respondents. For receiving the response of respondents, the investigator contacted them personally in their villages. The data were analyzed with the help of statistical tools such as frequencies, percentage methods.

RESULT AND DISCUSSION

Economic benefits derived by the farmers from protected vegetable cultivation: Economic benefit means net profit obtained from crop by subtracting total cost from gross income. Under protected structures, crop yield of capsicum, tomato and cucumber was enhanced due to off season production and appropriate temperature maintenance (Murthy *et al.,* 2009).

Economic benefits derived by the farmers from capsicum crop under protected vegetable cultivation: Data pertaining in Table 1 reveal that capsicum crop was cultivated in poly house by 67.86 per cent of capsicum growers, out of these maximum number of respondents (63.15%) obtained the capsicum yield between 236 to 304 quintals per acre. About 27 per cent of respondents obtained capsicum yield of 150-236 quintals per acre and about ten per cent of the respondents obtained capsicum yield between 304 to 370 quintals per acre by cultivating capsicum in poly house. Data further revealed that maximum number of respondents (36.84%) had earned net income of Rs. 4.33 to 5 lakh from capsicum cultivation in poly house while about 32 per cent of respondents obtained net income between Rs. 3.25 to 4.33 lakh per acre and 2.5 to 3.25 lakh per acre respectively from capsicum cultivation under poly house.

In net house technology, 51.79 per cent of the respondents cultivated capsicum crop, out of these 37.93 per cent of the respondents obtained the capsicum yield between 183 to 209 quintals and 34.48 per cent of the respondents obtained yield between 209 to 260 quintals per acre while 27.59 per cent of respondents obtained capsicum yield between 120 to 183 quintals per acre for capsicum cultivation in net house technology. Table further showed that 51.72 per cent of the respondents had gained net income between Rs. 2.42 to 3.02 lakh per acre and 31.04 per cent of the respondents had earned net income between Rs. 1.5 to 2.42 lakh per acre while 17.24 per cent of the respondents obtained net income of Rs. 3.02 to 4 lakh per acre of capsicum cultivation in net house technology (Table 1).

In low tunnel technology, 16.07 per cent of respondents were cultivating capsicum crop, out of them 55.56 per cent of the respondents obtained yield of capsicum crop between 150-153 quintals per acre

Table 1: Distribution of respondents according to capsicum yield and net profit under protected cultivation of vegetables

Crop / Structure	Yield		
	Yield (q/acre)	**Frequency**	**Percentage**
Capsicum			
Poly house (n=38)	150-236	10	26.32
	236-304	24	63.15
	304-370	4	10.53
Net House (n=29)	120-183	8	27.59
	183-209	11	37.93
	209-260	10	34.48
Low tunnel (n=9)	150-153	5	55.56
	153-206	4	44.44
	Above 206	-	-

Table 2: Distribution of respondents according to capsicum yield and net profit under protected cultivation of vegetables

Crop / Structure	Yield		
	Net profit (lakh Rs./acre)	**Frequency**	**Percentage**
Capsicum			
Poly house (n=38)	2.5-3.25	12	31.58
	3.25-4.33	12	31.58
	4.33-5.00	14	36.84
Net House (n=29)	1.5-2.42	9	31.04
	2.42-3.02	15	51.72
	3.02-4.00	5	17.24
Low tunnel (n=9)	1.3-1.4	2	22.22
	1.4-1.53	4	44.44
	1.53-1.6	3	33.34

while 44.44 per cent of the respondents obtained capsicum yield between 153 to 206 quintals per acre. Data further showed that 44.44 per cent of the respondents had earned net profit of Rs. 1.4 to 1.53 lakh per acre and 33.34 per cent of the respondents earned Rs. 1.53 to 1.6 lakh per acre from capsicum crop while 22.22 per cent of the respondents had earned Rs. 1.3 to 1.4 lakh per acre by cultivating capsicum crop in low tunnel technology (Table 1).

Capsicum yield of 70-75 quintals per acre was obtained by respondents under open field conditions which was too low as compared to yield obtained from protected cultivation. While price of capsicum crop under open field conditions was 10-15 Rs. per kg against 25-35 Rs. per kg under protected conditions. Due to high yield and price per kg of produce under protected structures, respondents earned high net profit from poly house, net house or low tunnel cultivation of capsicum.

It can be concluded that under protected cultivation, yield and net profit of capsicum crop was higher as compared to open field conditions. Similarly, Murthy *et al.* (2009) reported that capsicum and tomato were economic feasible vegetable crops under poly house with B:C ratio of 1.80. Similarly, Sreedhara *et al.* (2013) revealed that under net house cultivation, capsicum yield and net income was enhanced as compared to open field conditions.

CONCLUSION

It can be concluded that under protected cultivation, yield and net profit of capsicum crop was higher as compared to open field conditions. Maximum number of respondents (63.15%) obtained the capsicum yield between 236 to 304 quintals per acre and 51.72 per cent of the respondents had gained net income between Rs. 2.42 to 3.02 lakh per acre. There should be minimum support price for the vegetable crops to motivate the farmers to adopt vegetable cultivation. Training camps should be organized to train the labourers for successful cultivation of vegetable crops under protected vegetable technologies.

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Evaluation of Yellow Sticky Trap Against Mustard Aphid (*Lipaphis erysimi* Kalt.) on Farmer's Field

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ABSTRACT

Performance of yellow sticky trap (25 traps/ha) was assessed on farmer's field through frontline demonstrations. The percent increase in the yield under demonstration technology was 26.99 and 24.64 per cent over the farmer's practices during the year 2019-20 and 2020-21, respectively. Under the demonstrated technology, farmers were got maximum net return of Rs. 62806/ha and Rs.53712/ha in both the years, respectively as compared to farmers practice which registered net return of Rs. 45680/ha and Rs. 39520/ha. Reduction in the yield and net profit during 2020-21 is because of removal of the Imidacloprid 17.8SL @ 150 ml/ha in demonstration technology. Imidacloprid 17.8SL could not be included in study due to its adverse effect on honeybee pollination. The cost benefit ratio was also higher 3.17 and 2.88 under demonstration technology as compared to farmers practices 2.72 and 2.48 in the year 2019-20 and 2020-21, respectively.

Keywords: Aphid, Mustard, Yellow sticky trap

INTRODUCTION

Mustard is the second most important and most prominent winter oilseed crop of India. It is grown mainly in the northern plains of India with some cultivated area in the eastern geography as well. It belongs to the group Cruciferae, with several cousin species cultivated. The others crops under the 'Rapeseed & Mustard' category include Toria, Yellow Sarson, Brown Sarson, Gobhi Sarson or Canola and Black Mustard or Banarasi Rai. The small brown or yellow seeds contain up to 45 per cent oil. The de-oiled cake is used as animal feed. The mustard crop is more vulnerable to a wide variety of insect pests from sowing till harvest than other oil seed crops. Among various biotic factors responsible for reducing the yield of rapeseed-mustard, insect pests are the major one. Thirty eight insect pests are known to be associated with rapeseed-mustard crop in India (Bakhetia and Sekhon 1989). The invasion by insect pests are one of the important factors responsible for low yield such as; mustard aphid, *L. erysimi* (Kalt), cabbage aphid, *B. brassica* (L), mustard sawfly, *A. lugens proxima* (Klug), cabbage butterfly, *P. brassicae* (Linn), painted bug, *B. picta* (K), mustard leaf eater, *S. litura* (F), leaf miner, *Ch. horticola* (Goureau) thrips, *T. tabaci* and whitefly, *B. tabaci* (Gennedius).

Among them, *L. erysimi* Kalt enbach, (Aphididae: Homoptera) is the most devastating pest in India and is distributed in many other. Nymphs and adults of the mustard aphid suck cell sap from the leaves, inflorescences, and immature pods resulting into very poor pod setting and yield. On the other hand, aphid produces a good amount of honey dew which facilitates the growth of the fungus that makes the leaves and pods appear dirty black (Awasthi, 2002). The aphid attacks generally during December and continues till March. (Gautam *et al.*, 2019). *Lipaphis erysimi* causes 35.4 to 96 per cent yield loss, 30.9 per cent seed weight loss and 2.75 per cent oil loss (Bakhetia and Sekhon 1989; Singh and Premchand 1995; Bakhetia and Arora 1986). Mustard is most popularly crop grown in Rajasthan in Rabi season. Mustard aphid is very small insect and it also have resistance power against many insecticides and also insecticides causes

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so many adverse effect on human health and environment but mustard crop is playing most significant role in economics. Keeping in view of this point this study was conducted in Nagaur district of Rajasthan.

MATERIALS AND METHODS

Study on evaluation of yellow sticky trap against mustard aphid (*Lipaphis erysimi* Kalt.) on farmer's field was conducted in Nagaur district of Rajasthan through Front Line Demonstration. Total 4 hectare area was undertaken in this study and 10 mustard grower farmers were selected. 10 yellow sticky traps were installed in 0.4 hectare area on farmers field. Under this study, demonstration practice (use of yellow sticky against mustard aphid) was compared with farmers practice (un-relevant spray of insecticide).

RESULTS AND DISCUSSION

It was found in the study that mustard yield was found higher in demonstration technology as compare to farmers practice. Average yield of demonstration technology was 17.7 q/ha whereas, average yield 14.2 q/ha. was reported in farmers practice of mustard crop in the year of 2020-21. Aphid infestation were found very less if yellow sticky trap @ 25/hectare were installed in mustard crop (Nayak etc., 2014). The percent increase in the yield under demonstration technology was 26.99 and 24.64 per cent over the farmer's practices during the year 2019-20 and 2020-

Table 1: Result found in 2019-20

Area	Demonstration average yield (q/ha)	Local average yield (q/ha)	Increase in yield (%)	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		Benefit cost ratio	
				Demo	Local check	Demo	Local check	Demo	Local check	Demo	Local check
04 ha	20.7	16.3	26.99	28946	26625	91752	72305	62806	45680	3.17	2.72

Table 2: Result found in 2020-21

Area	Demonstration average yield (q/ha)	Local average yield (q/ha)	Increase in yield (%)	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		Benefit cost ratio	
				Demo	Local check	Demo	Local check	Demo	Local check	Demo	Local check
04 ha	17.7	14.2	24.64	28500	26650	82212	66170	53712	39520	2.88	2.48

Photo 1

21, respectively. Under the demonstrated technology, farmers were got maximum net return of Rs. 62806/ ha and Rs. 53712/ha. in both the years, respectively as compared to farmers practice which registered net return of Rs. 45680/ha and Rs. 39520/ha. Reduction in the yield and net profit during 2020-21 is because of removal of the Imidacloprid 17.8SL@ 150 ml/ha in demonstration technology. Imidacloprid 17.8SL could not be included due to its adverse effect on honeybee pollination. The cost benefit ratio was also higher 3.17 and 2.88 under demonstration technology as compared to farmers practices 2.72 and 2.48 in the year 2019-20 and 2020-21, respectively (Table 1 & 2 and Photo 1).

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