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ABOUT THE SOCIETY

MOBILIZATION Society was established in 2003 as an 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 980 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 5.30. 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

India has attained food security and has a sizeable buffer stock but enhancing the income of the farmers with increased production still remain elusive. The Government has put a target of doubling farmers' income by 2022. The producer's share in consumer's price is very meagre. Adoption of post-harvest management technologies including processing and value addition could ensure enhanced price of the produce and minimize post-harvest loss in perishable and semi-perishable commodities. Effective market linkage including direct marketing between producer and consumer will enhance producer's share. Group farming is another option for minimizing input cost and cost of cultivation. Of late, with the increased stress upon pluralistic extension management, the focus of the extension system has shifted to a holistic production-processing-supply environment. Concurrent to the shift, the technology transfer models are increasingly stressing upon an 'Agricultural Knowledge and Information System' in order to take into greater consideration the post production issues. Market intelligence and value chain management started receiving the primary focus amidst the huge postharvest losses.

The public agricultural extension system in the recent years has therefore required to look beyond production with added emphasis. Micro-scale on-farm processing units, value addition and other forms of secondary agriculture although are not new, a functional linkage between production and processing are found generally missing, especially in case of the small and marginal farmers. The present day threats posed by the climate change issues further add to the challenges of leveraging contingencies and a sustainable farm based livelihood. A serious multi-stakeholder involvement and convergence in an organized and committed way between agencies for a harmonious production-processing milieu is therefore felt increasingly essential.

Society for Community Mobilization for Sustainable Development (MOBILIZATION), in the above context, is organizing 8th National Seminar on "Potential, Prospects and Strategies for Doubling Farmers' Income: Multi-stakeholder Convergence" from November 9-11, 2017 in association with Assam Agricultural University and ICAR-ATARI, Guwahati at College of Veterinary Sciences, Guwahati.

We are happy to place before you the July-December, 2017 issue of the journal. Some of the pertinent research domains contained in the issue are attitude of farmers towards Bt cotton, assessment of improved technologies, adoption of improved technologies and related constraints, yield gap analysis, livelihood diversity in family farming, impact assessment of resource conservation technologies, ground water management, climate resilient technologies etc. This issue also highlighted income generation opportunities and market linkage for enhancing farmers' income.

I extend my heartfelt thanks to the members of the editorial team - Drs. Souvik Ghosh, S.K. Dubey, R. Roy Burman, Nishi Sharma, S.R.K. Singh, M.S. Nain and L. K. Tyagi who very professionally edited the papers to bring out this issue on time. I also express my sincere gratitude to the researchers who have contributed the quality research papers for the journal. I extend my special thanks to Drs. Sudipta Paul, Reshma Gills and Hema Baliwada in shaping this issue of the journal through on-line editorial assistance.

J.P. Sharma
Chief Editor

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Attitude of Farmers towards Bt Cotton Production Technology

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ABSTRACT

Since the introduction and commercialization of Bt cotton (*Bacillus thuringiensis*) in India, most of the area for cotton production has been occupied by the Bt cotton. However, despite its popularity, some farmers are still very much skeptical about the advantages of planting Bt and are wary of its possible effects on conventional cotton, the environment and the human health being genetically modified, as such, would not cultivate it. The present study was conducted to investigate the attitude of farmers towards Bt cotton production technology regarding environment aspect, economic, social and technological aspect of Bt cotton production technology in cotton growing districts of Haryana. According to the weighted mean scores attitude of the respondents towards all four aspects of sustainability (environment, economic, social and technological) of Bt cotton production technology was positive and favourable.

Keywords: Bt cotton, Economical, Environmental and attitude, Social

INTRODUCTION

Cotton accounts for an area of 610 thousand ha in Haryana with total production of 24,000 thousand bales and 664.50 kg/ha lint yield (Anonymous, 2014). It is attacked by several insect pests reducing the crop yield to a greater extent. The insect pests that attack cotton crop may be classified into sap sucking insects (aphids, jassids and white fly) or chewing insects (bollworms, leaf eating caterpillars etc.). Of the total pesticides used in Indian Agriculture, about 45 per cent is used on cotton crop alone. To reduce pesticide usage in cotton, several strategies like use of genetic resistance to insect pests, Integrated Pest Management (IPM), Insecticide Resistance Management (IRM) etc. are being advocated. In recent times, *Bt* cotton technology is found to be one of the best strategies to manage bollworms, the most important pest of cotton.

In India, biotechnology made its long-awaited entry into commercial agricultural in March, 2002 with the approval of three (MECH-12, MECH-162 and MECH-184) Bt cotton hybrids for commercial cultivation. The Genetic Engineering Approval committee (GEAC), Ministry of Environment and Forest, Government of India granted the approval, at its 32nd meeting held in New Delhi. The transgenic hybrids were developed by MAHYCO (Maharashtra Hybrid Seed Company Limited) in collaboration with Monsanto. Later five more events were undertaken namely: MON 15985, Event-1, GFM Event, Cry 1 Ac Event and Cry 1 Ac Event 9124. Bt-cotton was introduced in India in 2002 for commercial production in Southern states followed by Northern states (Haryana, Punjab and Rajasthan) in 2005. Presently, 1340 Bt cotton hybrids have been released and recommended for cultivation in India (Bharud, 2014), which has created a confusing situation for the farmers for choosing the appropriate hybrid. So, identification of suitable Bt cotton hybrid for a particular region on the basis of their performance and the thorough knowledge of hybrid characteristics is essential.

An attitude affects an individual's behaviors by filtering information and shaping the individual's perception of the world (Fazio, 1986), whereas the strength in the attitude amplifies or neutralizes the effect of the attitude on behaviors (Krosnick and Petty, 1995). Fishbein and Azjen's (1975) proposed theory of

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reasoned action, which recognizes that there are situations (or factors) that limit the influence of attitude on behaviour. In TAM, two factors are primary determinants of system use: perceived ease of use and perceived usefulness (Davis *et al.,* 1989). The theory postulates that technology usage is determined by behavioral intention to use the technology. Behavioral intention is in turn determined by attitude towards using the technology and by perceived usefulness, however, perceived ease of use could be a causal antecedent to perceived usefulness influencing both attitude and behavioral intention (Davis, 1986; Davis *et al.,* 1989). As such it become imperative to study the attitude of farmers towards promising (Bt cotton production technology) solutions to many problems related with cotton production. Bt cotton production technology. Previously, Nagaraja *et al.* (2014) reported a favorable attitude of farmers towards the Bt cotton than Hybrid cotton. It was perceived that the Bt cotton seeds were costlier beyond the capacity of small and marginal farmers and they require training in IPM and INM before the season commences. The present study is an attempt to capture the farmers' attitude towards Bt cotton production technology in Haryana state.

MATERIALS AND METHODS

The present study was conducted in two districts namely Sirsa and Hisar of Haryana state which have largest area and production under Bt cotton among all the district of Haryana. Multistage sampling technique was adopted for the selection of district, block, village and ultimately the respondents. There are nine blocks in Hisar district and six blocks in Sirsa district, out of these two blocks from each district were selected randomly. A list of all the village of the two selected blocks was prepared and two villages from each block were again selected randomly. Thus the eight villages were selected for the study. A village-wise list of Bt cotton growers, was prepared and from that list 20 farmers were selected randomly. Therefore, 160 Bt cotton growing respondents from 8 villages were selected for the present study.

Attitude of the respondent is a psychological variable that has been taken for study. According to Guliford (1954) "An attitude is a personal disposition common to individual but possessed in a different degree which impact them to react to object/situation in ways that can be called favourable and unfavourable. Psychological object as many symbol, phrase, slogan, person, institution ideal or idea towards which people can differ in varying degree. The attitude measurement scale was prepared using Likert's method of summated ratings. The procedural steps were followed in developing a standardized attitude scale to measure the farmers' towards the Bt cotton production. Based on the z value analysis of judges rating, twenty seven items having positive z value were accepted and 14 items negative z value were rejected. A list of statements was prepared and the farmers were asked to speak out their responses against each statement. Whether it was 'favourable', 'neutral' and 'unfavourable' weightage given to these response categories were 3, 2, and 1 respectively. Aggregate total was calculated for each statement separately and on the basis of calculated scores and mean score, percentages were arrived at. The item-wise scores of the respondents were pooled separately for each category of the respondents in the three columns against each item. The total scores, thus, obtained in each of the columns were multiplied by their respective weight. Then the scores of the columns were summed up. To standardize the raw scores of the items, these were transformed into Z-scores.

RESULTS AND DISCUSSION

Farmers' attitude towards environmental aspect was sought on three sub aspects namely- environmental safety, pesticidal pollution and under ground water contamination. The Table 1 shows that majority of the farmers (88.75%) showed favourable attitude towards Bt cotton as regard to safety for environment. Majority of the farmers (85.63%) found that use of less pesticide in Bt cotton saves the environment from pesticide pollution, whereas (3.12%) did not favour it. Majority of the farmers (88.12%) favoured that use of less pesticide in Bt cotton protect underground water from contamination. On the basis of weighted mean score which ranged 2.82-2.88, it is clear that farmers had very favourable attitude towards environmental aspect of Bt cotton production technology Gandhi and Namboodiri (2006) and Ceddia (2008) also studied and found less use of insecticide and pesticide in Bt cotton production.

Farmers attitude towards economical aspect was sought on six sub aspects namely income enhancement of small farmers, reduction of harmful insects, riskiness,

Table 1: Farmers' attitude towards Environmental aspects of Bt Cotton technology

S.No.	Farmers' attitude towards environmental aspects of Bt cotton technology	Category	Frequency	Percentage	Weighted Mean Score	Mean
1.	Bt cotton is safe for environment	Favourable (3)	142	88.75	426	**2.88**
		Netural (2)	18	11.25	36	
		Unfavourable (1)	0	0.00	0	
2.	Use of less pesticide in Bt cotton saves the environment from pesticides' pollution	Favourable (3)	137	85.63	411	**2.82**
		Netural (2)	18	11.25	36	
		Unfavourable (1)	5	3.12	5	
3.	Use of less pesticide in Bt cotton protects underground water from contamination	Favourable (3)	141	88.12	423	**2.86**
		Netural (2)	17	10.63	34	
		Unfavourable (1)	2	1.25	2	

enhances income of large farmers, does not give any benefit and recovers farmers from indebtness. The Table 2 shows that majority of the farmers (75.63%) showed favourable attitude towards Bt cotton enhances income of small farmers whereas 88.75%) favoured that Bt cotton enhances income of large farmers. Majority of the farmers (83.12%) found that Bt cotton reduces the harmful insects. Godara *et al.* (2012) also reported that Bt cotton production enhance the income of small as well as large farmer. Majority of the farmers (69.37%) favoured that Bt cotton production is not risky. A total of 45.00 per cent unfavoured that Bt cotton does not gives any benefit but 16.87 per cent farmers favoured it. A majority of farmers (68.12%) had positive attitude that Bt cotton recovers farmers from indebtness Finger *et al.* (2011) and Ready *et al.* (2011) findings also support these findings. On the basis of weighted mean score (range 1.71-2.86), it is clear that farmers had very favourable attitude towards economical aspect of Bt cotton production technology.

Farmers attitude towards social aspect was sought on nine sub aspects namely Bt cotton is helpful in fighting poverty, socially acceptable technology,

Table 2: Farmers' attitude towards economical aspects of Bt Cotton technology

S.No.	Farmers' attitude towards economical aspects of Bt cotton technology	Category	Frequency	Percentage	Weighted Mean Score	Mean
1.	Bt cotton enhance income of small farmers	Favourable (3)	121	75.63	363	**2.68**
		Netural (2)	27	16.87	57	
		Unfavourable (1)	12	7.50	12	
2.	Bt cotton reduces the harmful Insects	Favourable (3)	133	83.12	399	**2.78**
		Netural (2)	19	11.88	38	
		Unfavourable (1)	8	5.00	8	
3.	Bt cotton production is risky	Favourable (3)	13	8.13	39	**1.38**
		Netural (2)	36	22.50	72	
		Unfavourable (1)	111	69.37	111	
4.	Bt cotton enhance income of large farmers	Favourable (3)	142	88.75	426	**2.86**
		Netural (2)	15	9.37	30	
		Unfavourable (1)	3	1.88	3	
5.	Bt cotton does not gives any benefits	Favourable (3)	27	16.87	81	**1.71**
		Netural (2)	61	38.13	122	
		Unfavourable (1)	72	45.00	72	
6.	Bt cotton recovers farmers form indebtness	Favourable (3)	109	68.12	327	**2.63**
		Netural (2)	43	26..88	86	
		Unfavourable (1)	8	5.00	8	

enhances farmer's living standard, increase expenses on family education and health, improve purchasing power, no effect on social sphere, sign of progressiveness, enhances farmers savings and increase employment efficiency of women. The Table 3 shows that majority of the farmers (76.87%) showed favourable attitude towards Bt cotton production being helpful in fighting poverty. Majority of the farmers (66.25%) viewed that Bt cotton production is socially acceptable technology. Stone (2011) also reported that Bt cotton is a socially acceptable society. 60.62% favoured that Bt cotton production enhances farmer's living standard. Majority of the farmers (87.50%) favoured that Bt cotton production help increase expenses on family education and family health. A total of 82.50 per cent favoured that Bt cotton improves farmers' purchasing power. 58.13% of farmers viewed that Bt cotton has no effect on social sphere of the farmers. 78.75%viewed Bt cotton production as a sign of progressiveness whereas74.37% favoured that Bt cotton production enhances farmers' savings. Nearly half of the respondents (51.87%) viewed that Bt cotton production increases the employment efficiency of women in agriculture. On the basis of weighted mean score (range 2.38-2.83), it is clear that farmers had very favourable attitude towards social aspect of Bt cotton production technology Singh *et al.* (2016) also reported that farmers having positive attitude towards groundnut production.

Farmers attitude towards technological aspect was sought on nine statements namely; genuine seed from company, timely availability of seed, high yielding,

Table 3: Farmers' attitude towards Social aspects of Bt Cotton technology

S.No.	Farmers' attitude towards social aspects of Bt cotton technology	Category	Frequ-ency	Percen-tage	Weighted Mean Score	Mean
1	Bt cotton production is helpful in fighting poverty	Favourable (3)	123	76.87	369	**2.73**
		Netural (2)	32	20.00	64	
		Unfavourable (1)	5	3.13	5	
2	Bt cotton production is socially acceptable technology	Favourable (3)	106	66.25	318	**2.64**
		Netural (2)	51	31.87	102	
		Unfavourable (1)	3	1.88	3	
3	Bt cotton production enhances the farmer's living standard	Favourable (3)	97	60.62	291	**2.53**
		Netural (2)	52	32.50	104	
		Unfavourable (1)	11	6.88	11	
4	Bt cotton production helps the farmers to increase his expenses on family education and family health	Favourable (3)	140	87.50	420	**2.83**
		Netural (2)	14	8.75	28	
		Unfavourable (1)	6	3.75	6	
5	Bt cotton production improves farmers' purchasing power	Favourable (3)	132	82.50	396	**2.81**
		Netural (2)	26	16.25	52	
		Unfavourable (1)	2	1.25	2	
6	Bt cotton production technology has no effect on the social sphere of the farmers	Favourable (3)	93	58.13	279	**2.45**
		Netural (2)	47	29.37	94	
		Unfavourable (1)	20	12.50	20	
7	Bt cotton production is the sign of progressiveness	Favourable (3)	126	78.75	378	**2.76**
		Netural (2)	31	19.38	62	
		Unfavourable (1)	3	1.87	3	
8	Bt cotton production enhances the farmers' savings	Favourable (3)	119	74.37	357	**2.66**
		Netural (2)	28	17.50	56	
		Unfavourable (1)	13	8.13	13	
9	Bt cotton production increases the employment efficiency of women in agriculture	Favourable (3)	83	51.87	249	**2.38**
		Netural (2)	56	35.00	112	
		Unfavourable (1)	21	13.13	21	

reduced cost of pesticide, high technical knowledge required for cultivation, seed cost in not a issue, susceptibility to the white fly, resistance to all insect pest and susceptible to water lodging. Table 4 shows that majority of the farmers (90.62%) were having favourable attitude towards seed of Bt cotton from company is genuine whereas 54.37% favoured that Bt cotton seed is timely available, well supported by the findings of Godara *et al.* (2012) and Ready *et al.* (2011). Majority of the farmers (82.50%) favoured that Bt cotton is high yielding. Majority of the farmers (94.37%) favoured that cost of pesticide in Bt cotton production is less. Less than half of the respondents (45.00%) viewed that Bt cotton production required high technical knowledge. A majority of farmers (75.63%) favoured that seed cost is not an issue in the light of profit from Bt cotton. A large majority of the farmers (91.25%) favoured that Bt cotton is resistant to all the insect pest. On the basis of weighted mean score (range 2.16-2.94), it is clear that farmers had very favourable attitude towards technological aspect of Bt cotton production technology. Singh *et al.* (2010), Ekta *et al.* (2015), Rani and Selvaraj (2013) and Nagaraja *et al.* (2014) found that farmers were having positive and favourable attitude towards Bt cotton production.

CONCLUSION

Agricultural innovations require comprehensive assessment by farmers prior to their acceptance. Thus, understanding and awareness of stakeholder views and

Table 4: Farmers' attitude towards Bt cotton technology

S.No.	Farmers' attitude towards Bt cotton technology	Category	Frequ-ency	Percen-tage	Weighted Mean Score	Mean
1	The seeds of Bt cotton from company dealer is genuine	Favourable (3)	145	9.62	435	**2.86**
		Netural (2)	9	5.63	18	
		Unfavourable (1)	6	3.75	6	
2	Availability of Bt cotton seed is timely	Favourable (3)	87	54.37	261	**2.34**
		Netural (2)	41	25.63	82	
		Unfavourable (1)	32	20.00	32	
3	Bt cotton is high yielding	Favourable (3)	132	82.50	396	**2.77**
		Netural (2)	20	12.50	40	
		Unfavourable (1)	8	5.00	8	
4	Cost of pesticide in Bt cotton production is less	Favourable (3)	151	94.37	453	**2.94**
		Netural (2)	9	5.63	18	
		Unfavourable (1)	0	0.00	0	
5	High technical knowledge is required for Bt cotton production	Favourable (3)	72	45.00	216	**2.16**
		Netural (2)	43	26.88	86	
		Unfavourable (1)	45	28.12	45	
6	Seed cost is no issue in the light of profit from Btcotton	Favourable (3)	121	75.63	363	**2.73**
		Netural (2)	35	21.87	70	
		Unfavourable (1)	4	2.50	4	
7	Bt cotton is highlysusceptible to the white fly	Favourable (3)	109	68.12	327	**2.63**
		Netural (2)	23	14.38	46	
		Unfavourable (1)	28	13.50	48	
8	Bt cotton resistant to all the insect pest	Favourable (3)	146	91.25	438	**2.89**
		Netural (2)	11	6.88	22	
		Unfavourable (1)	3	1.87	3	
9	Bt cotton is highly susceptible to water lodging, requiring proper drainage system	Favourable (3)	128	80.00	384	**2.75**
		Netural (2)	25	15.63	50	
		Unfavourable (1)	7	4.37	7	

opinions may assist in planning and management of the Bt cotton production. The attitudinal dimensions identified for its sustainability in the form of attitude of the respondents towards environment, economical, social and technological aspects of Bt cotton production technology was positive and favourable. Although The theory of Reasoned Action advocates finding some of the reasons why an attitude (or behavioral intent) will not result in the expect behavior. As such the sustainability of the Bt cotton need to be looked into with a more in depth view. The farmers confusion regarding the adaptability of the upcoming new varieties of Bt Cotton suggests continuous monitoring and evaluated for their results.

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Development Perspectives of Women self help Groups in Punjab

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ABSTRACT

Self-help groups engaged in development activities have the potential to empower their members through the provision of knowledge, skills, motivation, and competencies that underpin sustainable agriculture. There is a shortage of empirical data on the development perspectives of women self help groups in Punjab. This study attempts to identify the functioning of 12 self help groups of Punjab. The results of the study indicated that all the groups were functional and most of them had the essential features for the effective group operations viz. selection of leader with consensus, regular conduct of meeting with active participation of members, maintenance of records and are working successfully in improving the economic and social status of members of self help groups.

Keywords: Development, Punjab, Self Help Groups

INTRODUCTION

In India, where around 62.5 per cent of the population lives in rural areas, the development of more sustainable agricultural system is a major policy concern. As in many other parts of the developing world, farmers are facing a range of challenges associated with cost-price pressures, climate change, knowledge and skill deficits, and difficulties accessing the latest technologies (Siddique, 2011). Until recently, government played a major role in the economic development of the country, particularly as it relates to agriculture. The main strategy was direct participation by the government in economic activities, such as production, marketing, research and development, and extension. The government also regulated private sector economies through a complex system of controls. In addition, the Indian economy was sheltered from foreign competition through the use of both the "infant industry argument" that provided price support for some agricultural commodities, and a binding foreign exchange constraint (Lal and Clemant, 2005). Policymakers in India now regard community participation as a vitally important strategy to work with rural people in improving their economic and social status.

Punjab State, located in north western part of India, with an area of 50,362 sq.km. The state falls in the Indus basin and is irrigated by three major rivers- Ravi, Beas and Sutlej apart from other canals including the Ghaggar that irrigates the southern parts of State. Agriculture is the largest sector in Punjab; it is the major producer of wheat in India. Other major industries include the manufacturing of scientific instruments, agricultural goods, electrical goods, financial services, machine tools, textiles, sewing machines, sports goods, starch, tourism, fertilizers, bicycles, garments, and the processing of pine oil and sugar. Punjab also has the largest number of steel rolling mill plants in India, which are located in Steel Town Mandi Gobindgarh, District Fatehgarh Sahib (Gupta, 2012). Punjab is one of the most fertile regions of the country. The region is ideal for growing wheat and rice. Sugar cane, fruits and vegetables are also grown. Indian Punjab is called the "Granary of India" or "India's bread-basket". It produces 10.26% of India's cotton, 19.5% of India's wheat, and 11% of India's rice. The state has been awarded the National Productivity Award for agriculture extension services for ten years from 1991–92 to 1998–99 and from 2001 to 2003–04. In recent years a drop in productivity has been observed

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mainly due to declining fertility of the soil, excessive use of fertilizers and excessive use of pesticides and sharp decline in water table. Moreover, villages are facing problems related to poverty, illiteracy and poor health. Rural indebtedness has emerged as a serious problem in the State. The magnitude of rural indebtedness due to borrowing to meet gap between farm income and family expenses has increased to a level where it has become a serious concern for the Government as well as farmers (Anonymous, 2013). These are problems that cannot be tackled individually but can be better solved through group efforts. Promotion of self help groups is one of the strategies that have been adopted by the government as part of their community participation approach for the socio-economic development of rural people.

MATERIALS AND METHODS

The study was conducted in six districts of Punjab. A sample of 200 women belonging to 12 functional women self help groups were selected by using probability proportion to size (PPS) of self help groups in each district. An interview schedule was used to document the information from members regarding impact of self help groups on women empowerment. Separate information from group leaders was collected by using questionnaire approach in relation to functioning of selected self help groups. Twelve group leaders were consulted to obtain information regarding historical perspectives of selected groups.

Historical perspectives of Majha Self Help Groups: Majha is a region of the Punjab comprising the modern districts of Amritsar, Gurdaspur and Tarn Taran in the Indian State of Punjab and the districts of Narowal, Lahore and Kasur in the Pakistani province of Punjab. Institutional development at the grass root levels, economic independence to the poor, especially women, generation of mutual trust and cooperation, localised planning and participative decision making, inculcate the habit of savings, leadership development, economic self-reliance and social security are the goals of SHGs. Keeping this in view, various self help group namely Maha Luxmi (2002) and Durga self help group (2006) from Pathonkot and Amar Das (2011) and Guru Ram Das (2006) from Amritsar with the help of Baba Dhana Singh Educational Welfare Society, Pathonkot and Save Planet Society, Amritsar were established by motivating the people to form the group and created awareness among them to avail credit facility to overcome from exploitation by money lenders.

Moreover, members engaged themselves in to various income generating activities such as pickle making, cultivation of pulses at small scale, making of soft toys and embroidery on shawls for their economic benefit. Due to this, their spare time has been utilized now. A study conducted by various researchers on self help groups (Singh, 2011; Gupta and Singh, 2012; Sharma *et al.,* 2012) observed that a diversified range of activities were carried out by the women members of self help groups for generation of income.

As head of the family is required to manage the home, similarly leader is essential in smooth functioning of the group. The leader was selected for a period of one year in Amar Das and Guru Ram Das group while two years in Durga and Amar Das self help group with the consent of the members. The principle of rotational leadership in these groups was to decentralized power and opportunity among all the members of the group. Conducting meetings on specified time and venue is of crucial importance. Properly conducted meetings by the leaders produced positive results and good decisions. Meetings were conducted at leader house in three groups except in Amar Das group, where meetings were held at common place. It was seen from the attendance that majority of the members (80%) of Durga and Maha Luxmi group and seventy per cent of Amar Das and Guru Ram Das group participated in the meeting to discuss group activities. Maha Luxmi and Amar Das group took no action for those who were not attending the meetings while a fine of Rs.20 was imposed on absentees of Durga and Guru Ram Das group. Meetings were conducted once in a month in all the three groups of Majha region except in Guru Ram Das where fortnightly meetings were conducted. Idea of holding fortnightly meetings was to retain and maintained the interest of members of the SHG. All the decisions taken by the group were recorded in the register.

NGOs of these groups acted as a financial intermediary between the microfinance institutions (Punjab Grameen Bank and State Bank of India) and self help groups. Sangeetha *et al.* (201) reported that almost all the respondents had joined the group

expecting financial assistance from the NGO under which the groups were formed.

NGOs linked the groups with various banks to avail loan facility for purchase of raw materials like mango, vinegar, spices, pulses for undertaking entrepreneurial activities on a small scale. They repaid the loan regularly. Self help groups pool monthly saving of Rs.100 and relend within the group on rotation and need basis at 1 per cent rate of interest.

These groups had a common perception of need and impulse towards collective action. The Maha Luxmi and Durga self help groups took part in state events; for instance the group has attended *Kisan Mela* held at Punjab Agricultural University and won second best stall prize. Self help groups of Majha zone act as a platform for the members to provide space and support to each other which was seen from their participation into various events like *Kisan Melas* held all over in Punjab. The collective efforts of group members, active participation and collective marketing of products were some strengths of the group while conflicts in decision making and lack of unity among members were weaknesses perceived by the members of region. This may be due to reason that the people of are more aggressive than other two regions.

Apart from economic development, the members of Amar Das group were also involved in social activities. They procured saplings free of cost from the Government and planted them near border of Punjab as the group settled near 'Atari' and were successful in creating awareness among the people to save environment. This effort was highly appreciated by the project officer of Forest Department (Table 1).

Historical perspectives of Malwa Self help groups: Malwa is a region of India in the south-east of the state of Punjab and parts of Haryana between the Sutlej and Yamuna rivers. It makes up the majority of the Punjab region, consisting of historical princely districts of the Punjab - Ferozpur, Patiala, Nabha, Faridkot and Ludhiana. The people of the region are called Malwais, and the dialect of Punjabi spoken is called Malwai (Table 1).

Two districts of Malwa region namely Ludhiana and Moga were selected for the present study. Ludhiana district is one of the 22 districts in the state of Punjab, which is the hub of industries. The main industries are bicycle parts and hosiery. Ludhiana is the biggest city of the state. It has eight tehsils, seven sub-tehsils and twelve development blocks. Moga district became the 17th district of Punjab State on 24 November 1995. It is also known as NRI district. Most Punjabi Non-resident Indians (NRIs) belong to rural areas of Moga District, who immigrated to the USA, the UK and Canada in the last 30–40 years. It is among the largest producers of wheat and rice in Punjab, India. In both the districts, women are educated and want to be independent. They planned to unite themselves in to self help group for women empowerment. Self help group is a small group of persons (10 to 20) who come together with the intention of finding a solution to a common problem, mainly to get access to credit and livelihood generation with a degree of self-sufficiency (Panda, 2008; Pandey *et al*., 2011).

It is an important institution for improving the economic and social empowerment of women. The basic objective of SHG is that it acts as the platform for members to provide space and support to each other (Kondal, 2014). Today, in Punjab, Non-governmental organizations play an important role in implementation of self help groups. Non-governmental organization (NGO) is an organization that is neither a part of a government nor a conventional for-profit business, usually set up by ordinary citizens, may be funded by governments, foundations or businesses. In Malwa region, Rameshwar Welfare Society (Ludhiana) and JS Educational Welfare Trust (Moga) realized the importance of self help groups and gave their contribution to agricultural development in several ways like; advisory services to farmers particularly the disadvantaged (poor, women and youth), helped women members to avail credit facilities, promoted inter-personal relationship among members and built capacity of women to plan and manage resources profitably. Therefore, they planned to formulate self help groups to help the needy and were successful in establishing groups viz Veer Honey and Assal (Ludhiana); Bibi Rajni and Baba Budha (Moga). Rajendran and Raya (2011) conducted study on role of NGOs in microfinance through self help groups and revealed that NGOs are playing vital role in the formation of SHGs and motivating women to join groups and linking the groups with the banks for microfinance.

Table 1: Historical perspectives of self help groups of Majha region

Name of group	Durga, Pathankot	Maha Luxmi, Pathankot	Amar das, Amritsar	Guru ram das, Amritsar
Year of establishment	2006	2002	2011	2006
Year of registration	2006	2002	2011	2006
Formation of group	Baba Dhana Singh Educational Welfare Society	Baba Dhana Singh Educational Welfare Society	Save Planet (NGO)	Save Planet (NGO)
Group size	2006 13 2013 15	2002 13 2013 15	2011 18	2006 102 013 14
Entrepreneurial activity	2006 Suit embroidery 2008 Suit embroidery, making of soft toys 2010 Suit embroidery, making of soft toys & painting, 2013 Suit embroidery, making of soft toys, painting & shawl embroidery	Pickle formation, squashes, mango chutney turmeric powder making, moong and mash dal	Pickle making, vermicelli	Tailoring
Selection of leader	Consensus	Consensus	Consensus	Consensus
Term of leader	Two years	Two years	One year	One year
Membership fee	Rs. 100/-	Rs. 100/-		
Venue of meeting	House of leader	House of leader	Gurdwara	House of leader
Duration	Once in a month	Once in a month	Once in a month	Fortnightly
Attendance(n=10)	80%	80%	70%	70%
Action taken for not attending meeting	Fine of Rs. 20/ meeting	No action taken	No action taken	Fine of Rs. 20/ meeting
Record of meeting	Complete and up to date	Complete and up to date	Complete and up to date	Complete and up to date
Maintenance of record	Group leader	Group leader	Group leader	Group leader
Purpose of loan	Purchase of raw materials	Purchase of raw materials	Purchase of raw materials	Purchase of sewing machine
Amount of loan taken for group	Rs. One lakh	Rs.40,000/- 2003 Rs. One lakh 2005 Rs Two lakhs 2012	Rs. 50,000	Rs. 40,000
Name of bank	Punjab Grameen Bank, Pathankot	Punjab Grameen Bank, Pathankot	State Bank of India	State Bank of India
Rate of interest of bank	1% per month	1% per month	2% per month	2% per month
Payment of instalment	Regularly	Regularly	Regularly	Regularly
Getting of loan	Easily	Easily	Easily	Easily
Inter loaning	1% rate of interest	1% rate of interest	1% rate of interest	1% rate of interest
Marketing of products	Collectively	Collectively	Collectively	Individually
Nature of production	Order basis	Continuous basis	Continuous basis	Order basis
Monthly saving of the group	Rs.100/member	Rs.100/member	Rs.100/member	Rs.100/member

Table 2: Historical perspectives of self help groups of Malwa region

Name of group	Assal, Ludhiana	Veer Honey, Ludhiana	Baba Budha, Moga	Bibi Rajni , Moga
Year of establishment	2009	2013	2010	2011
Year of registration	2009	2013	2010	2011
Formation of group	Rameshwar Welfare Society	Rameshwar Welfare Society	JS Educational Welfare Trust	JS Educational Welfare Trust
Group size	2009 20 2013 15	2013 15 2013 14	2010 16	2011 15 2013 13
Reasons for discontinuance	Non payment of instalments	Non- cooperation of husband		Non-cooperation of family
Entrepreneurial activity	2009 honey 2010 pickle formation 2013 food processing	Tailoring, toy shop, honey making, dairy	Making of soft toys, artificial flower, wall hangings	Candle making
Selection of leader	Election	Consensus	Consensus	Consensus
Term of leader	One year	One year	Two years	One year
Membership fee	———	——-	——-	———-
Venue of meeting	Member house (Rotation)	Temple	Temple	Gurudwara
Duration	Once in a month	Once in a month	Once in a month	Once in a month
Attendance (n=10)	80%	70%	70%	80%
Action taken for not attending meeting	Fine of Rs.50 (continuous absent from two meetings)	Fine of Rs.20/- meeting	Fine of Rs.20/- meeting	No action taken
Record of meeting	Complete and up to date	Moderate	Complete and up to date	Moderate
Maintenance of record	Group leader	Group leader	Group leader	Group leader
Purpose of loan	Purchase of raw materials	————-	Domestic purpose	Purchase of raw materials
Amount of loan taken for group	Rs. One lakh	————	Rs. 50,000/-	Rs. 50,000/-
Name of bank	Punjab National Bank, Ludhiana	————-	Cooperative Bank	Cooperative Bank
Rate of interest of bank	1% per month	————	9% annually	9% annually
Payment of instalment	Regularly	———-	Regularly	Regularly
Getting of loan	Easily	——-	Easily	Easily
Interloaning	1.5% rate of interest	1% rate of interest	2% rate of interest	1.5% rate of interest
Marketing of products	Collectively	Individually	Individually	Collectively
Nature of production	Continuous basis	Continuous basis	Continuous basis	Continuous basis
Monthly saving of the group	Rs.100/member	Rs. 100/- member	Rs. 100/- member	Rs.100/member
Seminars/ Workshop/Kisan melas	• Attended Seminar organized by Modern Kheti • Participated in Kisan Mela, PAU, Ldh • Participated in Saras Mela, Sangrur • Participated in Exhibition held at Pragati Madan, New Delhi	Participated in Kisan Mela 2013		Attended seminar organised byJS Educational Wel farae Trust
Awards	• Innovative Farm Woman Joint Award, PAU Kisan Club, Ldh • Award of Appreciation, PAU Kisan Club, Ldh • Participation Certi ficate by Indian Medical Association, Ludhiana • Award of Appreciation,Agriculture Deptt, Bathinda		Award of Honour, PAU Kisan Club, Ludhiana	

The first prime minister of India Pandit Jawahar Lal Nehru has rightly pointed out that "In order to awaken the people, it is the woman who has to be awakened. Once she is on the move, the household moves, the village moves and the community moves." So there is need for changing the mindset towards woman as to give equal rights as enshrined in the constitution. Today, more women of these groups of *Malwa* have been broken from the traditional, gender-specific roles and venturing in to business world by adopting entrepreneurial activities like honey making, decorative candle making, food processing of seasonal fruits, tailoring, making of household products. For the smooth functioning and managing of entrepreneurial activities, group leader played an important role. Leader knows the mission of group, vision (where the group want to go), goal to achieve mission and expert in leadership qualities. The group leader was selected by election and consensus basis. In order to avoid any singular control, the position of leader is generally rotated among the members after one year in Assal, Veer Honey, Bibi Rajni SHGs and after two years in Baba Budha self help group.

Monthly meetings of self help groups members was was regularly conducted in all the groups at a common place (Veer Honey, Baba Budha and Bibi Rajni) except in Assal group where meetings were conducted on rotation basis at member's house. This showed active involvement personal interest of members towards the group. Attendance of group members to discuss group activities was 70 per cent in case of Veer Honey and Baba Budha while 80 per cent in Assal and Bibi Rajni SHGs. A penalty of Rs.20 was imposed to those members who were absent during the meetings in Veer Honey and Baba Budha while no action was taken in Bibi Rajni group. A fine of Rs.50/- was imposed to those members who were continuously absent from two successive meetings. Apart from discussions on production and preparation of value-added products, group members socialize by solving the problems of family. Sandhu (2013) stated that presence of all the members and their active participation in meetings is essential to discuss group activities. Group leader maintained complete and up to date records in Assal and Baba budha while moderate in Veer honey and Bibi Rajni SHGs for sustainability of financial operations and continued mutual trust among members. The major strengths of these groups were its ability to unite and market the products collectively. One of the basic principles of SHGs is that even the very poor may save small amounts. Regarding mobilization of financial resources, monthly savings of Rs.100 was kept together in the Bank in the name of SHG which could be used by the women members for inter loaning among the members in times of emergencies.

After sustained efforts, these groups such as Baba Budha and Bibi Rajni availed the loan facility from Cooperative Bank, Moga at 9 per cent interest annually while Assal SHG availed loan amounting Rs. one lakh from Punjab National Bank, Ludhiana at one per cent per month to carry out entrepreneurial activities. It is noted that Veer Honey did not yet avail credit facility as it was recently established. Assal and Veer honey groups participated in *Kisan Melas* held at Punjab Agricultural University, Ludhiana to promote their products. Out of these four groups, Assal SHG is one who was several times awarded by PAU Kisan club, Ludhiana and also got appreciation award by Department of Agriculture, Bathinda and act as role model for other groups in *Malwa* region to take active part in all the group management activities (Table 2).

Historical perspectives of Doaba SHG: Shubh Karman Society is working for socio-economic development of the marginalised sections in the society since last few years. It has organised Chetna and Sada Shiv Modern (SSM) in Hoshiarpur for better participation of people by taking initiatives on thrift and easily available credit. Pahal (NGO) took initiative to serve the needy people with the collaboration of NABARD, Pahal has launched a large camping to form self help groups in Jalandhar and were successful in forming 50 self help groups. We identified two self help groups i.e. Mian Mamli and Nari Shakti for the present study. These groups started voluntarily with 15 active members in the Mian Mamli (2012), Nari Shakti (2013), Chetna (2010) and 30 members in Sada Shiv Modern (2003) with aim to socialize and achieve economic self-sufficiency. These groups adopted various income generating activities to achieve financial self-reliance like decorative candle making, pickle formation, *duna* (Bowl of *Bor*) making in three groups. Sada Shiv Modern (SSM) adopted pickle formation in the first year and squash making after three years. Presently SSM entered

Table 3: Historical perspectives of self help groups of Doaba region

Name of group	Mian mamli Jalandhar	Nari shakti, jalandhar	Chetna, Hoshiarpur, Doaba	Sada Shiv Modern, Hoshiarpur , Doaba
Year of establishment	2012	12-04-2013	2010	2003
Year of registration	2012	2013	2010	2003
Formation of group	Pahal (NGO)	Pahal (NGO)	Shubh Karman Society	Shubh Karman Society
Group size	2012 13 2013 15	2015	2010 15 2013	2003 35 2013 30
Reasons for discontinuance		Non-payment by the members Non-cooperation of family	_____	Lack of interest, less profit
Entrepreneurial activity	2012 Candle making 2013 Candle making, surf making	Candle making, pickle formation and mango chutney	*Duna* making	2003 Pickle formation 2006 Squash 2013 Aloe vera products, Bael Squash, Harar juice, murabba
Selection of leader	Election	Consensus	Election	Consensus
Term of leader	One year	One year	One year	One year
Membership fee			Rs.20/-	——-
Venue of meeting	Gurdwara	Temple	Gurdwara	Panchayat room
Duration	Fortnightly	4 meetings in a month	Fortnightly	Once in a month
Attendance (n=10)	85%	90%	85%	95%
Action taken for not attending meeting	No action taken	Fine of Rs. 20/ meeting	Fine of Rs. 20/meeting	Member should leave the group (not attending 3 meetings)
Record of meeting	Complete and up to date	Complete and up to date	Complete and up to date	Complete and up to date
Maintenance of record	Group leader	Group leader	Group leader	Secretary
Purpose of loan	———	Domestic purpose	_____	Purchase of raw materials
Amount of loan taken for group	_____	Rs.40,000/-	RS. 50,000/-	Rs. 1.5 lakh
Name of bank	———	Central Co-operative Bank, Jalandhar	State Bank of India	Punjab Grameen Bank, Amloh
Rate of interest of bank	———	2% per month	11% annually	10% annually
Payment of instalment	———	Regularly	Regularly	Regularly
Getting of loan	———	Easily	Easily	Easily
Interloaning	2% rate of interest	2% rate of interest	2% rate of interest	2% rate of interest, 3% outsiders
Marketing of products	Collectively	Collectively	Society	Collectively
Nature of production	Demand basis	demand basis	Demand basis	Continuous basis
Monthly saving of the group	Rs.100/member	Rs.100/member	Rs.100/member	Rs.50/member
Participation in events			Attended seminar organized by Shunb Karman Society on women empowerment	• Participated in Kisan Mela, PAU, Ludhiana
Awards				• Guest of Honour presented by The UNNATI Co-op, Talwara • Award of Honour, BY State Level Model Agency, Punjab • First Prize, Stall Competition, Kisan Mela 2013 • Award of Honour, BY National Rural Health Mission, Hoshiarpur, • Award of Honour BY SBI, Hoshiarpur • Grant Fund of Rs 77 lakh by S. Parkash Singh Badal. Chief Minister, Punjab

in to new business by taking up processing of fruits and vegetables, various Aloevera products and linked them with various extension personnel of KVKs and PAU, Ludhiana. They had increased their income ranged from Rs.500-1000 from these entrepreneurial activities. The leader controlled all the group activity was selected with the consent of group members for a period of one year. It is the responsibility of group leader to conduct regular meetings to review the work of group. Consequently leader of all the groups conducted meeting at common place which was convenient for all the members (Table 2). The penalty of Rs.20 was imposed to absentee in meetings in three groups whereas in SSM , member absent from regular three meetings was expel out from the group. The record of their meetings was complete and upto date.

Within six months all the groups opened accounts in various banks with the help of NGOs who had earlier assisted their initiation. There were regular transactions between the bank and the group. The group deposited their savings every month and withdrew when required. With financial support from the banks, the SHGs diversified from traditional agriculture and took up income generating activities. The group took loan for purchase of raw materials like wax, painting colours, mango, leaves of *Bor*, *amla*, aloe-vera and paid the installments of loan regularly. Micro-credit not only helped rural people attain improved economic status but also led to social cohesion and women's empowerment (Gupta and Singh, 2012; Kalra *et al.,* 2012; Murthy, 2013).

Sada Shiv Modern participated in various Kisan melas, got award of honour by State Level Model Agency, Punjab and National Horticulture Mission, Hoshiarpur. For its excellent performance in exhibition held at Delhi, the group was awarded a grant of Rs.77 Lakh by the Chief Minister of Punjab. Panda (2008) revealed that timely provision of grants and aids helps build adequate infrastructure that would eventually streamline various activities of groups. At present, the group is in progress of building infrastructure in Talwara district of Hoshiarpur which was a big achievement for all the members of SSM group (Table 3).

CONCLUSION

The self help groups of *Majha, Malwa* and *Doaba* regions of Punjab were functioning smoothly. The case studies of these groups gave an in-depth observations on their status, problems faced by the members at different stages of group and innovative techniques followed by them. The promoting agencies also played an active role in facilitating and designing group activities for overall group development and their sustenance. Findings of this study could be of immense importance in the formation, management and evaluation the SHGs.

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Livelihood Diversity in Family Farming in Selected Hill Areas of West Bengal, India

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ABSTRACT

The conventional wisdom for many years has been that rising output and incomes in agriculture itself are the catalyst for diverse non-farm activities in rural areas. The diversity of livelihoods is an important feature of rural survival and is closely allied to flexibility, resilience and stability. In this sense, diverse livelihood systems are less vulnerable than undiversified ones; they are also likely to prove more sustainable over time precisely because they allow for positive adaptation to changing circumstances. Incomes were larger in the families with more diversity which results in a more sustainable rural livelihood. With this backdrop, the present study was in selected hill district of West Bengal in different altitudes. The data was collected from farmers using structured interview schedule. The statistical methods such Percentage, Mean, t-test and Correlation analysis were used as per the characteristics of data. The study reveals that there is difference in income and livelihood diversity between higher altitude and lower altitudes. Parameters like income from animal husbandry, income from marginal works and income from labouring, are positively correlated with diversity; but land holding, income from agriculture, possession of household assets, average family education and maximum family education are negatively correlated with diversity.

Keywords: Diversity, Flexibility, Livelihood, Sustainable, Vulnerable

INTRODUCTION

Since 1950, agriculture's share of GDP declined substantially; but there was minimal decrease in the numbers of persons dependent on agriculture. Consequently, agriculture contributes only around 13 per cent of national GDP, but employs around 50 per cent of the workforce and more than 90 per cent of this work force is from small and marginal farmers. Small and marginal farmers mostly operate in family farming and contribute around 50 percent production cultivating only 44 percent of land (Singh *et al.,* 2016; Guha *et al.,* 2016b).

Family farming is defined by FAO as "a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family labour. The family and the farm are linked, co-evolve and combine economic, environmental, reproductive, social and cultural functions" (FAO, 2013; Wolfenson, 2013). Forty percent of the world's households depend on family farming for their livelihood. Of the 3 billion rural inhabitants in developing countries, 2.5 billion belong to families working in agriculture. It is important to note that women account for almost half of developing nations' agricultural labour resources (FAO, 2012). Family farming is understood not only as a means of production, but a way of life, a mode of preserving and transmitting culture and agricultural knowledge (van der Ploeg, 2013).

Realizing the important contributions that family farming is making towards food security and eradicating poverty, the year 2014 has been declared as the 'International Year of Family Farming (IYFF)' at the 66th Session of the United Nations General Assembly to stress the vast potential of family farmers to eradicate

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hunger and preserve natural resources and aims to upscale family farming by technological intervention, entrepreneurial skill development and business ownership.

Sustainability and family farming are closely linked to each other. Family farming preserves tradition and culture, cares environment, conserve ecology and maintain diversity in all respect (Das Gupta, 2016). Livelihood diversification is the process by which households construct a diverse portfolio of activities and social support capabilities for survival and in order to improve their standard of living. It is an infinitely heterogeneous process differentiated in its causes and effects (Ellis, 1998). Diversification of household's livelihood activities is a strategy of reducing overall risk (Allison and Ellis, 2001; Turner *et al.,* 2003).

In this backdrop, the present study was undertaken in selected hill areas of Darjeeling district of West Bengal, India to study the livelihood diversity found in the family farms in the study area.

MATERIALS AND METHODS

Study area and selection of respondents: The study was conducted in former Darjeeling district of West Bengal. Darjeeling formerly consists of four sub-divisions namely Darjeeling (Sadar), Kalimpong, (now a district) Kurseong and Siliguri. Among the four sub-divisions Kalimpong was taken purposively for convenience fit to the time frame for an M.Sc. (Ag) level dissertation. Kalimpong consists of three blocks namely Kalimpong-I, Kalimpong-II and Gorubathan.Again, among the three blocks Kalimpong-II and Gorubathan (Block-III) were purposively selected considering the altitude of the area. Two villages from each block were selected taking consideration of the altitude. Finally, 25 respondents from each village were selected randomly comprising a total number of 100 respondents from the whole district.

Measurement of livelihood diversity: Livelihood diversification has been defined in various ways (Sujithkumar, 2007). Measurement of livelihood diversity among the prominent definitions, diversification is seen as an increase in the number of income sources or the balance among different sources (Ersado, 2003), or as a shifting from agricultural activities to nonagricultural ones (Reardon, 1997; Escobal, 2001), or shifting from subsistence farming to commercial farming (Delgado and Siamwalla, 1997). A household with a higher number of income-generating sources can be said to be more diversified than a household with fewer income-generating sources, and a household that generates an equal amount of returns from each activity its members are involved in is more diversified than a household with the same number of income-generating activity but an unequal income share from each income source. Widely used methodology of diversity measurement is the index-based approach. Simpson index, Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite Entropy index etc. are some of the indices to measure livelihood diversification (Shiyani and Pandya, 1998). As suggested by Khatun and Roy (2012), this paper also used Simpson index because of its computational simplicity and wider applicability. The formula for Simpson Index of Diversity is given below:

$$S.I.D = 1 - \sum_{i=1}^{N} P_i^2$$

Where, N is the total number of income sources and Pi represents income proportion of i^{th} income source. Its value lies between 0 and 1. The value of the index is zero when there is a complete specialization and approaches one as the level of diversification increases.

RESULT AND DISCUSSION

Socio-economic characteristics of family farms of hill ecosystem: Table 1 shows the socio economic and personal characters of the family farms and their heads. From the table it is seen that the age of the family head varies from 28 years to 78 years with an average of 52.89 years in hill family farms. Educational achievements of household head is considerably low (average value 6.00 years of formal education), although ranges upto graduate level. Outside contact, media exposure, organizational participation and land ownership showed a lower status, whereas housing condition and possession of assets were moderate among the family farm holders of the hill areas of West Bengal.

A comparative picture between higher and lower altitude showed that there are significant difference between the higher and lower altitude in respect of outside contact, extension media contact and land

Table 1: Socio-economic characteristics of the family farms

Characteristics	Unit	Min.	Max.	Mean±SD
Age	Year	28.00	76.00	52.89±11.81
Education	Class Standard	0.00	15.00	6.00±3.94
Outside area exposure	Score[1]	1.00	6.00	2.61±1.24*
Organizational Participation	Score[2]	1.00	5.00	1.37±0.79
Extension media contact	Score[3]	2.00	11.00	2.58±1.36*
Home condition	Score[4]	3.00	7.00	4.35±1.23
Household assets	Score[5]	51.00	78.00	55.64±6.17
Land Holding	Area in Decimal	10.00	508.00	117.71±102.63*

[1]Sum total of numbers of visits to the state head quarters, district headquarters, sub-division town and nearest town in a specified period of time.
[2]Sum total of scale values composed of 'no member', 'member', 'office bearer' and 'leader', with corresponding scores of 0, 1, 2 and 3 respectively.
[3]Frequency of communication with mass media and interpersonal channels of information in a specified period of time.
[4]Sum total of scores of housing status (scale composed of 'no sanitation', 'ring with soft wall', 'ring with hard wall' and 'sanitary' with corresponding scores of 0, 1, 2 and 3 respectively), drinking water status (scale composed of 'open surface water', 'dug well', 'shallow tube well', 'deep tube well/pipeline' with 1, 2, 3 and 4 scores) and housing condition (scale composed of 'bamboo', 'tin', 'wood' and 'pucca' with corresponding scores of 1, 2, 3 and 4 respectively).
[5]Sum total of scores assigned to different household assets
*Significant difference exists between higher and lower altitude

holding. In case of other characters there is no significant difference between the family farms of higher and lower altitudes. Findings are in line with Guha *et al.* (2016a).

Occupational complex explored by the family farms of hill ecosystem: Livelihood diversity is the occupational complex found in a family. Diversity in occupation is one of the strategies to reduce vulnerability. Present section represents the livelihoods found in the family farms along with livelihood diversity and income contribution from different occupations to the total annual income of family farms.

Table 2 presented the type of primary occupations found in a family farm of the study area with the diversity found in each group and yearly average income of the family. The table also presents the part of total income extracted from alternative occupations under each primary occupation. It is seen that the family farms of Darjeeling district mainly relies on agriculture as their primary occupation. 73 per cent of total family farms rely on agriculture whereas 12 per cent on animal husbandry, 6 per cent on business, 4 per cent on labouring activities, 3 per cent on other marginal works (like vermi-compost, sericulture, home tourism etc.) and only 2 per cent families are accessing service as their primary occupation. Findings of Guha *et al.* (2016b) are also supporting the present conclusion.

If we give a look on the values on Simpson Index of Diversity (SID value), it is found that agriculture group having the lowest diversity (SID=0.41). So, it can be said that agriculture is yet perceived as the most stable occupation in respect of all other occupations found in family farms of Darjeeling hills. It is a satisfying information to all engaged for development of agriculture that when youths are being reluctant day-by-day with agriculture, the family farms of lower and middle altitude farmers of hill areas of West Bengal are getting sufficient remuneration from agriculture occupation for a safe living which is also confirmed by the annual average income extracted by this group (second highest following service group with Rs. 1,10,263/- per annum.

The highest diversity found in case of labouring groups (SID=0.71). It is quite natural that the families engaged in labouring activities are also engaged in other occupational activities. Labouring being a marginal working field, the families have to rely on other sources of income for a safe living. The average annual income (Rs. 62,963/- per annum) is also lowest in relation to other groups compelled them for diversification of occupational fields.

Table 2: Main livelihood groups found in the study area

Primary Occupation Group	(Percent of families)	Av. Income (Rs./annum) (2016 price)	Simpson Index of Diversity			
			Min.	Max.	Mean	SD
Agriculture	73	1,10,262.74	0.00	0.74	0.41	0.22
Animal Husbandry	12	89,437.50	0.19	0.72	0.60	0.14
Business	6	88,116.67	0.30	0.66	0.55	0.13
Service	2	1,54,700.00	0.33	0.50	0.42	0.12
Labouring	4	62,962.50	0.69	0.73	0.71	0.02
Other marginal works	3	96,466.67	0.31	0.61	0.48	0.16
Overall	100	1,05,017.80	0.00	0.74	0.46	0.21

F-value=3.59 ($p<0.01$) comparing Livelihood Diversity (SID) among different occupation groups

The second highest levels of diversity was found in case of animal husbandry (with SID value=0.60) and business groups (SID=0.55). Animal husbandry itself diversify livelihood with cultivation of fodder with other crops. The business group may have scope to diversify with other occupation. In both the cases the annual average income is moderate (Rs. 89,438/- per annum for animal husbandry and Rs. 88,117/- per annum for business group) which may also create a sense of vulnerability among the farm families under this group.

Service group had less diversity (SID=0.42) again due to their feeling of stability regarding living with the occupation. The annual average income for this group is Rs. 1,54,700/- which is highest among all the groups.

Other marginal workers (vermicompost, mushroom, home tourism etc.), had also less diversity index in the tune of 0.48 with an annual average income of Rs. 96,467/-. They have also perceived their occupation as comparatively stable as the families with agriculture or service occupations.

The overall diversity index considering all groups is 0.46 which may be considered considerably lower. It may be due to the fact that the family farms of hills are yet satisfied with their present occupation or they may not have much scope for diversification of livelihood.

Income share by alternative occupations to family farms: The present section tries to draw a picture on income share by alternative occupations to different primary occupation groups. It is found that the family farms of hill areas of West Bengal are engaged in agriculture, animal husbandry, business, service, labouring and other marginal works as their primary occupation (as in Table 2). Along with primary occupation, they are also engaged to other secondary and tertiary occupation to supplement and secure their livelihood. From Table 3 it is found that the agricultural groups are also engaged with all other occupations when viewed in a holistic manner. The income share from alternate occupations is around 23 percent ranging from only 0.65 percent from service to 10.68percent from animal husbandry. The agriculture itself is contributing as high as 77.26 per cent of total annual income to the families.

Table 3: Income share from alternative occupations under different primary occupation groups (percent)

Primary occupation groups	Agriculture	Animal Husbandry	Business	Service	Labouring	Other marginal works
Agriculture	**77.26**	10.68	3.39	0.65	2.82	5.21
Animal Husbandry	23.02	**51.91**	2.80	0.00	14.07	8.21
Business	26.92	13.43	**53.91**	0.00	0.00	5.75
Service	23.95	0.00	0.00	**71.11**	0.00	4.95
Labouring	26.88	20.25	0.00	0.00	**39.71**	13.16
Other marginal works	18.62	5.60	4.84	0.00	0.00	**70.94**
Total	64.79	14.81	5.73	2.59	4.55	7.54

In case of animal husbandry group, 51.91 percent is extracted from this primary occupation and 48.09 percent alternative occupations ranging from 2.80 per cent to 23.02 per cent. However none of the families is engaged in service from this group and agriculture provides the second highest income. For business group, business contributes 53.91 per cent along with 46.09 per cent from other occupations ranging from 5.75 per cent to 26.92 per cent. However, this group is not getting any income assistance from service and laboring activities. The second highest income is shared by agriculture for this group. Service group gets 71.11 percent from service, 23.95 percent and 4.95percent from agriculture and other marginal works respectively. None of the family of this primary group is engaged in laboring, animal husbandry or business.

From the table, it is also found that laboring groups are extracting income from number of sources in a balanced manner; and it is the group who are getting less than half share from their primary activity viz. laboring (39.71 per cent only whereas 60.29 per cent are coming from other sources). Although they are not getting any assistance from business or service but they are extracting 26.88 per cent from agriculture, 20.25 per cent from animal husbandry and 13.16 per cent from other marginal works. This may be the cause that the diversity index was found highest (SID=0.71) for this group. Other marginal works itself contributes 70.94 per cent to yearly income of the families who are primarily dependant on these occupations ((vermicompost, mushroom, home tourism etc.) and alternative occupations contribute only 29.06 per cent of total income ranging from 4.84 per cent to 18.62 per cent. It is also true for this group that they are not getting any assistance from business and service but extracting a considerable share (18.62 per cent) from agriculture.

On an average, the family farm of hill ecosystem extract their livelihood mainly from six occupations viz. agriculture (64.74 per cent), animal husbandry (14.41), business (5.73 per cent), labour (4.55 per cent), service (2.59 per cent) and other marginal work (7.54 per cent).Although agriculture is facing many challenges but family farms of hill areas of West Bengal yet rely on this sector for a safe livelihood.

Predictors of livelihood diversity in family farm in Darjeeling Hills of West Bengal: To delineate the factors which influence livelihood diversity is imperative to draw future plan of actions. The present section identifies the socio-economic and personal characters that influence it. Table 4 presents the correlation coefficient between different socio-economic characters with SID value.

It is found from the table that the socio economic characteristics such as land holding, total income and household assets shows significant negative correlation with livelihood diversity. But the outside exposure, organizational participation and extension media contact are significantly and positively correlated with diversity of farms. All other factors have no influence when considered singly.

Majority of the respondents were either marginal or having small land holdings and their capacity to have more household assets been difficult. Thus, land holding, total income and household assets, shows negative correlation. Moreover, income from agriculture may have given a perception that the vocation can help run the family safely. The annual average income from agricultural groups has confirmed this conclusion.

Higher land holding along with higher income developed a satisfying attitude not to undertake different occupations other than land based activities. The landless counterpart due to their marginality feeling may stretch their hands to other occupation for generating extra income. Higher income and higher level of household assets also reduce feeling of marginality which hinders to diversify livelihood. On the other hand outside exposure, organizational participation and media exposure might have developed favourable attitude towards diversification by more

Table 4: Correlation between diversity and socio-economic parameters

Socio-economic characters	r-value
Age of household head	-0.151
Education of household head	-0.099
Land Holding	-0.585(**)
Total Income	-0.538(**)
Outside exposure	0.275(**)
Organizational Participation	0.085
Extension media contact	0.236(*)
Housing Condition	-0.172
Household assets	-0.199(*)

*significant at 5 per cent level; **significant at 1 per cent level

Table 5: Predictors of Livelihood diversity extracted through stepwise multiple regression

Predictors	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.551	.044		12.618	.000
Land holding	-.001	.000	-.417	-4.183	.000
Total income	-6.962E-7	.000	-.254	-2.540	.013
Extension media exposure	.031	.012	.197	2.531	.013

Dependent Variable: Livelihood Diversity
Predictors: (Constant), Land Holding, Total Income, Media and extension exposure
Excluded Variables: Age, Education, Cosmopoliteness, Organisational Participation, Housing condition, Asset possession

exposure to different livelihood systems. Higher land holding with higher income developed a satisfying attitude not to undertake different occupations other than land based activities.

Frequent contacts of farmers with extension workers might have learned more about any technologies and could have benefited more and as the respondents who are really involved in mass media have acquired interest to obtain the benefits by becoming aware of the information and thus, the positive relationship with diversity was obtained.

A stepwise multiple regression analysis (Table 5) also extracted only three predictors (viz. land holding, total income and extension media exposure). The value of coefficients (B) confirmed the inverse relationship (Table 4) of land holding and total income with livelihood diversity, and a direct relationship with extension media exposure i.e. a decrease in one unit of land and total income will increase diversity in the tune of 0.001 unit and 6.96×10^{-7} unit respectively, and an increase of one unit of media exposure will increase 0.031 units of diversity. The phenomena can be explained from the similar reasons as in the previous section. However, low value of R^2 (0.428) suggests that only 42.8 per cent of total variability in diversity can be explained by these predictors, viz. there are many other predictors of livelihood diversity which can influence the relationship in the present set of study.

CONCLUSION

Family farms of hill areas of West Bengal, the livelihood diversity of agricultural groups is found low; which means that they yet perceive agriculture as a safe livelihood activity; which is also reflected in yearly average income of agricultural groups which is found second highest after service group. It is a satisfying fact indeed but, it is recommended to diversify their activities to reduce the livelihood vulnerability in this age of climate change. Media and extension exposure has been found to have a significant positive effect in enhancing livelihood diversity. At present it is found that the farmers especially the youths are reluctant to undertake agriculture as their primary occupation. Government can play a major role in attracting the youth through providing special livelihood enhancing training on entrepreneurship etc., thus increasing the level of media and extension exposure. There is a need of linkage of different institutions in the study area for a common objective. Sustainable tourism development is also an area which needs to be taken into consideration to diversify occupations in family farming. The similar type of research study may be conducted in a larger area to generalize the findings. In depth analysis can be carried out with respect to altitudinal difference.

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Factors influencing stakeholders to use Rice Knowledge Management Portal (RKMP)

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ABSTRACT

In India lots of efforts are being taken to develop new agricultural technologies for increasing productivity and income of farmers. Despite of efforts taken by *Krishi Vigyan Kendras* (KVKs), state departments, ATMA, private sectors and NGOs, farmers are not even aware about new technologies. In this scenario, ICT-led media helps in rapid dissemination of information and wider information accessibility of rural communities. Information and communication technology (ICT) has provided greater transparency in securing information by farmers and sped up the decision making process. It has expanded the horizons of accurate, timely, pertinent information and services thereby facilitating an environment to make agriculture a profitable venture. In this scenario, this study has focussed on an ICT initiative, Rice Knowledge Management Portal (RKMP) by Indian Institute of Rice Research (IIRR), Hyderabad, to accumulate diversified information and to disseminate it properly among the rice farmers of the country. The study was conducted in purposively selected districts of Nalgonda in Telanagan state and West Godavari in Andhra Pradesh state, with an aim to analyze the factors associated with utilization of knowledge repository of Rice Knowledge Management Portal (RKMP) by rice stakeholders. A total 140 respondents were selected for the study. The influential factors for the use of RKMP were studied through logit model. The findings of the study revealed that land size, education, annual income, extension contact and mass media exposure of farmers were the factors influencing the use of RKMP. For the scientists, it was availability of ICT tools and access to internet at office. For the extension personnel, it was availability of ICT tools, access to internet at office and training in handling ICT tools. This study suggests that these factors which facilitates the use of RKMP to be targeted to mobilize and motivate farmers and other stakeholders to use such knowledge management models.

Keywords: Rice farmer, Factors, Logit regression, RKMP, ICT

INTRODUCTION

For sustainable livelihoods, agriculture sector is important being ensure poverty reduction and food security (Arfan *et al.,* 2015). Information and Communication Technologies (ICTs) employ innovative means for development of agriculture sector which is the most vital part of economy in most of the developing countries. As communication technologies are growing every day, extension and rural advisory services are going to be more reliant on ICTs more efficient, appropriate and innovative ways as for effective delivery of agro-based advanced technologies to the all stakeholders of agriculture. Moreover, ICT based extension and advisory services are increasingly been seen as new factors of agricultural production partially replacing the traditional factors of production such as land, labour and capital. The growth of communication technologies is a process and is a phenomenon of globalization (Marrow, 2002). Keeping in view the significance of ICTs in overall agricultural advancement, it is necessary to promote ICT based agricultural information dissemination to enhance agricultural productivity and also to provide sustainable

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agricultural information delivery mechanism (Atibioke *et al.,* 2012). Considering these things Indian Institute of Rice Research, Hyderabad developed a knowledge portal, namely Rice Knowledge Management Portal (RKMP) which acts as a one stop solution to the different stakeholders of rice farming. This came into existence in collaboration with different partners. RKMP provides many specific queries for rice research and cultivation, such as variety selection, disease management, pest and site specific frequently asked questions (Das *et al.,* 2013). The efforts paved the way to reduce the gaps of the growing "digital information divide" specifically in the important cereal crop of the country namely rice (Meera *et al*., 2013). These types of agricultural information are very complex and critical procedure. It involves various steps and factors at farmer's level. Various socio-economic factors play a prominent role in utilizing RKMP. Utilization of improved agricultural technology by the farmers, to a large extent, depends upon the effective sources of information and channels to which they are generally exposed directly or indirectly. The mass media is quick, economical but lack crucial elements of empathy and feedback which are apparent in face to face situation (Devi and Verma, 2011). Various studies have been conducted to investigate socio-economic factors which influence farming community with regard to using ICT based agricultural extension services, approaches and other social activities. Diversified demographic attributes and social & economic variation associated with behaviour have been supposed to be manipulated by intellectual (Azilah *et al*., 2015). These factors may also promote and support improved farm productivity and sustainability in agriculture (Burton, 2014). Smallholder farmers with low agricultural income require less information due to lack of motivation and interest in agriculture, but sufficient and timely delivery along with reliable information could encourage them to improve their information utilization pattern and strategies for improved farm outcome (Nain *et al*., 2015) All the stakeholders viz. research institutes, extension agencies, farmers and government need to play their respective roles to bridge this gap for the overall development of the agriculture sector (Kaur *et al*., 2013).

MATERIALS AND METHODS

The study was conducted in the state of Telangana and Andhra Pradesh. These states were selected purposively for locale of study as these states are called rice bowls of India. Since, Indian Institute of Rice Research (IIRR), Hyderabad is the host institute of RKMP project, implemented this project in these states to understand how RKMP by using its knowledge repository can disseminate information to stakeholders (farmers, scientists and extension personnel) for managing timely and relevant information. A multi-stage random sampling technique was adopted to select the respondents, using a structured questionnaire information was collected on socio-economic characteristics of stakeholders, their access to different type of information sources. From each selected state, one district was selected purposively based on implementation of RKMP project. From Telangana state, Nalgonda district and from Andhra Pradesh, West Godavari district were selected purposively as the project was being implemented in these districts since its inception. For the detailed survey, from each district, 4 villages were selected randomly and from each village, 10 farmers were selected, so in total, 80 farmers were selected from these two states. For scientists, 15 respondents were selected for the survey from two selected organizations, Indian Institute of Rice Research, Hyderabad and Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, (APRRI & RARS) Maruteru, West Godavari District, Andhra Pradesh (Acharya N.G. Ranga Agricultural University). So, total 30 scientists were selected for the study. In case of extension personnel, 15 respondents were selected from each Nalgonda and West Godawari district and thus, total 30 were selected for the survey. Therefore, the study was conducted among 140 stakeholders of RKMP, namely, 80 farmers, 30 scientists, and 30 extension personnel. The independent variables that likely to influence the stakeholders' behaviour in accessing information from RKMP are defined as age, educational level, farm size, annual income, access to ICT tools and access to internet. The influence of socio-economic characteristics of the stakeholders such as farmers, scientists and extension personnel on the usage of RKMP has been studied through Logit model. It was assumed that better socio-economic profile of the respondents would improve the usage of portal. The goal of logistic regression is to find the best fitting model to describe the relationship between the

dichotomous characteristic of interest (dependent variable = response or outcome variable) and a set of independent (predictor or explanatory) variables. The main advantage of these models is that their prediction of probabilities always lies between zero and one, thus avoid nonsense prediction for binary variable, as they are based on proper continuous distribution function. The binary Logit model is given by,

$$P\left[y|x_{1,}x_{2,}...x_{k}\right]=F\left(\sum_{i=1}^{k}\beta_{i}x_{i}\right)$$

Binary lLgit model is used when dependent variable is binomial; there are only two outcomes of a variable. Therefore, in this study, the binary category has been arrived by taking the mean scores of the different uses of portal of the respondents. The respondents were asked a series of questions pertaining tom usage of RKMP and their mean score were calculated. The respondents were categorised into two groups such as 'high users' those who belong to above the mean score and 'low users'; those who belong to less than the mean score. The binary dependent variable was coded as high user (=1; event category) and low user (=0; base category).

RESULTS AND DISCUSSIONS

The findings of this study revealed that majority of farmers were male (88%) and about 13 per cent were female farmers and most of the farmers (56%) belonged to young age group followed by middle age group (39%) and elderly farmers were about less than 5 per cent, all the farmers were literate and all of them were having education upto or above the primary school. It was found that 33 per cent of farmers were educated below high school level and 31 per cent of the farmers were educated upto higher secondary school level. About 14 per cent of the farmers were graduate and above and majority of the them were involved only in farming (72%). Some of the farmers (18%) had farming and service as supplementary occupation and only (10 per cent) had farming and other business. Majority of the farmers (71%) were living in the nuclear family, whereas 29 per cent of them were residing in joint family and 56 per cent farmers had small family size (<4 members). A More than half (64%) of the farmers were categorised as large farmers having land holding greater than 10 acres, 23 per cent were medium farmers having 5-10 acres of lands. And only 14 per cent were under the small farmers' category (<5 acres). Majority of the farmers (66%) were earning about Rs.1to 5 lakhs/ annum, followed by less than one lakh category (20%) and more than five lakh category was found to be having least share (14%) in total distribution of the sample farmers. In the study, it was found that more than 78 per cent of the sampled farmers were having more than 10 years of farming experience and only about 23 per cent of the farmers were having less than 10 years of experience and about 43 per cent of the farmers were having 20-30 years of experience in farming. The results are well supported by previous studies by Mittal *et al.* (2016) who found that socio-economic characteristics of farmers like age, level of education and farm size are significantly related to farmers use of different sources of agricultural information. Okello *et al.* (2012) in their study reported that several factors specifically age, occupation, number of crop enterprises, farming experience, literacy and income from crops explain the use of ICT tools (Table 1).

Several studies reported that socio-economic and personal characteristics were positively associated with the use of agricultural information (Onu, 1991; Atala *et al.,* 1992 and Akande, 1999). The use of modern ICT information sources comprised mainly of mobile phones were positively and significantly associated with education level and farm size and which can be supported from some earlier studies (Jensen, 2007; Abraham, 2007; Mittal *et al.,* 2010).

Communication characteristics of farmers: In this study it was observed that most of the farmers were associated with social organisations. About 80 per cent of them were member of panchayat samiti and 64 per cent were member of youth club. For women farmers, self- help group was the major social organisation and about 74 per cent of them were members of it (Table 2).

This study is also supported by Babu *et al.* (2012) who found that farmers belonging to social organisations were having high information seeking behaviour. Tomar *et al.* (2016) found that 66 per cent respondents had medium level of social participation. Similar finding was also reported by Mahalakshmi (2003) whereas contrary findings were reported by Bhanotra *et al.* (2016).

Table 1: Socio-economic profile of farmers (n=80)

Description of variables	Respondents	
	Frequency	Percentage
Gender		
Male	70	87.5
Female	10	12.5
Age		
Young (below 35 years)	45	56.3
Middle aged (35 to 59 years)	31	38.8
Old (above 59 years)	4	04.9
Education		
Illiterate	0	00.0
Primary school	7	08.8
Middle school	11	13.8
High school	26	32.5
Higher secondary	25	31.3
Graduate and above	11	13.8
Occupation		
Farming	58	72.5
Farming and services	14	17.5
Farming and business	8	10.0
Family type		
Nuclear	50	62.5
Joint	30	37.5
Family size		
Small (<4 members)	45	56.3
Medium (4 to 7 members)	26	32.5
Large (>7 members)	9	11.3
Farm size		
Small (<5 acres)	11	13.8
Medium (5-10 acres)	18	22.5
Large (>10 acres)	51	63.8
Total annual income		
<1 lakh/year	16	20.0
1-5 lakhs/year	53	66.3
>5 lakhs/year	11	13.8
Farming experience		
Less than 10 years	18	22.5
10-20 years	27	33.8
20-30 years	34	42.5
More than 30 years	1	01.3

In this study it was observed that leaflets & newsletters (68 per cent) and mobiles (48 per cent) were the major mass media sources most frequently used by the respondents. Offline CDs and information kiosks were the least preferred sources of information (Table 3).

Tomar *et al.* (2016) found that two-third of the respondents (71 per cent) had medium level of mass media exposure in contrary with Bhanotra *et al.* (2016) found that majority (55 per cent) of the farmers were having low mass media exposure in utilizing ICT tools. Burman *et al.* (2013) found that farmers were the owners of modern Information and Communication Technologies. Radio was owned by 92 per cent farmers, while 82 per cent farmers had mobile phones. However, only 3 per cent of farmers owned computers.

Table 2: Distribution of farmers according to social participation (n=80)

Social organization	Nature of post		
	Non member	Member	Official post
Gram panchayat	56(70.0)	15(18.8)	09(11.3)
Panchayat samiti	0(00.0)	80(100)	0(00.0)
Cooperative society	18(22.5)	56(70.0)	06(07.5)
Self-help group	12(15.0)	59(73.8)	09(11.3)
Youth club	09(11.3)	64(80.0)	07(08.8)
Mahila mandal	69(86.3)	10(10.0)	03(03.8)
Farmers' organizations	28(35.0)	50(62.5)	02(02.5)
Zila parishad	68(85.0)	11(13.8)	01(01.3)
ATMA (at any level)	72(90.0)	07(08.8)	01(01.3)
Block development committee	63(78.8)	14(17.5)	03(3.8)

Figure in social participation is percentage

The findings of this study revealed that majority of farmers were dependent on input dealers, agriculture extension officers and neighbours and friends for agricultural informations. Agricultural researchers and SAUs were rarely sought for information by the farmers in the study area (Table 4).

On the same line, Tomar *et al,* (2016) and Vishwatej *et al.* (2016) reported that majority of respondents (49%) had medium level of extension contact, while Bhanotra *et al.* (2016) reported low extension contact from their study area.

Further it was found that 50 per cent of the farmers had smart phones and about 28 per cent were having computers, and about 20 per cent of them were having both computers and smart phones (Table 5).

Tomar *et al.* (2016) reported that 95 per cent of respondents possessed mobile phones and Burman *et al.* (2013) found that 81.6 per cent farmers had mobile phones.

Table 3: Distribution of farmers according to mass media exposure (n=80)

Mass media	Frequency of exposure				
	Always	Most often	Often	Sometimes	Never
Computer	10(12.3)	12(14.8)	55(67.9)	02(02.5)	01(01.2)
Mobile phones	39(48.1)	32(39.5)	08(09.9)	01(01.2)	00(00.0)
T.V.	01(01.2)	03(03.7)	24(29.3)	51(63.0)	01(01.2)
Offline CDs	0(0.0)	0(0.0)	0(0.0)	06(7.4)	74(91.4)
Leaflets and Newsletters	55(67.9)	20(24.7)	05(6.2)	0(0.0)	0(0.0)
Radio	09(11.1)	24(29.6)	21(25.9)	20(24.7)	06(7.4)
Information kiosk	0(0.0)	0(0.0)	0(0.0)	02(5.0)	75(91.5)

Table 4: Distribution of farmers according to extension contact (n=80)

Extension Personnel	Frequency		
	Regularly	Occasi-onally	Never
Progressive farmers	48(58.5)	22(26.8)	10(12.2)
Agricultural Extension officers	35(42.7)	25(30.5)	20(24.4)
Agricultural researchers	0(0.0)	13(15.9)	67(83.8)
Cooperative unions	09(11.3)	64(80.0)	07(8.8)
Neighbors / friends	69(86.3)	10(10.0)	03(3.8)
Farmer groups	05(6.1)	63(76.8)	12(14.6)
Village leaders	03(3.7)	68(82.9)	9(11.0)
Government agency	06(7.3)	59(72.0)	15(18.8)
Agricultural Input dealers	68(85.0)	11(13.8)	01(1.3)
NGOs	04(4.9)	28(34.1)	48(85.5)
SAUs	01(1.2)	14(17.1)	65(79.3)

Table 5: Distribution of farmers according to possession of ICT tools (n=80)

ICT tools	Frequency	Percentage
Computer	22	27.5
Smart phone/Android phones	40	50
Both	18	22.5

Table 6: Distribution of farmers according to access of internet (n=80)

Access of internet	Frequency	Percentage
Yes	54	67.5
No	26	32.5

The findings of this study revealed that about 68 per cent of the farmers had access to internet which helped them to use online sources. However, it was noted that all of farmers had offline access to RKMP portal. Tomar *et al.* (2016) reported in their study that only 16 per cent of the respondents possessed computer with internet (Table 6).

Determinant for use of RKMP by farmers: Some factors that were having a significant impact on the use of RKMP were analyzed. Although the Logit model regression coefficients could indicate the direction of the relationship but we cannot have magnitude of the influence. Therefore, exponential of beta coefficients or odds ratio were used for interpretation. From the table it is clear that some variables had positive effect like total land at 1 per cent of level of significance, education at 5 per cent of level of significance, annual income and extension contact and family size at 10 per cent of level of significance. Age and education were found to be negatively associated with usage, however it was not significantly influencing. If the land size of a farmer on an average increased by one unit then he or she is likely chance of including in high users category is increases by 1.2 times. Similarly, if the income increases by one unit there is a chance of increase of use of RKMP by 3.6 times. Those who were having better extension and mass media exposure were likely to have 1.2 times more chances of use of RKMP than those who were not (Table 7). Similar results were reported in previous studies by Iorliam *et al.* (2012), Warren *et al.* (2000) and Chauhan (2010).

Factors influencing scientists to use Rice Knowledge Management Portal: The investigation revealed that majority (60%) of the respondent scientists belonged to middle age group and 74 per cent of them were Ph.D. holders with 13 per cent of them were M.Sc. qualification and Post doctorate. It was observed that more than 90 per cent of the scientists were possessing computers and 100 per cent had mobile phones and majority of the scientists (60%) were having service experience of 10-20 years and 94 per cent of scientists

Table 7: Identification of factors influencing the use of RKMP by farmers (n=80)

Explanatory variables	B	S.E.	Sig.	Exp (B) or Odds ratio
Gender	-.463	.613	.450	.630
Education	1.072	.548	.050	2.920**
Age	-.076	.442	.863	.926
Family size	.560	.340	.100	1.750*
Total land	.188	.062	.003	1.206***
Occupation	.334	.395	.397	1.397
Farming experience	-.226	.372	.543	.797
Annual income	1.282	.571	.025	3.604**
Social participation	-.012	.138	.929	.988
Extension contact	.243	.101	.016	1.275**
Mass media participation	.159	.098	.105	1.172*

*Significant at 5% level; **Significant at 1% level

had internet access at office and rest were not having access. Whereas 93 per cent of scientists attended training to handle the ICT tools and remaining were having basic knowledge about use of ICT tools (Table 8).

Khamoushi *et al.* (2014) found that availability of sufficient number of ICT tools, familiarity and expertise and in-service training facilitation for using ICTs were observed as major factor in the effective use of ICTs by Agricultural extension scientists.

Table 8: Socio-economic profile of scientists (n=30)

Description of variables	Respondents	
	Frequency	Percentage
Age		
Young (<below 35 years)	12	40.0
Middle aged (35 to 59 years)	18	60.0
Education		
M.Sc.	4	13.3
Ph.D.	22	73.3
Post Doc.	4	13.3
Availability of ICT tools at office		
Computer	28	94.0
Smart phone	30	100
Both	28	94.0
Experience in service		
Less than 10 years	18	60.0
10-20 years	18	60.0
More than 20 years	0	00.0
Access to internet at office		
No	2	06.7
Yes	28	93.3
Training attended in handling ICT Tools		
Yes	28	93.3
No	2	06.7

Determinant for use of RKMP by scientists: Factors which affect the use of RKMP by scientists have been analysed. Socio-personal variables like ownership of ICT tools like mobile phones, computers or laptop had significant impact on use of RKMP portal at 5 per cent of level of significance. It shows that the use of RKMP was directly influenced by ICT tools possession. Access to internet was also positively influenced the use of RKMP at 5 per cent level of significance. It indicated that one having internet access at office were likely to use RKMP 15 times higher than those who were not having access at mean level. The experience in / profession negatively affected the use of RKMP and it was significant at 10 per cent level, which indicated that as experience increases use of RKMP decreases (Table 9).

A study done by Karimi *et al.* (2011) found that providing ICT equipments was most important factor to use ICTs, similarly, Hyesung (2004) found that computer self-efficacy had a significant direct influence on the intension to use information technology.

Factors influencing extension personnel to use Rice Knowledge Management Portal: The study revealed that most of the respondents (67%) belonged to young age group. It was found that 33 per cent extension personnel belonged to middle age group and majority (70 %) of the extension personal had only bachelor degree and remaining had master degree.

It was found that 70 per cent of extension personnel were possessing smart phones and 60 per cent had computers and most of the extension personnel (74 per cent) were having service experience

Table 9: Identification of factors influencing the use of RKMP (scientists) (n=30)

Socio- personal variables	B	S.E.	Sig.	Exp (B) or Odds ratio
Age	-0.648	1.008	.520	0.52
Ownership of ICT tools	3.201	1.542	.038	24.56**
Experience in service	-0.199	.124	.108	0.82*
Access to internet at office	2.684	1.401	.055	14.68**
Training attended in handling ICT tools	-18.900	21258.598	.999	000

*Significant at 5% level; **Significant at 1% level

of less than 10 years and remaining were having 10-20 years of experience. About 64 per cent of extension personnel had internet access. Majority of extension personnel (74 per cent) needed training on basic handling ICT tools. Raksha *et al.* (2015) found that training was positively and significantly associated with attitude of extension personnel in using ICTs (Table 10).

Determinants for use of RKMP by extension personnel: In case of extension personnel, socio-personal variables like ownership of ICT tools was found to affect the use of RKMP at 5 per cent level of significance. Access to internet at 5 Per cent level of significance showed the direct effect on use of RKMP. The result showed that in use of RKMP, possession of ICT tools and internet access had high influence and had 15 times more chances for use of RKMP portal. Training on use of ICT tools affects the use of RKMP and it was significant at 10 per cent level (Table 11).

It clearly indicated that as compared to scientists, the extension professionals needed training in using ICT tools which has significant influence on the use of RKMP portal. In turn, this will facilitate the faster information dissemination among the farmers by the extension personnel. Findings were well supported by Woodhouse and Baigent (2002), Coulson (2000), Small (2001) and Swann (2003).

Table 10: Socio-economic profile of extension personnel (n=30)

Description of variables	Respondents	
	Frequency	Percentage
Age		
Young (< 35 years)	20	66.7
Middle (35 to 59 years)	10	33.3
Old (>59 years)	0	00.0
Education		
B.Sc	21	70.0
M.Sc.	9	30.0
Ph.D.	0	00.0
Availability of ICT tools at office		
Computer	17	57.0
Smart phone	21	70.0
Both	19	63.3
Experience in service		
Less than 10 years	22	73.3
10-20 years	8	26.7
More than 20 years	0	00.0
Access to internet at office		
Yes	19	63.3
No	11	36.7
Training attended in handling ICT Tools		
No	8	26.7
Yes	22	73.3

Table 11: Identification of factors influencing the use of RKMP (extension personnel) (n=30)

Socio- personal variables	B	S.E.	Sig.	Exp (B) or Odds ratio
Age	1.137	1.054	.281	3.119
Availability of ICT tools at office	2.828	1.331	.034	16.91**
Experience in service	-.056	.194	.771	.945
Access to internet	2.875	1.491	.054	17.75 **
Training in handling ICT tools	1.963	1.158	.090	7.118*

*Significant at 5% level; **Significant at 1% level

CONCLUSION

It could be concluded from the study that the majority of farmers, extension personnel and \scientists were using the RKMP. Majority of the farmers had mobile phones and used it for getting information.. It was found that land size, education, annual income, extension contact and family size were the main factors influencing the use of RKMP by farmers. In case of scientists, access to internet and possession of ICT tools at office and in case of extension personnel, possession of ICT tools, access of internet and training in using ICT tools influenced the use of RKMP. It indicates that basic physical facilities are very much essential for promotion of such ICT based interface followed by training in using modern ICT tools. The study further suggests for development of ICT mediated such interventions in other crops and other vocations of agriculture for the effective and efficient extension system in the country.

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Perception of Scientists of Anand Agricultural University towards Organizational Climate

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ABSTRACT

The present study was conducted in the Anand Agricultural University, Gujarat through personal interview on 150 proportionately selected scientists engaged in teaching, research and extension activities. For measuring the perception of scientists, a structured interview schedule was developed. It was found that 50.67 per cent of the scientists had most favourable perception about organizational design, 83.33 per cent had high to very high level of trust on their staff and university authority, 90.00 per cent were having good to very good perception about their superiors' leadership skill, 83.34 per cent had good to very good level of overall communication, 89.33 per cent had favourable to most favourable perception about their organizational culture, 85.33 per cent perceived that teamwork within the organization was good to very good level, 85.34 per cent perceived high to very high level of motivation from their superiors and 88.67 per cent had favourable to most favourable overall perception about their organizational climate. The outcome of the study may act as guidelines for scientists to perform their job / duties more effectively and help officials of the universities in understanding the psychology of scientists. This study would enable the programme planners and policy makers to gear up their activities towards improving perceived organizational climate of the scientists.

Keywords: Agricultural university, Organizational climate, Perception, Scientists

INTRODUCTION

Organization is a social arrangement consisting of a number of individuals, with different tasks for each individuals, interdependence and interaction of these individuals and aiming at the achievement of prefixed objectives. Organizations that are able to create environment that employees perceive as benign and in which they are able to achieve their full potential are seen as a key source of competitive advantage (Brown and Leigh, 1996). Organizational climate serves as a measure of individual perceptions or feelings about an organization. Organizational climate includes management or leadership styles, participation in decision making, provision of challenging jobs to employees, reduction of boredom and frustration, provision of benefits and personnel policies, provision of good working conditions and creation of suitable career ladder for academics.

The capacity to influence organizational climate is perhaps the most powerful leverage point in the management system because organizational climate properties could have profound effect on performance and satisfaction of employees. On the other hand, low levels of discipline, confidence and responsibility are created in organization under the circumstances of the contemporary world, which influence employees' commitment within the organization.

The nature of organizational climate differs from one university to the other. The outcome of the study may act as guidelines for scientists to perform their job/ duties more effectively and help officials of the universities in understanding the psychology of scientists. This study would enable the programme planners and policy makers to gear up their activities towards improving perceived organizational climate of the scientists. The different activities in which scientists

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are participating more and also the activities for which they are not contributing much will be known so as to facilitate policy makers and programme planners act suitably.

The study facilitated in knowing perception of scientists of Anand agricultural university towards organizational climate, which may directly or indirectly affect their commitment towards organizational, and it would act as a guideline to the administrations or higher authority to plan, implementing programmes related to human resource development within the organization.

MATERIALS AND METHODS

The study was conducted in the Anand Agricultural University of Gujarat state. A list of all the scientists performing teaching, research and extension activities was obtained from the office of the Registrar, Anand Agricultural University, Anand. Thereafter, the scientists from each of the activities were selected randomly in such a manner that would be proportional to total size of the scientists in respective activities. In all, 150 scientists comprising 90 Assistant Professors, 42 Associate Professors and 18 Professors were selected as the respondents of the study. The data were collected through structured interview schedule. The exploratory research design was employed for conducting the proposed study.

The perception of scientists towards organizational climate was measured with the help of structured schedule. For analysis of the data, the statistical measures such as frequency, percentage, mean score and arbitrary method for categorization were used.

RESULTS AND DISCUSSION

In the present investigation an attempt hasbeen made to study the perception of the scientists of Anand agricultural university towards organizational climate. This variable was divided into seven components viz., organizational design, trust, leadership, communication, culture, teamwork and motivation. The data has been presented under the following seven heads:

Organizational design: A look from the data depicted in Table 1 indicates that 50.00 per cent of the Assistant Professors, 52.38 per cent Associate Professors and 50.00 per cent of Professors had most favourable perception about organizational design. However, only 5.56 per cent of the Assistant Professors had unfavourable perception about organizational design.

The possible reason behind this might be that the organizations' structure, infrastructure facilities and arrangement of workspace were better to perform their work in efficient way. It has positive impact on scientist's performance and their work productivity resulted in most favourable perception about organizational design.

Trust: The perusal of data presented in Table 2 reveals that within the organization 80.00 per cent of the Assistant Professors, 83.34 per cent of Associate Professors and 55.56 per cent Professors had high to very high level of trust on superiors and their colleagues. However 5.56 per cent of Assistant Professors and 11.90 per cent of Associate Professors were having low level of trust on superiors and their colleagues, while none of the Professors had low level of trust on superiors and their colleagues within the organization.

The probable reason behind this might be due to that the overall scientists of Anand Agricultural University perceived that their work environment as very energetic, supportive, motivating, comfortable and productive. Moreover, the high level of job satisfaction and low level of stress within the organization might

Table 1: Distribution of the scientists according to their perception about organizational design (n=150)

Organizational Design	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Unfavourable [10.81 to 15.60]	5(5.56)	0(0.00)	0(0.00)	5(3.33)
Neutral [15.61 to 20.40]	3(3.33)	5(11.90)	0(0.00)	8(5.33)
Favourable [20.41 to 25.20]	37(41.11)	15(35.72)	9(50.00)	61(40.67)
Most favourable [Above 25.20]	45(50.00)	22(52.38)	9(50.00)	76(50.67)
Total	100.00	100.00	100.00	(100.00)

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

Table 2: Distribution of the scientists according to their perception about trust (n=150)

Level of Trust	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Low [9.01 to 13.00]	5(5.56)	5(11.90)	0(0.00)	10(6.67)
Medium [13.01 to 17.00]	13(14.44)	2(4.76)	0(0.00)	15(10.00)
High [17.01 to 21.00]	28(31.11)	18(42.86)	8(44.44)	54(36.00)
Very high [Above 21.00]	44(48.89)	17(40.48)	10(55.56)	71(47.33)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

have resulted in high level of trust among staff members.

Leadership: The data depicted in Table 3 shows that 55.56 per cent of Assistant Professors, 47.62 per cent of Associate Professors and 66.67 per cent of the Professors perceived their superiors' leadership skill as very good. On the other hand within the organization only 4.44 of the Assistant Professors perceived leadership skill as poor.

This might be due to that the superiority of the university was capable to influence and encourage their subordinates to achieve particular organizational goal, which increases we-feelings among subordinate.

Communication: As it is obvious from the Table 4, that 82.23 per cent of Assistant Professors, 80.95 per cent of Associate Professors and 94.45 of the Professors had good to very good level of overall communication. Conversely only 2.22 per cent of the Assistant Professors were found in poor level category of communication.

Overall, it can be concluded that 83.34 per cent of the overall scientists of Anand Agricultural University engaged in teaching, research and extension education had good to very good level of overall communication.

Organizational culture: A look from the data depicted in Table 5 indicates that 66.67 per cent of Assistant Professors, 40.48 per cent of Associate Professors and 77.78 per cent of the Professors had most favourable perception about organizational culture. On the contrary only 3.33 per cent of the Assistant Professors had unfavourable perception about organizational culture.

Table 3: Distribution of the scientists according to their perception about leadership (n=150)

Perception about Leadership	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Poor [18.01 to 26.00]	4(4.44)	0(0.00)	0(0.00)	4(2.67)
Average [26.01 to 34.00]	4(4.44)	7(16.67)	0(0.00)	11(7.33)
Good [34.01 to 42.00]	32(35.56)	15(35.71)	6(33.33)	53(35.33)
Very good [Above 42.00]	50(55.56)	20(47.62)	12(66.67)	82(54.67)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

Table 4: Distribution of the scientists according to their perception about communication (n=150)

Perception about Communication	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Poor[18.01 to 26.00]	2(2.22)	0(0.00)	0(0.00)	2(1.33)
Average[26.01 to 34.00]	14(15.55)	8(19.05)	1(5.55)	23(15.33)
Good[34.01 to 42.00]	24(26.67)	18(42.86)	7(38.89)	49(32.67)
Very good[Above 42.00]	50(55.56)	16(38.09)	10(55.56)	76(50.67)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

Table 5: Distribution of the scientists according to their perception about organizational culture (n=150)

Perception about Organizational Culture	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Unfavourable [7.21 to 10.40]	3(3.33)	0(0.00)	0(0.00)	3(2.00)
Neutral [10.41 to 13.60]	8(8.89)	5(11.90)	0(0.00)	13(8.67)
Favourable [13.61 to 16.80]	19(21.11)	20(47.62)	4(22.22)	43(28.67)
Most favourable [Above 16.80]	60(66.67)	17(40.48)	14(77.78)	91(60.66)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

Minute observation reveals that 89.33 per cent of the overall scientists engaged in teaching, research and extension education activity had favourable to most favourable perception about their organizational culture.

Teamwork: The perusal of data presented in Table 6 reveals that within the organization 46.66 per cent of Assistant Professors, 45.24 per cent of Associate Professors and 50.00per cent of the Professors perceived teamwork on very good level. However 2.22 per cent of the Assistant Professors and 2.38 per cent of the Associate Professors perceived teamwork on poor level, while none of the Professors perceived teamwork within the organization on poor level.

The probable reason behind this might be due to that the success of organization to coordinate works into work groups and leadership style of the organization possibly most favorable to teamwork. It may also be due to that the presence of designing motivational programs, educational growth, increments and job rotation.

Motivation: It is obvious from the Table 7, that within the organization 52.22 per cent of Assistant Professors, 50.00 per cent of Associate Professors and 44.44 per cent of the Professors were very highly motivated from the superiors. On the contrary only 5.56 per cent of the Assistant Professors were belongs to low level of motivation category.

Overall perception about organizational climate: It is evident from the data depicted in Table 8 indicates that 57.78 per cent of the Assistant Professors, 47.62 per cent of the Associate Professors and 55.56 per cent of the Professors had most favourable overall perception about their organizational climate. However 4.44 per cent of the Assistant Professors and 2.38 per cent of the Associate Professors were having unfavourable perception about organizational climate.

Table 6: Distribution of the scientists according to their perception about teamwork (n=150)

Level of Teamwork	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Poor [14.41 to 20.80]	2(2.22)	1(2.38)	0(0.00)	3(2.00)
Average [20.81 to 27.20]	14(15.56)	5(11.90)	0(0.00)	19(12.67)
Good [27.21 to 33.60]	32(35.56)	17(40.48)	9(50.00)	58(38.67)
Very good [Above 33.60]	42(46.66)	19(45.24)	9(50.00)	70(46.66)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

Table 7: Distribution of the scientists according to their perception about motivation (n=150)

Level of Motivation	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Low [9.01 to 13.00]	5(5.56)	0(0.00)	0(0.00)	5(3.33)
Medium [13.01 to 17.00]	7(7.78)	8(19.05)	2(11.11)	17(11.33)
High [17.01 to 21.00]	31(34.44)	13(30.95)	8(44.44)	52(34.67)
Very high [Above 21.00]	47(52.22)	21(50.00)	8(44.44)	76(50.67)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

Table 8: Distribution of the scientists according to their overall perception about organizational climate (n=150)

Organizational Climate	Assistant Professor (90)	Associate Professor (42)	Professor (18)	Overall (150)
Unfavourable[86.41 to 124.80]	4(4.44)	1(2.38)	0(0.00)	5(3.33)
Neutral[124.81 to 163.20]	6(6.67)	6(14.29)	0(0.00)	12(8.00)
Favourable[163.21 to 201.60]	28(31.11)	15(35.71)	8(44.44)	51(34.00)
Most favourable[Above 201.60]	52(57.78)	20(47.62)	10(55.56)	82(54.67)
Total	100.00	100.00	100.00	100.00

[ ] Figures in parentheses indicate the score ( ) Figures in parentheses indicate percentage

The probable reason behind this might be due to that the climate within the organization was open and friendly in which employees feel comfortable.

CONCLUSION

From the above discussion it can be epitomize that 50.67 per cent of the overall scientists had most favourable perception about organizational design,83.33 per cent of them had high to very high level of trust on their staff and university authority, 90.00 per cent of the them were having good to very good perception about their superiors' leadership skill, 83.34 per cent of them had good to very good level of overall communication, 89.33 per cent of them had favourable to most favourable perception about their organizational culture, 85.33 per cent of them perceived that teamwork within the organization was on good to very good level, 85.34 per cent of them had high to very high level of motivation from their superiors and 88.67 per cent of overall scientist had favourable to most favourable overall perception about their organizational climate.

The findings of the study clearly imply that perception of the scientists about the organizational climate of Anand Agricultural University, Gujarat was moderately favourable. Hence, there is scope for tuning this performance to perform better by further improving the organizational climate through better human resource development measures. This can be done by recognizing good work, through promotions and rewards/incentives. This requires to be increase their willingness towards work by providing them adequate facilities.

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Assessment and Demonstrations on Management of Stem Rot Disease in Mustard Crop

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ABSTRACT

Rapeseed- mustard is an important edible oilseed crop among nine major oilseed crops i.e. soybean, groundnut, sunflower, safflower, sesame, caster, linseed, rapeseed mustard & niger. Rapeseed-mustard group of crops has diversified domestic and industrial uses. Rapeseed mustard is the third most important source of vegetable oil in the world and is grown in more than 50 countries across the globe. The present study was carried out to assess and demonstrate the management technology of stem rot disease in mustard. The seed treatment with Carbedazim @ 2.0 g/kg seed controlled stem rot disease more efficiently in mustard crop among two recommended practices i.e. Soil treatment @ 9.75 kg/ha followed by seed treatment @ 5 g/kg seed with *Trichoderme harzinium* and only Seed treatment with Carbendazim @ 2.0 g/ kg. The demonstration of thee years resulted 18.9 percent average increase in yield of mustard crop and 22% higher net returns over checkplots. The front line demonstration on management of stem rot disease on mustard as seed treatment with Carbendazim resulted 2.76 q/ha higher yield and farmers got Rs. 8303/ - additional return over farmers field (Without seed treatment). The Average extension gap was observed 2.68 q/ha, which emphasized the need to educate the farmers through various extension means for adoption of improved agricultural technologies, to bridge the wide extension gap. The technology index varied from 21 to 51 percent. The average technology index of 3 years was 41.33 percent.

Keywords: Assessment, Crop, Demonstrations, Disease, Management, Mustard, Rot, Stem

INTRODUCTION

Krishi Vigyan Kendra (Farm Science Centre) plays an important role in bringing the scientists closure with farmers and increasing face to face interactions. The main aim of Krishi Vigyan Kendra is to reduce the time lag between generation of technology and its transfer to the farmers for increasing productivity and income from the agriculture and allied sectors on sustained basis. KVKs are grass root level organizations meant for extending the proven technology through assessment, refinement and demonstration under different 'micro farming' situations in a district (Das, 2007). Front line demonstration (FLD) is a long term educational activity conducted in a systematic manner at farmers' fields to show the worth of a new practice/ technology. Farmers in India are still producing crops based on the knowledge transmitted to them by their forefathers leading to a grossly unscientific agronomic, nutrient management and pest management practices. As a result of this, they often fail to harvest the potential yields of various crops.

Oilseed plays an important role in agriculture economy in many regions of the world. Oilseed is a major source of protein and contributes considerably in the export earnings. Major oilseed producing countries in the world are USA, Brazil, Argentina, China and India and account for 82 per cent of oilseed production in the world.

During 2010-11 a serious problem of stem rot disease in mustard crop was observed by Krishi Vigyan Kendra, Ujwa in the rural area of NCT Delhi. The scientists of KVK found the possible preventive measures by consulting the plant protection scientists from IARI, New Delhi and CCSHAU, Hisar. During 2011-12 to 2012-13 On Farm Trail (OFT) were conducted on two recommendations viz. soil treatment @ 9.75 kg/ha followed by seed treatment @5 g/kg seed with *Trichoderma harzinium* and only seed treatment with Carbendazim @ 2.0 g/kg.

After assessment and validation of these technologies Front Line Demonstrations (FLD) were planned on seed treatment with Carbendazim @ 2.0 g/kg and was demonstrated at farmers' fields during 2012-13 and 2014-15 with following objectives:

- To demonstrate the performance of recommended stem rot control technology.
- To analyze the economics of recommended seed treatment technology to control stem rot disease of rapeseed-mustard.

MATERIALS AND METHODS

The study was conducted in rural Delhi on control of stem rot disease in mustard crop using the technology of Soil treatment @ 9.75 kg/ha followed by seed treatment @ 5 g/kg seed with *Trichoderme harzinium* and only Seed treatment with Carbendazim @ 2.0 g/kg seed to assess its performance during the two consecutive *rabi* seasons under FLD on rapeseed-mustard. The comparative analysis was done for these two technologies at the fields of randomly selected three farmers during 2011-12 and 2012-13. On the basis of performance under OFT's the technology of seed treatment with Carbendazim @ 2.0 g/kg of seed was selected for FLD's at farmers' field during three successive years; 2013-14, 2014-15 and 2015-16. Every year 10 progressive farmers were selected randomly in order to demonstrate this technology. The soil of the demonstration fields was sandy loam, having low nitrogen, medium phosphorus and potash. The major crop rotations were pearl millet-mustard and fallow-mustard. The crop was sown during first fortnight of October. Each demonstration was of one acre area and recommended package of practices were used in all the demonstration plots. The demonstrations at farmers' fields were regularly monitored at different stages of crop by a multi disciplinary team of scientists. To spread the technology in large area, the outcomes of demonstration were shared with neighbouring farmers and were also invited on field day before the harvest of the crop. Other farmers were also updated about this technology in kisan goshthis and trainings. The average yield and economics of demonstration and check plots was recorded and analyzed. Different parameters as suggested by Yadav *et al.* (2004) and Dayanand *et al.* (2012) were used for calculating gap analysis, costs and returns. The analytical tool used for assessing the performance of the FLD is as follows:

- Extension gap = Demonstration yield – Farmers' practice yield
- Technology gap = Potential yield – Demonstration yield
- $$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSIONS

On Farm Trial: The results from the OFT's conducted at farmers' field show that the seed treatment with Carbedazim @ 2.0 g/kg seed controlled stem rot disease more efficiently in mustard crop among two recommended practices. Application of Carbendazim resulted in lowest disease incidence and highest grain yield compared to *Trichoderme harzinium* in both the years (Table 1). The net returns was also highest for seed treatment with Carbendazim.

Front line demonstrations yield: Perusal of data in table 2 revealed that under demonstration plots, mustard yield was substantially higher than farmer's practice during all the years. Under different locations, the grain yield in demonstration plots ranged between 14.3 and 26.9 q/ha over observation period of three years, which was 6.7 to 27.8 percent more than farmers practice (check). On overall basis, 18.9 percent increase in yield was recorded in demonstrations plots. These results are in conformity with the findings of Tiwari and Saxena (2001) in oil seed crop however Haque (2000) and Tiwari *et al.* (2003) in other crops. However, the variation in yield from location to location and year to year can be accounted for varying climatic conditions, prevailing microclimate and variation in agricultural

Table 1: Effect on disease incidence and yield of mustard of two practices under OFT

Technology	2011-12				2012-13			
	Stem rot disease incidence (%)	Yield (qt/ha)	Net returns (Rs./ha)	B:C ratio	Stem rot disease incidence (%)	Yield (qt/ha)	Net returns (Rs./ha)	B:C ratio
T_0- No. Treatment	9.73	18.46	34700	4.03:1	11.46	20.50	50925	4.2:1
T_1-Soil treatment @ 9.75 kg/ha followed by seed treatment @ 5 g/kg seed with *T. Harzinium*	2.53	19.65	37675	4.29:1	3.06	21.26	53195.	4.3:1
T_2-Seed treatment with Carmedazim @ 2.0 g/kg	1.60	20.90	40800	4.56:1	2.80	21.83	55047	4.4:1

practices followed by the farmers. Almost same reasons were also putforth by Tomar *et al.,* 2003. Higher yields were recorded during 2015-16 crop season due to favourable climatic condition and less incidence of insects-pests and diseases.

Gap analysis: The Average extension gap was observed 2.68 q/ha, which emphasized the need to educate the farmers through various extension approaches for adoption of improved agricultural technologies to fill these extension gaps.

The technology gap shows the feasibility of the technologies at the farmer's field. The lower the value of technology gap, more is the feasibility of the technology demonstrated (Sager and Chandra, 2004). The technology index varied from 21 to 51 percent (Table 3). On an average, technology index was observed 41.33 percent during the 3 years of FLD. The difference in technology gap during different years could be due to variation in climatic conditions across years. Higher technology index reflected the inadequacy of technology and or insufficient extension services in transfer of technology. The results are in conformity with the findings of Singh and Kumar (2012).

Economic analysis: Cost of inputs on seed, fertilizers, herbicides and pesticides were considered as cash inputs for both FLD demonstrations as well as farmers practice. An additional investment was made on seed treatment with Carbendazim. Economic returns was observed to be a function of grain yield and Minimum Support Price (MSP) or sale price which varied along years. The average net returns of demonstrated plots

Table 2: Yield analysis of front line demonstrations of mustard on farmers' field

Year	Technology demonstrated	No. of Demons-trations	Yield (q/ha)				% Increase over check plots
			Demonstration			Check	
			Highest	Lowest	Avg.		
2013-14	Seed treatment with	10	16.50	15.00	15.90	13.00	22.3
2014-15	Carbedazim @ 2.0 g/kg	10	16.50	14.30	15.60	12.20	27.8
2015-16		10	26.90	24.15	25.49	23.90	06.7
Mean		10	19.96	17.82	19.00	16.36	18.9

Table 3: Gap analysis of front line demonstrations of mustard on farmers' field

Technology demonstrated	Potential yield (q/ha)	Demonstration yield (q/ha)	Farmers practice yield (q/ha)	Extension gap	Technology gap	Technology index (%)
2013-14	32.22	15.90	13.00	2.90	16.32	51.46
2014-15	32.22	15.60	12.20	3.40	16.62	51.58
2015-16	32.22	25.49	23.90	1.59	6.73	21.00
Average	32.32	19.00	16.36	2.63	13.22	41.33

Table 4: Economic analysis of front line demonstrations of wheat on farmers' field

Year	Cost of input (Rs/ha)	Gross returns (Rs/ha)		Net returns		Benefit Cost Ratio (Gross Returns/ total cost)	
		Demo.	Check	Demo.	Check	Demo.	Check
2013-14	15000	47775	39000	32025	24000	3.03:1	2.60:1
2014-15	16250	49920	39040	33670	22540	3.07:1	2.36:1
2015-16	17450	86666	81260	69216	63460	4.96:1	4.56:1
Average	12175	61454	53100	44970	36667	-	-

was Rs. 44970/- which was 22% higher than the check plot. The benefit cost ratio of was also higher than check during all these three years of demonstration (Table 4). The results are in conformity with the findings of Dayanand *et al.* (2012), R.K. Verma *et al.* (2014) and Venkatta Kumar *et al.* (2012). The average of three years front line demonstration on management of stem rot disease on mustard by seed treatment with Carbendazim resulted in 18.9 per cent increase in yield (Table-2) and got Rs. 8303/- additional return (Table 4) over farmers practice (without seed treatment). This increase was achieved with a very less amount of extra expenditure on seed treatment that could easily be afforded by all category of farmers.

CONCLUSION

It has been observed that farmers of the study area were not aware of seed treatment in mustard crop which results in heavy loss due to seed borne diseases such as stem rot. The seed treatment with Carbendazim @ 2.0 g/kg of seed is quite helpful in controlling the stem rot disease at very low cost. This will not only help the farmers in increasing mustard yield but also enhancing their farm profitability. It is further suggested that the farmers should be made aware about the seed treatment and they should be trained on seed treatment procedure through different programmes. There is a need to popularise seed treatment technology in mustard through all line departments for the benefit of the farmers.

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Cluster Frontline Demonstrations: A tool for Productivity Enhancement and Dissemination of Technologies for Rapeseed and Mustard in Northern Region

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ABSTRACT

Krishi Vigyan Kendras (KVKs) of the ICAR-ATARI, Zone-I, Ludhiana conducted the Cluster Frontline Demonstrations (CFLDs) on oilseed to increase productivity and farmer income in this Zone during 2015-16. In rapeseed & mustard the low production and productivity of local varieties is considered as one of the major constraints of traditional mustard farming which has created gap between demand and supply of edible oil. Thus, 6 KVKs of the Haryana and 1 KVK of Jammu & Kashmir conducted the CFLDs on mustard crop. For conducting the demonstrations the KVKs were guided to follow up the recommended and latest technologies i.e. latest variety, seed treatment with bavistin and biofertilizer (Azatobacter) and integrated crop management. However, in particular KVK, salt tolerant variety and foliar spray of Boron & Sulphur were also followed. For dissemination of these technologies, total 49 extension activities were conducted across the states of this zone in which 2681 farmers actively participated. In Haryana, RH-0749 variety was used in 300 FLDs on an area of 120 ha while CS-56 variety was demonstrated under salt conditions in Rewari district. This resulted in increment of the yield by 20.21 per cent over the local check in Haryana. In Haryana, maximum yield was recorded in Bhiwani followed by Jhajjar district. Similarly, in Anantnag district of Jammu & Kashmir; 31.58 per cent higher yield was recorded under rainfed conditions in 50 CFLDs on 20 ha.

Keywords: CFLDs, Demonstrations, Rainfed, Technology

INTRODUCTION

Oilseed crop, the second major group among agricultural crops after cereals, occupies an important position in Indian agricultural economy by virtue of its high fat content. Among oilseed crops, rapeseed-mustard is the third important group of oilseed crops in the world after soybean and palm oil. Vegetable oil constitutes an important part of our daily diet being source of energy, essential fatty acids and amino acids; while rapeseed-mustard oil contains 38-40 per cent crude protein, 12-13 per cent crude fibre and 7-8 per cent ash. In India, per capita consumption of vegetable oils is 13.36 kg/year/person, which is much lower than USA (36 kg/year/person) and world (17 kg/year/person) (Anonymous, 2015a).

Domestic consumption of edible oils has increased substantially in India, over the years, with increasing population and improving purchasing power. It has touched the level of 19.12 million tonnes during 2014 against the domestic availability of 9.00 million tonnes whereas 10.12 million tonnes of edible oil requirement was fulfilled by imports (Anonymous, 2015b). It indicates that there is still a wide gap between edible oil production and actual demand; this deficit is bridged through massive imports costing huge amount of foreign exchange. The Government decided to achieve self-sufficiency in edible oilseeds production by various technological interventions to overcome stagnant oilseed production through promoting latest production technologies in oilseed production. Government of India, again initiated technology under National Mission

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on Oilseeds and Oil Palm (NMOOP) by providing funds during September 2015-16 to the KVKs of ICAR-ATARI, Zone-I, Ludhiana to increase oilseed production in this Zone and achieve self-sufficiency in edible oils production through CFLDs. The objectives of CFLDs was to demonstrate the improved technologies among the famers recommended by the State Agricultural Universities (SAUs) and Indian Council of Agriculture Research (ICAR) Institutes so that it would improve the production and generate interest in the growing of oilseed crops which is losing importance due to stagnation in the yield faced by farmers while executing the Cluster demonstrations. During 2015-16, 350 CFLDs were conducted on the farmer's fields on Rapeseed & Mustard by the 6 KVKs of Haryana and 1 KVK of Jammu & Kashmir.

MATERIALS AND METHODS

The present investigations on CFLDs were conducted during *rabi* 2015-16 by the 7 KVKs of Haryana and Jammu & Kashmir. The districts were selected on the basis of the potential of the soil for cultivation of the oilseed crop. The CFLDs were conducted by demonstrating selected technologies mainly to improve the production and productivity of the area. A large numbers of CFLDs were conducted in the farmer's field in the district so that the maximum number of farmers can observe the demonstrations in the fields and interest for cultivation of the crop can be generated among the farmers as the main objective of CFLDs is seeing in believing. So a total of 350 demonstrations in an area of 140 hectares were conducted in Rapeseed & Mustard during *rabi* 2015-16 (Table 1).

RESULTS AND DISCUSSION

The improved variety seed as input was provided by the KVKs to 350 farmers in 140 hectares areas along with the other essential inputs included in the full package of technologies were demonstrated. The list of beneficiaries was prepared for conducting the FLDs in selected blocks as given in Table 1; and the technologies were provided by the KVKs for mustard cultivation. Farmers were guided to follow the recommended practices as per provided by the SAUs and ICAR Institutes. The details of the FLDs conducted have been given in Table 1. The basic inputs i.e. improved variety of oilseed, biofertilizers and sulphur containing micronutrients were provided to the farmers. Locally cultivated varieties of rapeseed and mustard were used as local check.

In Haryana, 20.21 per cent higher yield was recorded over the local check. The maximum increase in yield was recorded in Bhiwani district followed by Jhajjar district. In Bhiwani district, 30.35 per cent higher yield was recorded as compared to local check; increase in yield of farmer's field was due to adoption of package of practices along with Orobanche management. Orobanche, the most notorious and destructive parasitic weed in mustard, was controlled by application of Glyphosate @ 25 ml/ha at 30 DAS and @ 50 ml/ha at 55-60 DAS. Seed treatment with *Rhizobium* and Bavistin, ensured better growth of seedlings and provided protection against diseases, was demonstrated in districts of Hisar and Mahendergarh which resulted in increase the yield by 15.65 and 15.86 per cent over the local check. As compared to local check, 27.07 per cent higher yield was recorded in Jhajjar and this percentage increase in yield was due to demonstration of integrated crop management technology. In Rewari, 11.49 per cent higher yield was recorded over the local check and this increase might be due to demonstration of integrated nutrient management technology under CFLDs. The integrated pest management technology was demonstrated in district Sirsa, resulted in increase of the yield by 20.00 per cent over the local check. In Anantnag district of J&K, 31.58 per cent higher yield was recorded over the local check. This improvement might be due to seed treatment of improved variety with Azotobactor, application of sulphur fertilizer and foliar spray of Potassium and Boron.

Extension activities during Cluster Frontline demonstrations: During CFLDs, a total of 49 extension activities were conducted across the selected states of Zone-I in which 2681 number of farmers actively participated (Table 3). The extension activities comprised farmers-scientists inter-face, method demonstrations on scientific practices, *kisan goshthis*, trainings, etc. KVK scientists usually visited farmers' fields, particularly to popularize oilseed cultivation in the region. KVK scientists paid visits to selected farmers where CFLDs on oilseeds were demonstrated. The main purpose of organization of field days was to disseminate the improved technologies i.e. biofertilizers,

Table 1: Details of FLDs on Rapeseed-Mustard

State	KVKs	FLDs		Crop variety	Demonstrated technology	Blocks
		Demo. (No.)	Area (ha)			
Haryana	Bhiwani	50	20.00	RH-0749	Full Package Practices, Orobanche management practices	Badhra, Behal, Loharu, Bawani and Khera
	Hisar	50	20.00	RH-0749	Seed treatment with *Rhizobium* and Bavistin	Hisar-I, Agroha Adampur, Uklana and Hansi
	Jhajjar	50	20.00	RH-0749	Integrated crop Management	Salhawas, Jhajjar, Beri and Bahadurgarh
	Mahendergarh	50	20.00	RH-0749	Seed treatment with Bavistin	Mahendergarh and Ateli
	Rewari	50	20.00	RH-0749 and CS-56	Integrated Nutrient Management, salt tolerant improved variety	Rewari, Nahar, Khol and Jatusana
	Sirsa	50	20.00	RH-0749	IPM	Rania and Ellenabad
	Total	300	120.00			
Jammu & Kashmir	Anantnag	50	20.00	KS-101	Improved Variety, INM, Biofertilizer (Azatobacter)	Khovripora, Anantnag, Shahabad and Bijbehara
	Total	50	20.00			
Grand total		**350**	**140.00**			

Table 2: Details the results of rapeseed and mustard in Haryana and J&K

State	KVKs	Average yield (q/ha)		% increase
		Demonstration	Local check	
Haryana	Bhiwani	22.16	17.00	30.35
	Hisar	17.00	14.70	15.65
	Jhajjar	16.90	13.30	27.07
	Mahendergarh	16.80	14.50	15.86
	Rewari	16.50	14.80	11.49
	Sirsa	24.00	20.00	20.00
	Total	**18.89**	**15.72**	**20.21**
J&K	Anantnag	12.50	9.50	31.58
	Total	**12.50**	**9.50**	**31.58**

Table 3: Extension activities conducted during *rabi* season 2015-16

Extension activities	No. of programmes	No. of farmers
Farmer scientist interaction	5	157
Input Distribution	5	155
Lectures delivered	2	105
Kisan Goshti	6	533
Field days	15	599
Exposure visit	2	110
Awareness camp	1	35
Field visit	12	287
Kisan mela	1	700
Total	**49**	**2681**

newly released variety etc. through the demonstrations following the principle of "Seeing is believing".

CONCLUSION

The results signify that the production and productivity can be increased in oilseed production through Cluster demonstrations by motivating the farmers for the adoption of improved agro technologies which were demonstrated in the CFLD plots. But additional extension work is required to decrease the gap between demand and supply. However, soil moisture availability, rainfall conditions, climatic aberrations, diseases infestation and change in the location are also

responsible for disparity in yield of the crop. Thus, technologies demonstrated under CFLDs were helpful to improve the production, productivity, farmer's income as well as increase in area under mustard crop.

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Problems Faced by the Farmers in Adoption of Water Saving Technologies in Sri Muktsar Sahib District of Punjab

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ABSTRACT

The study was conducted to identify constraints faced by farmers in adoption of water saving technologies in Sri Muktsar Sahib district of Punjab. Eight villages from two blocks of district were selected purposively. A total of 150 respondents were randomly selected from 8 villages based on the probability proportion to the number of farmers in each village. Majority of the farmers were of the middle age group of 38-50 years, had gained education of matriculation and fell in the category of medium (10-25 acres) operational land holdings. It was also found that majority of the respondents (46%) had low mass media exposure and had low extension contacts. Regarding the constraints in direct seeded rice, it was found that voluntary rice germination and high infestation of weeds were the most expressed constraints. Straw management and inadequate soil moisture at the time of sowing were highly faced problems in the zero tillage in wheat. Mostly farmers had not faced any problem in case of Laser Leveler adoption but a meager per cent of them found that rent of machine was high and sometimes machine was not available at required time.

Keywords: Adoption, Farmers, Problems, Punjab, Technologies

INTRODUCTION

Water is a fundamental element for existence in the world. Water security is the foundation for food and energy security, and for overall long-term social and economic development in the world (Axwrthy and Sandford, 2012). India got to be independent in nourishment grains after the Green Revolution era. Punjab was selected by the Indian government to be the first site to try the new crops because of its reliable water supply and a history of agricultural success. The technology of the Green Revolution involved high yielding verities' seeds that worked in conjunction with chemical fertilizers and heavy irrigation to increase crop yields (Sebby, 2010). The early success of the Green Revolution in Punjab prompted the Government of India to target the state as a source for rice and wheat for the national food procurement and distribution system, at a guaran-teed price. Subsequently, the state authorities of Punjab provided energy for agricultural pumping at a flat price, irrespective of the quantity of groundwater used. These two factors led to the establishment of a rice-wheat annual crop rotation. But this crop rotation consumes huge amount of water, much higher than the average annual rainfall and renewable supply in the region, leading to severe groundwater depletion (Sharma *et al.,* 2012). At present, ground water level is depleting rapidly in the Punjab state and 110 out of 141 blocks have already been categorized as over exploited or dark blocks and 3 other blocks are at critical stage (CGWB, 2014). At the same time, there is growing pressure on country to meet the increasing demand of grains, especially for food; with the increasing demand for non-grain crops poised to be an even greater challenge. Therefore, better water saving technologies, efficient irrigation system, soil-centric rather than crop-centric policies and better awareness with regards to conservation techniques are the need of the hour (Mittal, 2008). Scientists have advised several ways of water saving in the rice-wheat system, including laser land levelling, alternate wetting and drying, delayed rice transplanting, shorter duration

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rice varieties, cultivation on raised beds, and replacing part of the rice area with other crops (Humphreys *et al.,* 2010) and have been widely adopted in tropical, subtropical, and temperate regions of the world for rainfed and irrigated systems (Jat *et al.,* 2011). Farmers were opting for water saving practices but to a lesser extent (Kaur and Vatta, 2015). Dissemination and utilization of new technology is most complex and significant problem (Tanwar, 2011). But farmers are facing some constraints in adoption of these technologies. The achievements of the new technologies might have been much higher if these constraints were removed (Bhakar *et al.,* 2009). So, the present study was planned with the objective to determine constraints faced by farmers in adoption of water saving technologies.

MATERIALS AND METHODS

Study was conducted in Sri Muktsar Sahib district of Punjab. Out of four blocks, two blocks i.e. *Muktsar* and *Malout* were selected purposively, where selected water saving technologies i.e. direct seeded rice, zero tillage in wheat and laser leveler were being practiced by the farmer. Four villages from each block were selected. These eight villages were *Mehraj Wala*, *Bham*, *Tamkot*, *Phullewala*, *Khirkia Wala, Ghoori Sangar, Dhoorkot* and *Kauni*. A total of 150 respondents were randomly selected from 8 villages based on the probability proportion to the number of farmers in each village. An interview schedule was designed and finalized in consultation with experts and by consulting relevant literature. Data were collected from the respondents by personal interview approach.

RESULTS AND DISCUSSIONS

Socio personal characteristics: The information regarding socio-personal characteristics of selected farmers which include age, education, operational land holding, crop rotation, mass media exposure, extension contacts, member/office bearer of organizations and participation in extension activities was discussed and has been given in Table 1.

Age: Age is an important characteristic of an individual as it governs the physical, psychological and behavioral development of the person. Data in Table 1 demonstrated that age of farmers varied from 25-63 years. The greater part of respondents (41.33%) had a place within the age group 38-50 years followed by 32.00 per cent of them falling in category of 25-37 years. The remaining farmers (26.67%) were in the age group of 51-63. These finding are in line with Kaur (2015); Ram *et al* (2015) and Singh (2005).

Education: It is assumed that educational background of the farmers play a significant role trait of innovativeness. With this consideration in mind the education level of the respondent was studied and categorized into seven groups i.e. illiterate, primary, middle, matric, secondary, graduate and post-graduate. Data presented in Table 1 showed that about one third of the respondents were matriculates followed by19.33 per cent who had gained education upto primary level, 17.33 per cent were educated upto senior secondary level, nine per cent were graduate and only one per cent of them were post graduate. There were also six per cent farmers, who never got any formal education. Similar finding were reported by Kaur (2015) and Tiwari (2008).

Operational land holdings: The farmers were categorized into five groups according to their operational land holding. Data in Table 1 revealed that 48.67 per cent of the farmers had medium (10-25 acres) operational land holdings, followed by 30.67 per cent having large (>25 acres) operational holdings and almost 17 per cent farmers had semi-medium (10-25) operational holding. Only about three per cent and one per cent of the farmers had small and marginal operational land holding respectively. These findings were in agreement with Kaur (2015) and Kaur (2007).

Crop rotation: In Punjab, rice-wheat rotation is mostly followed by the farmers, but crop rotation varies with geographical condition and resources available. Data presented in Table 1 revealed that all the respondents were following rice-wheat crop rotation. Only 11 per cent of them had some area under cotton-wheat crop rotation also.

Mass media exposure: Mass media plays an important role in adoption process. Mass media aware and influence the farmers to adopt new technologies. In the present study, the farmers were placed into three categories pertaining to their mass media exposure on the basis of their scores using range method. It was studied in terms of reading farm literature, viewing

Table 1: Distribution of respondents according to their socio-personal characteristics (n=150)

S.No.	Characteristics	Category	Frequency	Percentage
1.	Age (years)	25-37	48	32.00
		38-50	62	41.33
		51-63	40	26.67
2.	Education	Illiterate	9	6.00
		Primary	29	19.33
		Middle	23	15.33
		Matric	48	32.00
		Senior Secondary	26	17.33
		Graduate	13	8.67
		Post Graduate	2	1.33
3.	Operational land holding (acres)	Marginal (<2.5)	1	0.67
		Small (2.5-5.0)	4	2.67
		Semi-Medium (5-10)	26	17.33
		Medium (10-25)	73	48.67
		Large (>25)	46	30.67
4.	Crop rotation*	Rice- Wheat	150	100.00
		Cotton- Wheat	17	11.33
5.	Mass media exposure	Low (12-15)	69	46.00
		Medium (15-18)	58	38.67
		High (18-21)	23	15.33
6.	Extension contacts	Low (5-8)	104	69.33
		Medium (8-11)	30	20.00
		High (11-14)	16	10.67
7.	Social participation	Office bearer	8	5.33
		Member	142	94.67
8.	Participation in extension activities	Low (4-7)	102	68.00
		Medium (7-10)	34	22.67
		High (10-13)	14	9.33

*Multiple response

television programme and listening to radio. Data given in Table 1 indicated that more than 45 per cent of the farmers had low mass media exposure and 38.67 per cent of them had medium mass media exposure. Only 15.33 per cent of the farmers were found to have high mass media exposure. The findings were in contradiction with Singh (2013) and Roy (2015).

Extension contacts: Extension contacts play a significant role in the adoption of an innovation. It not only helps the farmers to get new information but also change the mindset of the farmers towards the adoption of new technologies. Data presented in Table 1 showed that majority of the farmers (69.33%) had low extension contacts. So it can be concluded that farmer-extension linkage were not very strong and farmers' visit to the various agricultural organizations such as PAU, Krishi Vigyan Kendras (KVKs) were not very frequent. Twenty per cent of the respondents had a medium level of extension contacts and about 10 per cent farmers had high level of extension contacts. These findings were in line with Tiwari (2008).

Social participation: Farmers registered themselves with some of the organizations either as life member or some of them as office bearer of these organisations. A perusal of data given in Table 1 further indicates that all the respondents were engaged with the organization of cooperative agricultural service society because they get fertilizers and other agricultural inputs from this society. About 95 per cent respondents were engaged as life member and other five per cent respondents were office bearers on the positions such as secretary, *pradhan* etc. These finding were in line with Ram *et al.* (2015).

Participation in extension activities: To get the information regarding water saving technologies,

farmers participate in different extension activities. Participation of farmers in extension activities was studied in terms of *kisan mela's*, field day, demonstrations and campaigns. Data presented in Table 1 reveals that majority of the respondents had low (68.00%) participation in extension activities while about 23 per cent of them had a medium participation in extension activities. Only about nine per cent of respondents had a high participation in extension activities.

Problems faced by the farmers in adoption of selected recommended water saving technologies: The various problems faced by the farmers in adoption of water saving technology were studied under different sub heads as following:

- Problems faced by the farmers in adoption of direct seeded rice
- Problems faced by the farmers in adoption of zero tillage in wheat
- Problems faced by the farmers in adoption of laser leveler

Problems faced by the farmers in adoption of direct seeded rice: The various problems faced by direct seeded rice growers were studied. The information, so collected has been presented in Table 2. Result shows that voluntary rice germination was the major problem faced by the DSR adopters and about nine per cent found difficulty in availing the quality herbicide at required time to manage weeds. About 84 per cent of DSR adopters revealed that, seed remained in soil in the previous years had grown in the fields and perceived high difficulty in management of this problem. About 71 per cent of DSR adopters faced difficulty in weed management as other major problem. A standard quality seed drill is also required for proper sowing of crop, but about 45 per cent DSR adopters reported that seed drill was not available for sowing at required time. More than 52 per cent of the DSR adopters perceived that co incidence of rains at the time of sowing can delay the sowing of crop or can affect proper germination of crop.

Iron deficiency is also main deficiency appears in direct seeded rice fields. DSR is recommended from medium to heavy soils, but when farmers sow DSR in light soil fields, deficiency may appear. Due to this deficiency, chlorosis among the young seedling appears after three weeks of sowing and after some time whole plant can die. It can be seen from the data given in Table 2 that about 26 per cent DSR adopters faced the problem of iron deficiency. About 17 per cent DSR adopters perceived that there was more pest or disease attack as compared to puddled rice. Direct seeding of rice is a new technology and farmers had not adequate knowledge about it. From the data, it can be seen that about 24 per cent of DSR adopters had less access to required information. Majority of DSR adopters found that cost of cultivation for DSR was increased due to more manual labour for removing the off variety plants. Some (14.28%) adopters had also reported decrease in yield of DSR as compared to conventional method.

Table 2: Distribution of respondents according to the problems faced by respondents in adoption of direct seeded rice (n=42)

S.No.	Problems	Frequency*	Percentage
1	Non-availability of seed drill	19	45.24
2	Co incidence of rain at early stages	22	52.38
3	Iron Deficiency	11	26.19
4	Difficulty in weed management	30	71.43
5	Availability of quality herbicide at required time	4	9.52
6	Voluntary rice germination	35	83.33
7	Less access to information	10	23.81
8	More Pest/Disease attack	7	16.67
9	Rodent attack	2	4.76
10	Decrease in yield	6	14.28
11	Increase in cost	20	47.62

*Multiple response

Problems faced by the farmers in adoption of zero tillage in wheat: When wheat is being grown without any preparatory tillage, there should be proper management of rice straw. Majority (89.66%) of ZTW adopters had faced problem in management of rice straw to clean their fields. So they have to burn rice straw to prepare field for sowing of wheat by zero tillage. Data pertained to Table 3 indicated that about 45 per cent of ZTW adopters found difficulty in sowing of wheat due to high soil moisture. About 34 per cent of ZTW adopters had difficulty in availability of ZTW drill at the sowing time of wheat. Success of any crop depends on its yield, but about 17 per cent and 14 per cent of ZTW adopters faced the problem of low yield of wheat and wheat straw respectively. More mechanical power was required for sowing of crops in terms of horse power of tractor was being felt by 10.34 per cent of ZTW adopters. Same proportion of ZTW adopters faced weeds problems in ZTW. About 14 per cent farmers found that there was problem of yellowing of crop leaves at seedling stage, whereas 17 per cent farmers faced problem of nutrient deficiency in ZTW. Rodent attack was also a major problem faced by (34.48%) farmers due to remains of paddy straw in the field.

Problems faced by respondents in adoption of laser leveler: About all the respondents had adopted the laser leveler in their fields, because it levels the field with high precision. Most of the farmers had used this technology on custom hiring. So they did not face much problems regarding use of laser leveler. But about 21 per cent adopter found that rent was high in terms of money for use of laser leveler. Cost of laser leveler was high, so some farmers (3.38%) want subsidy on it. Whereas, about seven per cent farmers faced the problem of high cost of maintenance for proper use of laser leveler, whereas skilled labour is also required, otherwise laser levelers cannot be properly operationalized. About 18 per cent Laser leveler owners faced problem of lack of skilled labour. Maintenance of laser leveler is costly as well as there was non-availability of mechanics at local level was perceived by the eight per cent respondents.

Table 3: Distribution of respondents according to the problems faced by respondents in adoption of zero tillage in wheat (n=29)

S.No.	Problems	Frequency*	Percentage
1	Non availability of zero till drill	10	34.48
2	Less yield of wheat	5	17.24
3	Straw management	26	89.66
4	More problem of weeds	3	10.34
5	Soil texture problem	8	27.59
6	Less wheat straw	4	13.79
7	Inadequate soil moisture at the time of sowing of wheat	13	44.83
8	Yellowing at seedling stage	4	13.79
9	Rodent attack	10	34.48
10	Nutrient deficiency	5	17.24
11	Require more mechanical power at time of sowing	3	10.34

*Multiple response

Table 4: Distribution of respondents according to the problems faced by respondents in adoption of laser leveler (n=148)

S.No.	Problem	Frequency*	Percentage
1	High cost of maintenance	10	6.76
2	Lack of subsidy	5	3.38
3	Lack of skilled labour	27	18.24
4	Non availability of local mechanics	12	8.11
5	High rent of laser leveler	32	21.62
6	Non availability at required time	28	18.92

*Multiple response

CONCLUSION

It can be concluded that regarding the constraints in DSR, voluntary rice germination and high infestation of weeds were the most expressed constraints. Straw management and inadequate soil moisture at the time of sowing were highly faced problems in the zero tillage wheat. Mostly farmers had not faced any problem in case of Laser Leveler adoption but a meager per cent of them found that rent of machine was high and sometimes machine was not available at required time. So, trainings and demonstrations should be organized for capacity building to adopt water saving technologies. Research should be conducted on the areas which were problematic to farmers in adoption of water saving technology.

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Perspectives of Agritourism in Himachal Pradesh: A New Dimension in Hill Agricultural Diversification

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ABSTRACT

The synergetic interaction of primary sector agriculture and service sector tourism is new way of generating more income from limited resources by the farmers while gratifying tourist need to be close to nature is agritourism. Farmers of Himachal Pradesh have small land holdings. They cannot sustain on agriculture as per future family requirements. Introduction of tourist in beautiful hill farms of the state have scope to diversify agriculture and generate more income from the same piece of land. Though the state has vast agritourism potential having beautiful farms and huge tourist inflow increasing year after year, state government have not started any specific plan for agritourism development. Various development programmes in agriculture and tourist separately has contributed to agritourism in the state. The present paper conceptualizes agritourism in the state describing scope, contributing factors, associated problems, initiatives, and an attempt to pave out future path has been made through this study.

Keywords: Agricultural, Agritourism, Dimension, Diversification, Himachal Pradesh, Perspectives

INTRODUCTION

In India 68.33 percent population still lives in rural areas and doing the farming as a main occupation. But about 50% of the villages have very poor socio-economic conditions (2011 Census). Poverty and unemployment are the major problems faced by the rural community whereas industrialization spreads the urbanization by exploiting scarce resources. In this situation, approach of sustainable agricultural development is needed to study the economic, environmental, and social sustainability

At global level, India supports 16.8% of worlds' population on 4.2% of water resources and 2.3% of land. The availability of resources are about 4 to 6 times less as compared to world average. This will decrease further due to increasing demographic pressure and consequent diversion of land for non-agriculture uses. Natural resource base of agriculture, which provides for sustainable production is shrinking and degrading which is adversely effecting production capacity of the eco-system. Agricultural sustainability can be achieved when the ends are targets from the means.

The problem is more serious in mountainous state like Himachal Pradesh where only 11 per cent of the total geographical area is available for cultivation. More than 85 percent holdings in the state are small and marginal owing less than two hectares of land and accounted for 51 percent of the operated area (Sharma, 2011). Agricultural sustainability in such conditions need to be relooked in a way that farming serve a source of livelihood to the coming generation. The problem are surmountable by identifying new areas in agriculture and introduction of tourism in agriculture comes here as a ways to sustain hill farming. The amalgamation of two large industries, agriculture and tourism has created a new industry called agritourism. Agritourism is seen as a diversification option which could assist in creating jobs for the vulnerable and unemployed community while at the same time create financial incentives to the farmers. Strengthening linkages and creating synergies

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between agriculture and tourism will help in harnessing the tourism rupee to achieve the objective of sustained growth in agriculture. Agritourism has been practiced since many centuries but it was theoretically conceptualized in the last few decades. In Himachal Pradesh this practice has very limited theoretical conceptualization.

WHAT IS AGRITOURISM?

Agri Tourism is the most recent idea in the Indian Tourism industry. It gives a chance to encounter true contact with genuine living. Advancement of Agri tourism needs reasonable joining with provincial tourism, wellbeing tourism and enterprise tourism.

Agritourism is an activity where agricultural farms are open for tourists. Travelers can enjoy various types of agricultural activities like watching agricultural operations, ride carts, photography, feed animals, milk cows and taste fresh produce directly from the farms etc. for recreational values.

Tourism is named as instrument for work era, neediness mitigation and manageable human advancement. The world tourism association has assessed that the tourism business is developing at the rate of 4 percent a year. While Indian tourism industry is developing at 10.1 percent which is 2.5 times more than the world average

Farmers can incorporate agritourism activities to their farms in various ways according to the situation. The possible ways are; as a supplementary, complementary or primary enterprise, farmer must be ready to think creatively and plan effectively for the success of the agritourism enterprise (Mnguni, 2010). In hill state like Himachal Pradesh, Agritourism has a capacity to create additional source of income for the farmers as the state is already having potential for tourism activities. The farmers are benefitted by additional farm income and at the same time tourists' hunger to natural environment is satisfied. Agritourism does not only benefit farmers and tourist but also have contribution in overall rural development by developing individual components of rural economy like agriculture, education status, transportation, employment generation, health consciousness, enriching rural heritage and ultimately rural economy.

Agri tourism is one such type of tourism which has as of late risen in Maharashtra. It is a field with potential to create. Unquestionably as a recently creating field it has its own particular offer of difficulties and administration issues to confront. The issues like visitor host relationship, maintainability, monetary attainability are vital for any new tourism improvement at a goal. It is all the more so on account of agro tourism as it directly affects the host culture and rustic group all in all.

In today's time of progression and globalization travel and tourism is broadly perceived as a critical common industry overall which gives real potential to financial development and improvement.

RATIONALE

The rationale for the study is:

- Tourism is one of the emerging sector in the country as well as in the state of Himachal Pradesh. Concepts like Agri-tourism offers new agricultural product which are expected to create more demand.
- India ranked 11th among 184 countries in terms of travel and tourism's contribution to GDP in 2015 generating 37.4 million jobs in 2015.The 12th five year planhighlights "Pro-poor tourism" for increasing net benefits to the poor and ensuring tourism growth contributes to poverty reduction.
- Tourism and agriculture in Himachal Pradesh has growth potential as the state has witnessed 14% increase in tourism activities during last five years.
- There is immediate need of capacity building and advisory services in the sector.

OBJECTIVES

The study is based on the secondary data and personal opinion of the authors. The objectives of this paper are:

1. To clarify the concept of agritourism, its significance and scope in the state of Himachal Pradesh.
2. To describe the initiative for agritourism in the state.
3. To delineate the problems associated with agritourism in Himachal Pradesh.
4. To suggest possible measures to sustain agriculture with tourism as a new dimension of rural development.

Scope and Significance of Agritourism

Himachal Pradesh is popularly known as Devbhumi- "Land of Gods" is a beautiful hill state nestled in the north-west region of western Himalayas. From vast tracts of high altitude , trans Himalayan desert to dense green deodar forests, from apple orchards to cultivated terraces and tea gardens, from snow-capped high mountains ranges to snow fed lakes, gushing rivers, Himachal Pradesh offers a breath-taking pristine beauty to tourists. Various researchers like Singh and Mishra (2016), Shrivastava (2016) have studied scope of agritourism as an inexpensive way, Curiosity about the farming industry and life style, demand for wholesome family oriented recreational activities, Health consciousness of urban population, Desire for peace and tranquility, Interest in natural environment, Disillusionment with overcrowded resorts and cities, Nostalgia for their roots on the farm, Rural recreation and Educational value of Agri-Tourism. The agricultural conditions in Himachal Pradesh in natural environment are the perfect blend to serve the tourist to meet all these requirements. In this section an attempt has been made to identify the major contributing areas that enhance the scope of agritourism in the state.

a. Physical features and climate: The state is almost wholly mountainous with altitudes ranging from 350 to 6975 m.a.m.s.l. It is deeply dissected topography, complex geological structure and a rich temperate flora. Panoptic basket of flora and fauna in the lap of Himalayas with mild to cold climate enhances scope for tourist.

b. Rivers: Five rivers flows through the state. These five rivers and their tributaries flowing though beautiful valleys having terraced agricultural fields has always been a major attraction to the travellers enhancing scope of amalgamation of farms with tourists.

c. Tourism: tourism is already a well-established economic activity in the state. Tourism has been identified as the most important sector of the economy in the state. The state is endowed with all basic resources necessary for thriving tourism activities like geographical and cultural diversity, clean, peaceful and beautiful streams, sacred shrines, historic monuments and friendly & hostile people. Compared to national average of 12.50 per cent, the number of tourists in Himachal Pradesh has grown at a CAGR rate as 14.00 per cent during the period of 2006-10. The total number of tourist (Foreign as well as domestic) visiting state has consistently increased over last 5 years increasing from 88 lakhs to 163 lakhs in 2013 (Economic Survey of Himachal Pradesh, 2015-16).

d. Agriculture: 85 per cent of the land holdings in the state are small and marginal that too on sloppy mountainous terrain. Wide variety of crops are grown in the state which attract tourist towards their scenic beauty. Hypnotic views of paddy fields in Kangra and Mandi, blooming apple orchards in Kullu and Shimla, terraced potato fields of Lahaul valley contribute to the wide scope of agritourism in the state.

e. People: People in the state has always been honest, friendly and hostile creating perfect tourism niche.

f. Infrastructure: Tourism activity cannot manifest without infrastructure in any state but Himachal Pradesh has developed sufficient road connectivity through which tourism from regular tourist places can penetrate agricultural niches.

g. Organic Farming: The consumers of agricultural products are now well aware of the healthy food and usually want to purchase foods which are free of chemicals uses. The organic farming has come as a potential way in Himachal Pradesh. At the moment as Himachal Pradesh grows vegetables, cereals and fruits under organic farming which fetches farmers 20 to 30% more price in the market. As urban population is inclined towards organic food and Himachal farms have potential to meet the requirements creating a dimension in the state for Agritourism widening scope of Agritourism in the state.

h. Fishery and Angling: Himachal Pradesh is blessed with vast network of fishery resources in the form of glacier-fed rivers and streams besides man made reservoirs, other impoundments viz. lakes, check dams, Kuhals and village ponds etc. While these resources are means of rich proteinacious food in the form of fish, at the same time these are acting as source of tourist attraction. The department of Fisheries, Himachal Pradesh has identified the following trout waters for angling which can act as potential agritourism points.

i. Tea Farming: The unique blessed state with the potential areas to produce tea in the lap of Himalayas has always been a attraction for tourist point of view.

Name of river	Stretch	Stream length (kms)
Beas	Katrain to Manali	18
Tirthan	Largi to Nagni	20
Sainj	Largi to Ropa	22
Lambadug	Barot to Lohardi	6
Uhl	Barot to Kothikhad	10
Ravi	Holi to Main bridge	5

http://himachal.nic.in/index1.php?lang=1&dpt_id=4&level=1 &lid=168&sublinkid=146

The tea production in Himachal Pradesh is limited to Kangra District and small part of the Mandi district only. In District Kangra too, the area of production is confined to the Palampur which is known as Tea capital of North West India ((https://en.wikipedia.org/wiki/Palampur). Tea tourism is gaining momentum in and around Palampur. Several of the tea estates and tea factories in Palampur and Dharamsala offer factory tours as well as home stays for those interested in learning more about the tea. The Dharamsala Tea Company offers guided tours of its factory and tea gardens, starting from its factory in Mann Tea Estate.

j. Medicinal Plants: Himachal Pradesh has an enormous wealth of medicinal plants. Herbal Gardens, Herbal Trails will be developed as tourist attractions The Tourism Department/Board in collaboration with Department of Indian System of Medicine, Department of Ayurveda and Forests will organize such tours which will further develop awareness and interest about medicinal plants amongst the school children and tourists (Department of Tourism and Civil Aviation. 2005).

k. Livestock and Shepherds: According to the 19th Livestock Census 2012, the total population of livestock in Himachal Pradesh is 48,44,431. Out of which 21,49,259 are cow cattle, 7,16,016 are buffaloes, 8,04,871 are sheep, 11,19,491 are goats and 15,081 are horses and ponies population. Poultry population of the State is 11,04,476. In Himachal Pradesh besides keeping the animals in the farms, one more system of animal rearing is prevalent i.e migration along with animals. Due to snow bound agricultural lands during winter, a system of migration along with animals has been developed in the state. Gaddis and Gujars are two communities who are seasonal migrant along with livestocks such as sheep, goat, cattle, buffalo, horse and pony. The Gaddi community is well known to pass dhauladhar range along with their livestock from District Kangra and Mandi to Chamba and vice-verse. This unique livestock rearing and pattern of migration opens doors for tribal tourism.

l. Fair and Festivals: Fairs and festivals celebrated in different seasons all around the year in the rural atmosphere increase the scope of Agritourism in the state as most the fairs and festivals are either ritual or related to agriculture. The Minjar fair celebrated in the month of August in Chamba (related to maize production), Sair festival in Kangra (To worship agricultural products from fields) are examples. Urban people can participate in these fairs and festivals to watch rural agricultural practices closely. Full of charm and Melody, the Folk songs of Himachal are often based on religion and romantic ideas. In village fairs, People form circles and sings these songs. The spontaneous dancing is also a symbol of the jolly nature.

m. Traditional Dining: Cooking himself at farm and serving the food to their group is an unique Away from urban hectic life and daily routine foods, Himachal Agritourism can provide variety of foods which are never experienced in cities. The colocasia leaf rolls (*Patrora*), wild vegetables such as rare guchhi (*Morchellaesculanta*) mushrooms, Tardi (*Diaoscoriasativa*), lungru (*Diplazuimesculentum*), Rhododendron, Ficus leaves and fruits etc are unique tastes which are also having medicinal values with no chemicals treatments can enhance the Agritourism activities in the state. Dinning on herbal leaves plates and using earthen pots make dinning a different experience. The traditional recipes which are never seen in urban culture can be enjoyed while staying at the farms.

n. Art and craft: Tourists' second favourite activity is shopping. Local arts and crafts have always been in demand by domestic and foreign tourists. This includes food items and other value added food products produced on farm. likedry vegetables, pickles, art and craft like Kangra paintings, local traditional dresses etc. Another specialty of Himachal is the thapada which is a long shawl with embroidery. A wall hanging called Kohana, blouses; pillow covers and finely embroidered caps are other famous products. The caps particularly of the Kulu, Kinnaur, Lahaul and Sirmair regions are always in great demand. The shawls, Carpets and Woolen rugs depict the similar pahari design despite being from different regions in the state. Gorgeous pieced together

quilts, Dolls and several other stuff toys are made here and find a place in the bride's repertoire. Byangi wool is widely used to make woolen stuff. Another traditional craft is the printing and dyeing of fabrics which is done by the Farahada and Chibbapeole. Fine household products of the Dom Tribe are usually made in Bamboo and are later colored in bright hues. The boxes, baskets, sofas, chairs, racks are some of the products they make. The craft of leather is also worthy in Himachal. The Chamba region manufactures slippers and shoes that are in fashion.

o. Home stays: With the aim of providing comfortable Home Stay facilities of standardized world class services to the tourists, and to supplement the availability of accommodation in the rural tourist destinations, State Government introduces Home Stay Facilities on the basis of Ministry of Tourism, Government of India "Incredible India Bed and Breakfast scheme. The basic idea is to provide a clean and affordable place for foreigners and domestic tourists alike including an opportunity for foreign tourists to stay with Himachali families.

PROBLEMS

Through Agritourism is potential area of rural development but there are many problems associated withAgritourismin the state.

Some of the problems associated with the venture can be summarized as under.

(i) Lack of specific schemes.

(ii) Lack of funds.

(iii) Laissez Fair planning by different agencies.

(iv) Lack of Agritourism training.

(v) Geography and connectivity.

(vi) Lack of finances with the farmers

(vii) Awareness among tourists/customers.

(viii) Lack of facilities in rural areas.

AGRITOURISM INITIATIVES

The government efforts in agriculture and tourism that have direct bearing on agritourismhas been highlighted which ultimately will strengthen state economy throughagritourism.

1. Establishment of HPTDC: The Himachal Pradesh Tourism Development Corporation (HPTDC) was formed in September, 1972 as an undertaking of the Government of Himachal Pradesh under the company act 1956. HPTDC is a Government run organization is a premier organization of Himachal Pradesh operating in tourism sector. The corporation is running hotels, restaurants at various places for tourists, besides providing transport facilities. The HPTDC using print media to promote tourism in the state and at national and international tourism market. This includes advertisement in Newspapers and publishing books like "Unforgettable Himachal". The department has also used TV Channels, Primarily News Channels to advertise tourism. Department also participated in various national level tourist festivals across the countries and also conduct road shows to draw more tourist attention. Monal is a periodical Journal published under the establishment of HPTDC highlighting tourism potential of the state.

2. Community Based Tourism Activities: Under the ADB funded project, Community Based Tourism Activities in Villages including Skill Development, Training etc. are also being undertaken in 4 Clusters, namely Dhameta, Kangra-Pragpur, Naina Devi and Shimla. Upto December 2015, community based committees such as 5 Panchayat Tourism Development Committee, 1 Town Tourism Development Committee and 14 Self Help Groups comprising of members from the local communities both female and male have been formed. Under the project, 15 trainings and workshops on tourism related skills such as cooking, boating, water based activities, solid waste management, marketing and communication etc with total participation of 1,187 persons (including 703 women and 484 men) have been organized.(Economic Survey of HP. 2015-16). Up to March 2016, it was expected to train more 150 people.

3. Training programs: Adding even a small agritourism or value-added processing business to an existing farm operation may require more time and attention than expected by farmers. The ability to train and properly manage good employees is critical to success. Tapping into existing training opportunities that relate to customer service and marketing as well as tourism business management practices is required. The Indian Agritourism Council (IAC) may establish and implement

training programs dealing with hiring employees, customer service, business plan development and marketing. Information sources such as those produced for the Opportunity Analysis for Farm-Based Businesses study provide a good start for the development of such training programs. IAC should coordinate with Tourism Industry Institute's professionals to find out whether the existing manuals and training programs from, FHRAI (The Federation of Hotel & Restaurant Associations of India) Training Institute that might be adaptable to Indian agritourism industry.

4. Training to Youth: The department of Tourism organizes various adventure and general training courses for unemployed youth in the state like trekking guide, water sports, skiing, bird watching and river rafting. The department also organizes and support tourism related events for the attraction of the tourist and showcase the potential of the state for hosting different events. Provision of training unemployed youth in skill oriented courses to achieve sustainable tourism growth has been kept in Himachal Pradesh Sustainable Tourism Development Policy 2013. Besides this the provision of guide training and taxi drivers training in the tourism hubs covering courtesy, professionalism, marketing, safety and rules has also been kept under Tourism Policy 2013.

5. Awareness among children: Awareness drives on cleanliness, conservation of heritage and culture have been organized amongst school children through painting, slogan writing and clean street competitions. More than 900 students have been involved in these awareness drives. Plan to integrate sustainable tourism in primary school curriculum (e.g traditions of Indian hospitality, importance of security and safety etc.) strengthening existing environmental curriculum and introducing cultural- heritage curriculum to children has been planned under Himachal Pradesh Sustainable Tourism Development Policy 2013.

6. Budget Allocation: Tourism Industry in Himachal Pradesh has been given very high priority and enhanced budget of Rs. 5,273.01 lakh has been allocated under State budget for development of tourism in the State. During the year 2011-12 the budget allocation was 2094.44 lakh for development of the tourism. Thus almost fund allocation has been doubled in the five years.

7. Advertisement through media: Government of Himachal Pradesh is popularizing Himachal Pradesh as a tourism destination through print, and electronic media. In the field of publicity and promotion the department has established brand Himachal as an attractive tourist destination under the caption "Unforgettable Himachal". During November 2011, the state has been awarded as 'Best State to Travel" in India and Best Hill Destination –Shimla by CNBC. In order to promote tourism, dissemination of tourist information has been given priority. Department of Tourism prepares brouchers for tourist information and participates in tourism fairs and festivals at National & International level.

8. Heli-Taxi Services: The State government has taken initiative to introduce Heli-Taxi services in the state and at present Heli-Taxi service are being operated in the Mani-Mahesh sector, Distt. Chamba during the Mani-Mahesh yatra.

9. Public-Private Partnership: One of the goal of latest Tourism Policy 2013 is "To encourage a strong and sustainable private sector participation in creation of tourism infrastructure especially through public private partnerships. To achieve the goal commercially viable projects and establishments of Public Private Partnerships will be evaluated on an open competitive tender basis for selecting state run tourism and related services including accommodations, destinations development, transport (e.g. airport, bus railway and parking). Tourism amenities (e.g. toilet complexes, restoration of heritage sites) and tourism construction on public lands(e.g. tourist information centres, existing guest houses in forest land).

10. Home Stay Scheme: An excellent scheme to penetrate tourism activities in the villages. The scheme is attracting hordes of tourists to lesser known and remote destinations of the State. This scheme was launched in 2008 by Himachal Pradesh Government with the aim to provide clean, comfortable and affordable supplementary accommodation to tourism in rural areas in the vicinity of famous tourist destinations when hotel and guest houses are packed to capacity. This scheme was intended to broaden the stake holders' base for tourism in the state by including rural and interior areas of the state in providing tourism accommodation infrastructure and at the same time decongest the urban areas, which cannot support any further tourism traffic.

The scheme has proved to be highly successful for the Himachal Pradesh Government with home stay unit evoking overwhelming response in Kullu, Manali, Shimla, Dharamshala, Palampur and Dalhousie Regions. A Total of 891 rooms in 332 units were registered as home stay units by February 2011. Up to 2015-16, a total of 550 Home stays are registered with state Government**.**

11. Eco tourism policy 2005: Himachal Pradesh Forest Department formulated the Eco-tourism Policy during 2001 which was subsequently revised in 2005. The central theme is to decongest and disperse over flowing city tourist destinations and bring the tourists closer to nature and ensure adequate economic return to the State and livelihood opportunities to the local communities. In the policy.

12. Agriculture Promotion: State Department of Agriculture, Horticulture, Fisheries, Animal Husbandry, Rural Development and Two State Agriculture Universities under Government of Himachal Pradesh are implementing various development schemes which helps in enhancing production, marketing and business skills of farm families. Some specific programmes which attracts tourism towards agriculture fields are as under.

13. Organic Agriculture: The naturally organic areas holds great potential for conversion to organic agriculture which holds a potential as Organic Agriculture Tourism. Organic agriculture in the state is blooming under the preamble of the Department of Agriculture which coupled with rural home stays help to attract travellers. The State has diverse agro-climate conditions and due to its favourable positioning in the Himalayan region, has great scope for promotion of Organic farming. The use of chemical fertilizers and pesticides in the State is very low and 80% of the area is rainfed. The State Government formulated a Policy on Organic Farming in 2010 and has covered 30,110 farmers with an area of 17,848 ha under Organic farming. During current financial year 2000 hectare additional area is being covered under organic farming. During 2015-2016 200 Villages will be converted into complete Bio-Villages. During current financial year 20,000 Vermi-Compost Units with 50 per cent assistance will be set up in the state of Himachal Pradesh. (http://www.hpagriculture.com/schemes.htm). Paramparagat Krishi VikasYojna under National Mission on Sustainable Agriculture for adoption of organic villages & PGS certification by mobilizing farmers in cluster mode to enable them to certify their own organic products is also been implemented by Go HP through development department.

14. Playhouse: The playhouses are used to grow high value crops in Himachal with the adoption of 'all weather' technology. Polythene is used to build the protective shade of playhouses for growing high value agricultural products. Temperature, humidity and ventilation are kept under control with the help of equipment installed inside the playhouses. Crops that are grown in such playhouses are thus protected from unfavourable weather conditions. The unique products and agricultural practices in playhouses add to diversification in agriculture opening new avenues to enjoy for tourists.

15. Fisheries: Trout in Himachal Pradesh has always been a attraction for tourist. Himachal is the first state in the country to introduce private trout farms which attracts travellers to the fragrance and taste besides angling n the water streams identified by the fishery department.

16. Rural Heritage initiatives: The state Government is sensitive towards protecting and preserving this aged old culture of Himachal Pradesh. A separate department of Art, Language & Culture has been set up in the state. Besides, Art, Language and cultural Academy is implementing various schemes and programmes for preserving the rich culture and traditions of the state. Various steps has been taken up by the Government for promotion and protection of rich cultural heritage and art of the state. Keeping in view the importance of archives the state Govt. has set up Himachal Pradesh Record Management Committee which is looking after the archaeological works to preserve cultural ethos of the state. The eleven member committee has been constituted for the same (HP Govt. official website)

17. Tax Rebate: In order to promote tourism in the rural areas of the state, special exemption on luxury tax has been given by the state Government. Examples are presently 550 home stays which are exempted from VAT, luxury tax along with supply of electricity and water at domestic rates only.

18. Linking Development Schemes to Tourism: Himachal Pradesh happens to be First State in the

country to link MNREGA with tourism promotion activities. Tourism infrastructure of the selected villages is planned to be developed by roping in local villagers and using funds under Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGA).

19. Popularization of major crops and products: Himachal Government is organizing food fests and fairs to promote rural commodities. Apple festivals is celebrated to offer delicacy of Himachal apples for attracting tourists towards apple and its processed products. Besides this rural art and craft, local agricultural products are kept in showcases in exhibition of different fairs in the state. In almost all local and international fairs like Minjar fair, Lavi fair, Kullu Dushehra various development department present specialties in organized stalls. Apple and orchard tourism has been considered to be an area of focus in the Districts of Shimla, Kinnaur, Kullu and parts of Mandi District. Traditional farm houses could be converted into home steads wherein the tourists could enjoy the beauty right from apple blossom to harvesting (HP Govt. Tourism Policy, 2005).

20. Other initiatives of state Government: The Government of Himachal Pradesh continuously promotes tourism through various activities. *"Har Ghar Kuchh Kehta Hai"* a scheme known to popularize history of Shimla gained achievement and many stories were uncovered by the initiative. Government also plans to pass social messages through tourism activities e.g. on 37th year of HPTDC, a scheme to promote tourism under the banner "*Beti Hai Anmol"* was offered in which tourist visiting with the daughter to Himachal Pradesh were offered one night free stay in HPTDC hotels all over the state. Government organized Travel Mart in Himachal in 2015 where representatives from ten countries and eight potential tourism states were invited.

CONCLUSION AND RECOMMENDATIONS

For surviving farmers in the same piece of land, new dimensions needs to be introduced in agriculture. Though the state Government has tried to diversify agriculture by switching some area to non- traditional crops like vegetables, floriculture, medicinal plants, fruits etc but an area 'offering farm leisure to tourism' is still lacking. Introduction of tourists to farms is not a new concept but has been practiced in the history in an unsystematic way. Study of literature shows that agritourism is an important field to exploit for rural development and in India it is at infant stage. Poor agricultural commodity prices coupled with rising input costs are slowly but substantially eroding small farm incomes. Agritourism plays a huge role in the activation of rural areas. Its position and market power affects a number of external components and mechanisms. Its positive impact on the economic and social development in rural areas is noticeable.

Agritourism allows farmers to capture both the consumer's food rupee as well as some of the money spent on entertainment and recreation each year providing an additional source of revenue for farms that allows them to keep farming and increase the quality of life for their family. If some part of the heavy tourist inflow of the state is attracted towards farms it will bolster rural economy in hills. The state has tourist inflow, potential farms, rich heritage and culture and if these resources are utilized the farm tourist will flourish in the state. After going through the conditions following recommendations in the state will boost rural economy through Agritourism:

1. An independent agency handling agritourism affairs needs to be established to collaborate the efforts of research and extension in the new field.
2. Tourist department of the state should oversee the primary role of marketing agritourism business using its marketing expertise, advertisement and infrastructure which is already in place.
3. State agriculture universities must act as a key trainer for agritourism business by offering trainings for those who are interested in running an agritourism business. Hospitality training needs to be introduced for the farmers which is a key to successful agritourism.
4. Agritourism development must be at the priority of government. For making agritourism a priority area, it must be from the top of the government down through ranks.
5. Government must introduce new components of agritourism in present extension projects to impart know-how to the farmers.
6. The credit requirements of the farmers interested in agritourism venture needs to be taken care with

government backed loans/ subsidy. The present credit facilities like kissan credit cards can be enhanced for limits to deal with a successful agritourism venture.

7. It is hardly possible for a farming family to advertise their farm venture which is an expensive affair. The State or specific potential districts must be highlighted through mass media to attract tourists in the agriculture farms.

8. There is a strong need to identify potential agritourism area and development of basic facilities like good roads, health services, transport and security at priority.

9. Successful agritourism business generally do not provide just one service. They cater to an overall visitor experience which includes some sort of refreshments/food, a form of shopping, occasional festivals or special events, a changing focus depending upon the season as well as the agritourism experience in which they specialise. Such seasonal events time to time guidance required to be provided by extension agencies.

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Adoption of Production Technologies among Jute Growers in West Bengal

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ABSTRACT

Adoption of improved jute production technologies are crucial to increase the farm production and income level of the jute growing communities. A study in North 24 Parganas district of West Bengal was conducted during 2015-16. It was revealed that majority of the respondents had medium level of adoption followed by low and high adoption level. Most of them had equally adopted weed management through herbicide and balanced application of fertilizer. Sources of information utilization, social participation and scientific orientation of the respondents had shown significant relationship with extent of adoption of improved cultivation practices of jute at 5% and 1% level, respectively. While analyzing constraints as perceived by the respondents revealed that non-availability of inputs (RBQ 92.30), low minimum support price (RBQ76.06) and high wages of labour (RBQ76.06) were major constraints faced by them in adoption of improved jute production technologies. The implications of the study may guide in solving the field level problems which could pave the way for the higher adoption of improved technologies by the jute growers.

Keywords: Adoption, Correlation co-efficient, Jute production, Rank Based Quotient, Technologies

INTRODUCTION

Jute is an important commercial crop in Eastern India. It occupies about 1.0 mha area and provides livelihood to about 6.0 million people directly or indirectly. The demand of jute and jute products are likely to increase tremendously because of environmental consciousness around the globe. To fulfill the increasing demand of jute, it is inevitable to increase the productivity of jute fibre as the area under jute is hovering around 9 lakh hectares since last 10 years. Although the productivity of jute has increased from 1138 kg/ha (1947) to 2300 kg/ha (2009-10). The difference between realizable potential and current productivity is about 2000 kg/ha. This yield gap can be narrowed down through faster adoption of improved agricultural technologies (Ghorai *et al.,* 2013). Our country earns Rs. 1200 crore/annum through export of jute goods. Moreover, jute industry employs over two lakh workers and accounts for another 27 lakh in ancillary activities (Anon, 2006). Hence it plays a vital role both in rural as well as industrial economy. West Bengal contributes about 80 percent of total jute production from more than 70 percent area of the country. The economy of the small (25%) and marginal farmers (65%) of the state is more or less dependent on jute cultivation. Around 30% of annual agricultural income of these farmers comes from cultivation of jute (Das *et al.*, 2006). Even in jute growing districts there is a wide variation in yield levels. Adoption of all the recommended technologies by large number of jute growers is considered as quick method of enhancing productivity in such areas.

Adoption studies attempt to analyze and understand the observed adoption patterns and depict individual behaviour towards use of a new innovation. In a social system, farmers' decisions to adopt a new farm technology depends on various criteria such as simplicity, cost effectiveness and relative advantage. Studies have indicated that the adoption of recommended jute production technologies has the potential of higher yield and more income to the farmers (Jha *et al.*, 2008). Higher

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extension gap was identified in jute growing areas (Chapke *et al.*, 2009) indicated that solution lies in adoption of recent jute production technologies.

ICAR-Central Research Institute for Jute and Allied Fibres (CRIJAF), Barrack pore is a pioneer institute for the development of jute and allied fibre crops production technologies. It has transferred technical know- how on better management of jute and allied fibre crops to enhance productivity. In the district of North 24 Parganas field demonstrations and trainings were conducted during 2008-12. An attempt was been made to assess how far participating jute growers have been able to adopt the improved practices of jute production transferred to them.

MATERIALS AND METHODS

The study was purposively conducted during 2015-16 at Goaldah village of Swarupnagar block of North 24 Parganas district of West Bengal. North 24 Parganas district is a major jute producing district of the state. This district has 61,274 ha area under jute crop with production of 8,52,203 bales (1 bale = 180 kg) and productivity 16.62bales /ha (Anon, 2015). A sample of 52 jute growers was drawn randomly from the list of beneficiaries participated in different training and demonstration programmes executed by Agricultural Extension Section of ICAR-CRIJAF, Barrackpore. To assess the extent of adoption of selected technologies namely, improved varieties, multi row seed drill, CRIJAF Sona, weed management through herbicides, weed management through CRIJAF Nail weeder and balanced fertilizer application were taken up. All the selected respondents were interviewed personally using well-structured interview schedule. The first part of the schedule was associated with the collection of general information, personal and socio-economic variables of the respondents. The second part was regarding extent of adoption of selected recommended jute cultivation practice and constraints. The pre-testing of schedule was done to overcome the weaknesses of the schedule and necessary modifications were made accordingly. Descriptive and analytical statistics were used for analysis of collected data.

The extent of adoption score of the each respondent regarding each of the selected technology was calculated by giving 2 score for full adoption, 1 score for partial adoption and zero (0) for non adoption. The extent of adoption score of each respondent for all the technologies of jute cultivation was calculated as Equation no. 1:

$$E_a = \frac{\Sigma O_n}{\Sigma O_{pm}} \times 100$$

E_a = Extent of adoption for a respondent

ΣO_n = sum of score obtained by a respondent for n cultivation practices

ΣO_{pm} = sum of maximum possible score obtained by a respondent for n cultivation practices

On the basis of the computed score the respondents were classified into three categories viz. low, medium and high. Satisfaction level of jute growers with respect to selected technologies was calculated by addition of scores assigned by jute growers on a 0-5 continuum. Constraints in adoption of jute production technologies were ranked using Rank Based Quotient (R.B.Q.) technique (Sabarathnam, 1998) as given in the following formula:

$$RBQ = [\Sigma f_i (n+1-i) / N n] \times 100$$

Where in,

f_i = Frequency of respondents for the i^{th} rank of a constraint,

N = number of respondents

n = number of constraints

RESULTS AND DISCUSSION

Socio-economic and psychological profile of jute grower: In order to know the socio-economic and psychological profile of the respondents, eleven socio-economic and psychological variables were studied using appropriate tools. Perusal of Table 1 showed that most of the respondents belonged to middle age group (36-55 years). While with regards to literacy level, the highest proportion of the respondents (26.92%) had education upto high school level followed by middle school (25%). Only 7.69% respondents were graduate. With regard to land holding, majority of the respondents (86.42 %) had <0.5 ha area. Majority (88.32%) of the respondents had low annual income (<Rs.2 lakh) followed by 7.69% middle income (Rs. 2-

Table 1: Socio-economic and psychological profile of respondents (n= 52)

Variables	Number of respondents	%	Mean	S.D.
Age				
Young (<35 years)	3	5.76	49	8.98
Middle (36-55 years)	37	71.15		
Old (>56 years)	12	23.07		
Education				
Can read and write	11	21.15	3	1.28
Primary school	7	13.46		
Middle school	13	25.00		
High school	14	26.92		
Intermediate	2	3.84		
Graduate and above	4	7.69		
Land holding (ha)				
Low (Mean- S.D.)	29	55.76	0.55	0.2
Medium (Mean ± S.D.)	16	30.76		
High (Mean + S.D.)	7	13.46		
Annual income (Rs. lakh /annum)				
Low (<Rs. 2 lakh)	46	88.32	3.13	1.96
Medium (Rs. 2-5 lakh)	4	7.69		
High (>Rs. 5 lakh)	2	3.84		
Farming experience (Years)				
Less (Mean- S.D.)	9	17.30	34	9.00
Medium (Mean ± S.D.)	32	61.53		
High (Mean + S.D.)	11	21.15		
Family size				
Low (Mean- S.D.)	3	3.84	4	2.00
Medium (Mean ± S.D.)	47	90.38		
High (Mean + S.D.)	3	5.76		
Sources of information utilization				
Low (Mean- S.D.)	-	-	4	2.47
Medium (Mean ± S.D.)	62	75.60		
High (Mean + S.D.)	20	24.40		
Social participation				
Low (Mean- S.D.)	-	-	3	2.5
Medium (Mean ± S.D.)	39	75.00		
High (Mean + S.D.)	13	25.00		
Risk orientation				
Low (Mean- S.D.)	11	21.15	8.5	1.05
Medium (Mean ± S.D.)	34	65.38		
High (Mean + S.D.)	7	13.46		
Scientific orientation				
Low (Mean- S.D.)	7	13.46	21	3.60
Medium (Mean ± S.D.)	33	63.46		
High (Mean + S.D.)	12	23.07		
Marketing facilities				
Low (Mean- S.D.)	3	5.76	7	0.23
Medium (Mean ± S.D.)	49	94.23		
High (Mean + S.D.)	-	-		

5 lakh) and 3.84% high annual income (>Rs.5 lakh). Most of the respondents had medium level of farming experience. In case of family size, around 90% respondents had 4-5 family members. For sources of information utilization, majority of respondents (75.60%) were in medium category. Similarly, social participation of the majority respondents (75.00 %) were also in medium category. Only 13.46 % of the respondents had high risk orientation. Majority of them possessed (63.46%) medium level of scientific orientation while, 23.07 % of the respondents possessed high level of scientific orientation. Regarding marketing facilities available for selling of jute fibres, majority of the respondents (94.24%) fell in medium level category followed by low level (5.76%).

Distribution of the jute growers according to adoption level of selected technologies: The responses of respondents were collected on six improved technologies of jute production (Table 2). Majority of the respondents (76.92%) completely adopted weed management through herbicide. The possible reason for adoption of weed management through herbicides may be the quick action of the pre and post emergence herbicides, saving of time, simple in application and reduction in labour cost and easy to adopt. The possible reason for non-adoption of this intervention might be less weed population, low soil moisture, location of field and lack of knowledge about herbicides. Similarly, with regard to application of balanced use of fertilizer, most of the respondents (76.92%) followed it. It might be due to easy availability of fertilizers in the local market. In case of application of Urea and Farm Yard Manure (FYM) partial adoption (23.07%) was observed. Very few respondents followed recommended dose of FYM because of less availability of FYM in the market and thin population of livestock in the area. CRIJAF Nail weeder, is a mechanical device, which can be operated in broadcasted and line sown jute field. It can save Rs. 10,000-15,000/ha by managing 80-85% composite weed population. It was adopted by 40.38% respondents. The limiting factor for non-adoption might be specific field condition (clay soil having big clods and lack of proper soil moisture) of the respondents. CRIJAF Sona, a microbial consortium is developed by ICAR-CRIJAF, Barrack pore for enhancing the retting process was adopted by only, 23.07% respondents. These respondents regularly procured it on time through personal efforts from the institute. In general, advantages of improved seed were known to all of the respondents. Local availability of seed in time has a major in adoption of recent varieties. Hardly, any respondents needed more than three kg of seed because of their small land holding (recommended seed rate is 3-4 kg/ha). Only one fourth of the respondents (25.00%) were very much responsive. They took special initiative and ensured regular procurement of seed (such as JRO 204, CO 58, and JRO 2407 etc.) from stipulated location by proportionate sharing of cost and time involved in it. While 15.38% respondents partially adopted. They used when they got it and abandoned when did not get it. Majority of the respondents (59.61%) did not use seeds of improved CRIJAF varieties due to its non-availability in the local market. As per them, it was time consuming and costly affair to personally visit research institutions and State Agricultural Universities before the crop season. Regarding multi row seed drill, only 25% respondents adopted it. Majority of them (59.61%) could not adopt it because of lack of proper soil moisture. Dependence on onset of monsoon restricted the use multi row seed drill in a larger area. While, 15.38% respondents partially adopted it. Similar findings have been reported by Mondal *et al.* (2012) where majority of jute growers did

Table 2: Distribution of respondents according to adoption level of selected jute production technologies (n=52)

Particulars	Level of adoption					
	Complete		Partial		Non	
	F	%	F	%	F	%
Improved CRIJAF varieties	13	25	8	15.38	31	59.61
Multi row seed drill	13	25	8	15.38	31	59.61
CRIJAF Sona	12	23.07	-	-	40	76.92
Weed management through herbicides	40	76.92	-	-	12	23.07
Weed management through CRIJAF Nail weeder	21	40.38	-	-	31	59.61
Balanced fertilizer application	40	76.92	12	23.07	-	-

not adopt line sowing through seed drill in Nadia district of West Bengal.

Extent of adoption of improved production practices of jute: The level of adoption with respect to improved production of jute has been presented in Table 3.

Table 3: Distribution of respondents according to overall adoption of selected jute production technologies (n=52)

Categories	Number of respondents	%
Low	4	7.69
Medium	37	71.15
High	11	21.15
Total	52	100

It was revealed that majority of the respondents (71.15%) had medium level of adoption of jute production technologies. A negligible percentage of the respondents i.e. 7.69 per cent and 21.15 per cent had low and high adoption level, respectively. It can be inferred that respondent's inclination towards scientific rationality and their social participation coupled with sources of information utilization might have helped in adoption of improved production practices of jute.

Satisfaction level of jute growers regarding technologies: Jute being a labour intensive crop, high expenditure is required to complete various intercultural operations. A study on satisfaction level of respondents' regarding benefit accrued from individual selected technologies are presented in Table 4.

Table 4: Satisfaction level of respondents regarding selected jute production technologies (n=52)

Particulars	Score	Rank
Weed management through herbicides	4.96	I
CRIJAF Sona	4.38	II
Weed management through CRIJAF Nail weeder	3.88	III
Multi row seed drill	3.31	IV
Improved CRIJAF varieties	3.12	V
Balanced fertilizer application	2.38	VI

Farmers could get maximum satisfaction with the adoption of weed management through herbicide technology and it was ranked first. As per the respondents, its operational cost was less and it could save time (1.5-2 ha/day) in controlling of composite and specific types of weed flora such as *Trianthemasp, Phalaris minor, Cynadon dactylon* etc. In monetary term, maximum benefit was derived from its adoption. Second best technology was application of CRIJAF Sona. As it reduces the time of retting by one week in comparison to conventional retting and it also upgraded the quality and colour of jute fibre (1-2 grade) resulting in more selling price. Weed management through CRIJAF Nail weeder was ranked III It could be used in both broadcasted and line sown jute crops, and is eco-friendly and efficient as compared to manual weeding. Thinning and soil mulching were also possible at the time of weeding. There was labour and cost saving in all the three best rated technologies and hence respondents felt more satisfaction by adopting those technologies. Lesser degree of satisfaction was perceived from use of multi row seed drill (Rank IV), CRIJAF varieties (Rank V) and balanced fertilizer application (Rank VI).

Socio-economic characteristics of jute grower vis-à-vis extent of adoption of improved production practices of jute: Socio-economic factors play an important role in adoption process which has been widely acknowledged through various studies, therefore it has been attempted here too. Data presented in Table 5 revealed that sources of information utilization (r=0.282), social participation (r=0.279) and scientific orientation (r=0.391) of the respondents had significant association with extent of adoption of improved cultivation practices of jute. But age, education, annual income, farming experience, land holding size and family size have no such significant relationship with extent of adoption.

Table 5: Correlation co-efficient of independent variables of respondents with their adoption level of selected jute production technologies

Variables	r value
Age	-0.209
Education	0.255
Farm size	0.271
Annual income	0.018
Farming experience	-0.159
Family size	-0.024
Sources of information utilization	0.282*
Social participation	0.279*
Risk orientation	0.092
Scientific orientation	0.391**
Marketing facilities	-0.057

*Significant at 5% level and *Significant at 1% level

It can be inferred from the above findings that with the increase in sources of information *i.e.* personal cosmopolite and localite, indigenous sources of communication (religious group/village meeting, talk at tea stall) there were chances of increase in the extent of adoption of improved production practices of jute. Penetration of mobile phone and television channel (Doordarshan/ETV Bangla) at village level had multiplied this possibility. Further, it was found that neighbours/friends were the most credible sources of information. This finding is in agreement with a study done by (Mondal and Bandopadhyay, 2014) on jute growers of West Bengal, where sources of information utilization had significant relationship with level of adoption. Similarly, increase in social participation offers more opportunities to gather and process the information and it has also played a significant role on the extent of adoption. Their habit of frequent contacts with local jute growers having more scientific outlook might have helped in understanding the importance of science and technology. A study on potato growers of Jammu and Kashmir (Peer *et al.*, 2014) has also reported similar findings. Scientific orientation makes an individual to systematically proceed from problem identification to a solution, thus making the decision making effective. It seems that scientific orientation might have prompted the respondents to adopt latest technologies for solution of their field problems. The findings are in agreement with a similar study conducted by Chouhan *et al* (2013) on sugarcane cultivators of Madhya Pradesh.

Constraints in adoption: Constraint is a limiting factor which restricts to achieve the potential with reference to a goal. The constraints as perceived and prioritized by the respondents have been worked out. These were focused on technology, market, retting and labour related factors (Table 6).

Non-availability of inputs (92.30) such as seeds of high yielding varieties, CRIJAF Sona, was the most serious constraint. Low support price (76.06), high wages of labour (76.06) and water for retting were other major constraints. High labour cost was a major constraint especially in the case of fibre extraction. Distress sale (57.69), non-availability of labour (49.50), lack of regulated market (40.49), weak extension activities (30.76) and complexity of new practices (30.34) were some other constraints perceived by the respondents.

Table 6: Constraints faced by respondents in adoption of selected jute production technologies (n=52)

Factors	RBQ	Rank
Technology related		
Non availability of inputs	92.30	I
Complexity of new practices	30.34	VIII
Market related		
Distress sale	57.69	IV
Low support price	76.06	II
Lack of regulated market	40.59	VI
Retting related		
Water for retting	75.21	III
Labour related		
High wages of labour	76.06	II
Non availability of labour	49.50	V
Others		
Weak extension activities	30.76	VII

CONCLUSION

Based on above discussion, it was concluded that majority of the jute growers of the study area were selective to adopt the improved technologies and belonged to medium adopter category. Their wider acceptability for weed management through herbicides and balanced fertilizer application reflect their wisdom to apply improved technologies for their benefit. Their acquaintance with inputs and its availability in nearby market persuaded them to continue the same. Non-availability of inputs in nearby market were the reason of poor adoption level of improved jute varieties and CRIJAF Sona. Sources of information utilization, social participation and scientific orientation of the respondents had significant association with extent of adoption of improved production technologies of jute. These factors should be taken care of by the service/ input providing agencies to redesign the activities of transfer of technologies in jute growing areas having similar kind of socio-economic situation. It is assumed that higher adoption of the improved jute production technologies will accelerate the production, which in turn will lead to the sustainable livelihood of the jute growers.

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Correlates of Selected Independent Variables and Attitude of Rural Women towards Homestead Technologies of Rajendra Agricultural University (RAU) Bihar

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ABSTRACT

Attitude is the degree of favourable or unfavourable feelings towards a psychological object. In the present context, it shows the degree of positive or negative attitude rural women of Bihar have towards the selected homestead technologies of RAU. The type of attitude they have is influenced by many socio-personal, economic, communicational, psychological, situational variables. Hence an attempt was made to find out the factors which affect knowledge level of rural women about homestead technologies of RAU. The study was conducted on 225 rural women who were exposed to the nine selected homestead technologies from three districts of Bihar viz. Samastipur, Muzaffarpur and Vaishali. The independent variables education, family support, information source utilization, scientific orientation, innovativeness, perceived attributes of homestead technologies and input availability were positively and significantly associated with attitude of the respondents towards homestead technologies of RAU.The variables information source utilization, scientific orientation and input availability were positively and significantly contributing to attitude of rural women towards homestead technologies of RAU.

Keywords: Attitude, Homestead technologies, Rural women, Bihar

INTRODUCTION

Attitude is the degree of positive or negative effect associated with a psychological object. Home Science is a field of knowledge and service primarily concerned with strengthening family life and enhancing potentials of the individuals for meaningful life. Homestead technologies are those technologies that are related to farm and home activities of rural women.. A number of homestead technologies has been developed by the scientists throughout agricultural universities for rural/ farm women. Rajendra Agricultural University (RAU) has developed a variety of value added food products from Quality Protein Maize (QPM), roots & tubers, minor millets, mushroom, vermicompost, apiculture to list a few of them. As scientists continuously develop and refine technologies, the feasibility and practicability of these technologies must be assessed. One of the major approaches to determine the effectiveness of a technology is to begin with the farm women's attitude towards such technologies. The attitude of an individual is the result of a no. of factors to which the individual is exposed. Several personal, socio-economic, communicational, psychological and situational variables directly or indirectly affect it.

Several studies and researches have been carried out on the attitude of farm women to agricultural technologies but very few in contexts to homestead technologies. Hence it becomes imperative to unearth the facts so that the results of the research would serve as a guideline for the researchers to work on it and make these technologies more feasible, women-friendly and beneficial for them. Keeping these facts in mind, the study was conducted to find out the correlates of selected independent variables and attitude of rural women towards homestead technologies of Rajendra Agricultural University (RAU) Bihar.

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MATERIALS AND METHODS

The study was conducted on a sample of 225 rural women from three randomly selected districts of Bihar viz. Samastipur, Muzaffarpur and Vaishali. One block was randomly selected from each of the districts and three villages were randomly selected from each of the block. Twenty five rural women from each of the nine selected villages were selected as respondents for study. Thus 225 respondents who were exposed to all the nine selected homestead technologies of RAU viz. fruit and vegetable preservation, stitching and embroidery, value addition to garments, arts and craft making, value added products from cereals and pulses, mushroom production, value added mushroom products, vermicompost technology and apiculture constituted the sample for study. Attitude was the dependent variable represented by Y_1. Age (X_1), Education (X_2), Family size (X_3), Occupation (X_4), Family income (X_5), Family support (X_6), Information source utilization (X_7), Economic motivation (X_8), Scientific orientation (X_9), Innovativeness (X_{10}), Perceived attributes of homestead technologies (X_{11}), Value orientation (X_{12}), Risk orientation (X_{13}), Input availability (X_{14}), Rural customs (X_{15}), Market intelligence (X_{16}), Institutional support (X_{17}) and Socio-capital aspects (X_{18}) were the independent variables.

In order to assess the extent of relationship between the selected dependent variable and the independent variables, the data was put to correlation analysis. The values of correlation coefficient (r) were computed and tested for their statistical significance.

Multiple linear regression was carried out to find out the contribution of independent variables in predicting the attitude of the respondents towards homestead technologies of RAU. The eighteen independent variables were fitted in the regression equation to predict their potency towards the selected dependent variable along with coefficient of determination (R^2) and F-value.

RESULTS AND DISCUSSION

From the data of Table 1 it was found that family support and innovativeness were positively and significantly related to the attitude of the respondents at 5 per cent level of significance, whereas the variables education, information source utilization, scientific orientation, perceived attributes of Homestead technologies and input availability were positively and highly significant at 1 per cent level of significance. Rest of the eleven independent variables viz. age, occupation, family income, family size, economic motivation, value orientation, risk orientation, rural customs, market intelligence, institutional support and socio-capital aspects did not had significant relation with the dependent variable.

Table 1: Relationship of independents variables with the dependent variable

Independents variables	Coefficient of correlation (r)
	Dependent variable attitude (Y_1)
Age (X_1)	0.10208NS
Education (X_2)	0.19252**
Family size (X_3)	-0.12187 NS
Occupation (X_4)	0.09338NS
Family income (X_5)	0.10327NS
Family support (X_6)	0.13165*
Information source utilization (X_7)	0.30023**
Economic motivation (X_8)	0.08543NS
Scientific orientation (X_9)	0.19807**
Innovativeness (X_{10})	0.13089*
Perceived attributes of homestead technologies (X_{11})	0.23447**
Value orientation (X_{12})	0.08975NS
Risk orientation (X_{13})	0.06222NS
Input availability (X_{14})	0.26459**
Rural customs (X_{15})	0.06800NS
Market intelligence (X_{16})	0.05238NS
Institutional support (X_{17})	0.02154NS
Socio-capital aspects (X_{18})	0.12362NS

*Significant at 5% level of significance; **Significant at 1% level of significance; NS = Non-significant

The result of Table 1 highlighted that with increased family support and more innovativeness of the respondents, their attitude towards homestead technologies of RAU had also increased. Because of increased family support the respondents got an opportunity to attend various training programs conducted by the institutions and hence could develop favourable attitude towards them. Regarding innovativeness, it is quite logical that innovativeness and attitude are directly proportional to each other. Increase in the educational level of the respondents had developed favourable attitude towards the technologies

of RAU as is evident from the positive association and the correlation coefficient values.

Respondents who utilized more information sources had more positive attitude than the respondents whose information source utilization was less. Scientific orientation of the respondents was also positively correlated with attitude towards homestead technologies which signifies that respondents who were more scientifically oriented had favourable attitude towards homestead technologies than respondents who were less scientifically oriented. Perceived attributes of homestead technologies and input availability were also positively correlated with the attitude of the respondents which connotes that respondents whose perception about the attributes of homestead technologies was high and had better and easy accessibility to inputs had more favourable attitude than its contrary.

This is supported by the study of (Sreenivasulu, 2011) who found that education, information source utilization and innovativeness had positive and significant relationship with the attitude of the FFS farmers. (Isreal, 2003) reported that scientific orientation of the respondents exhibited positive and significant relationship with attitude at 1 per cent level of significance.

Relative contribution of independent variables towards attitude of the respondents about homestead technologies of RAU: The relative contribution of independent variables towards attitude of the respondents towards homestead technologies of RAU is presented in Table 2.

The t-values of the independent variables highlighted the fact that scientific orientation was positively significant at 5 per cent level of significance, whereas information source utilization and input availability were highly and positively significant at 1 per cent level of significance. The remaining fifteen variables under study could not emerge as significant contributors towards attitude of the respondents.

All the variables together explained 51.75 per cent variability which is obvious from the coefficient of determination R^2 value. The F-calculated value (7.532) also stood out to be significant which supports that R^2 is significant. It can be inferred from this result of Table 2 that out of the eighteen selected independent variables, only three of them were significantly

Table 2: Relative contribution of independent variables towards attitude of the respondents about Homestead technologies of RAU

Independent variables	b-values	Standard error	t-value
Age	0.0093	0.8131	0.122NS
Education	0.0716	0.2712	0.802 NS
Family size	-0.1021	0.5330	1.533 NS
Occupation	-0.0665	0.3859	0.894 NS
Family income	0.0865	0.8281	1.134 NS
Family support	0.0620	0.1037	0.782 NS
Information source utilization	0.3015	0.0344	2.702**
Economic motivation	-0.0016	0.2826	0.023NS
Scientific orientation	0.2405	0.2519	2.358*
Innovativeness	-0.1810	0.1801	1.763NS
Perceived attributes of Homestead technologies	-0.1630	0.1084	1.953NS
Value orientation	0.1007	0.2431	1.126NS
Risk orientation	-0.0960	0.1251	1.025NS
Input availability	0.2026	0.1V204	2.759**
Rural customs	-0.0593	0.1108	0.758NS
Market intelligence	-0.0231	0.1815	0.277NS
Institutional support	-0.0022	0.2281	0.033NS
Socio-capital aspects	0.0494	0.1456	0.673NS

R^2= 0.5175; F calculated Value= 7.532

*Significant at 5% level of significance; **Significant at 1% level of significance; NS = Non-significant

contributing towards attitude level of rural women towards homestead technologies of RAU. It means that extraneous variables were contributing upto 48.25 per cent towards attitude level of rural women and these variables should be taken into account to study their attitude towards any phenomenon and while formulating any programs that involves their attitude also as one of the variable.

This is supported by the studies of (Sreenivasulu, 2011) who found that information source utilization had significant relationship with the attitude of the FFS farmers and (Isreal, 2003) who reported that scientific orientation of the respondents had significant relationship with attitude.

CONCLUSION

It can be concluded from this study that the variables education, family support, information source utilization, scientific orientation, innovativeness, perceived attributes about homestead technologies and input availability are significantly correlated with the attitude of rural women towards homestead technologies of RAU. The scientists and extension personnel should take these factors into account when they develop a technology and disseminate it among them so that they develop favourable attitude towards those technologies. Only when they have positive attitude towards such technologies, can their knowledge level about them be improved, leading ultimately to higher rate of adoption and its sustained acceptance among rural women.

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Study on Milk Ability of Murrah Buffaloes in Relation to its udder and Teat Morphology

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ABSTRACT

An investigation was undertaken to study the milkability of Murrah buffaloes in relation to its udder and teat morphology. Thirty lactating Murrah buffaloes in early lactation were taken for the study over a period of 2 months. Various measurements were taken on udder and teats early in the morning before milking. Visual appraisals were made on these animal related to udder and teat characteristics. The milk production in entire lactation was found to be higher in animals having long, wide and deep udder. The mean daily milk yield was significantly ($P<0.05$) higher for animals having longer udder with greater width and depth. The milking time was affected significantly ($P<0.05$) by the type of udder, udder attachment and number of udder folds. The flow rates were similar in all buffaloes except those animals having too low or high udder. There was significant ($P<0.01$) effect of teat shape on milk yield, milking time and milk flow rate. The study revealed that Murrah buffaloes having greater udder length, width and depth with cylindrical teats and rounded teat ends showed better milkability than other animals. These criteria may also be used as a reliable method in selection and purchase of Murrah buffaloes.

Keywords: Milk ability, Murrah, Teat, Udder

INTRODUCTION

The morphology of udder and teats are the important characteristics of mammary system of dairy animals, having direct association with their milk production. The size and shape of udder plays a vital role for the suitability of economical milk production and are considered for selecting dairy animals (Bhuiyan *et al.*, 2004). The fore and hind quarters in bovines are seldom equal and these traits differ considerably in dairy buffaloes and cows (Bharti *et al.,* 2015). The bovine udder also show certain structural malformations viz. udder abnormalities, very short and small teats, improperly placed teats, supernumerary teats, etc. which affect the milking process as well as the milk yield of animal (Rahman and Gill, 1992; Bardakcioglu *et al.*, 2011). Similarly, there are udders which hang too low are susceptible to injuries, mastitis and possess difficultly in milking (Sagar, 2009). It is therefore, presumed that the size and morphology of udder varies greatly from individual to individual animal and affects their milkability.

The Murrah buffaloes are well established and documented breed known for their high milk producing ability. The physical characteristics as well as shape, size, attachment and placement of udder and teats are reported to be associated with milk production (Bhuiyan *et al.,* 2004, Andrade and Garcia, 2005). However, there is no consensus amongst scientists, field veterinarians and farmers regarding the extent of deviation in important udder and teat characteristics of Murrah breed and its effect on the level of production. Therefore the present investigation was carried out to study the effect of various morphological traits of udder and teat on milkability of Murrah buffaloes.

MATERIAL AND METHODS

The observation and measurements were taken in buffaloes maintained at Livestock Research Centre, SVPUAT, Meerut. The study was conducted on 30 early lactating buffaloes (30-60 days in milk) in 3rd-5th parity for a period of 2 months. These buffaloes were milked twice a day, i.e. morning and evening by full-hand method of milking. The stimulation for milk ejection was done by allowing the calf to suckle its dam. Various measurements were taken on udder and teats early in the morning before milking. The length, depth and attachment of udder were measured as defined by Davis (1962).

Udder length (UL): Length from the rear to the front attachments of udder along with its sole, where fore udder blends smoothly with the body.

Udder width (UW): Distance between two lateral lines of attachment of the udder to the abdomen wall on ventral.

Udder depth (UD): Udder depth was obtained by taking the difference of the two under-mentioned measurements (a – b).

a) Distance from the floor to the base of the udder.
b) Distance from the floor to the lowest point of the udder floor at place of attachment of the teats.

The teat shapes were classified based on the visual appraisal into 3 categories as cylindrical, bottle and funnel shape. The tip of teat was recorded as rounded and pointed present in these animals. The teat placement was measured as the distance between the teats i.e. distance between fore to fore teats (DFF), distance between rear to rear teats (DRR), distance between left fore to left rear teat (DLFR), distance between right fore to right rear teat (DRFR).

Statistical Analysis: The data obtained on various udder and teat parameters and milkablity traits in buffaloes were analyzed using general linear model procedure in SAS version 9.3. The means that were significantly different were compared using Duncan's Multiple Range test.

RESULTS AND DISCUSSION

The milk production in entire lactation based on udder length, udder width and udder depth was found to be higher for long, wide and deep udders (Table 1). Similarly, the mean daily milk yield was found to be significantly higher for animals having long udder ($P<0.05$) with greater width and depth ($P<0.01$). In a similar study, Hafeez and Naidu (1981) reported that milk yield was significantly related with udder width and length. Bhardwaj *et al.* (2007) compared the results of farm and field in Murrah buffaloes and found that the milk yield of buffaloes in both cases decreased significantly as the length of the udder decreases. This means that lactation milk yield was higher in buffaloes with udder that extended more forward and backward, *i.e.* more capacious udders are associated with higher yields. Singh and Bhatnagar (1977) noticed that the width of the udder played more important role than the length of the udder in cattle whereas, on the contrary, the length of the udder in the buffaloes played an effective role in producing more milk. They reported that the milk yield was significantly higher in buffaloes having deep udder as compared to buffaloes having shallow udder. The results of the present study were also supported by Bhuiyan *et al.* (2004) who indicated that size and depth of udder were very important conformation traits for milk production. The daily milk yield for the animals having high udder attachment with few folds was also significantly ($P<0.01$) higher than animals in which udder was hanging low and having numerous folds. Similar results were reported by Bhardwaj *et al.* (2007) and Bhardwaj *et al.* (1991) who found positive and significant association of milk yield with depth and rear attachment of udder. The flow characteristics of udder showed that milk let-down time was not affected by the type of udder. The milking time was affected significantly ($P<0.05$) by the type of udder, udder attachment and number of folds. The flow rates were similar in buffaloes except in those animals in which udder hang too low or high ($P<0.01$). The results obtained in the present study were in agreement with Prasad *et al.* (2010) and Rao and Murthy (1991) who reported similar variation in milk yield based on udder shape and attachment.

The study on the influence of shape of teats and distance between the teats on milk ability of Murrah buffaloes are presented Table 2. The daily milk yield was significantly ($P<0.01$) higher in cylindrical teats as compared to bottle or funnel shaped teats; and buffaloes with round tips yielded significantly more milk

Table 1: Milk ability in Murrah buffaloes according to udder characteristics (Mean ±SE)

Parameter	N	Lactation milk yield (kg)	Daily milk yield(kg)	Milk let-down time (sec)	Milking time (sec)	Flow rate (gm/sec)
Udder length						
Long	65	2813.95±269.71	6.06±0.43^{b}	103.01±3.89	276.84±11.25	21.20±0.62
Medium	49	2550.62±101.74	5.56±0.24^{ab}	130.54±15.01	265.287±9.51	21.05±0.75
Short	45	2278.13±459.14	4.83±0.25^{a}	79.80±5.19	256.60±8.91	18.62±0.94
Udder width						
Wide	60	3053.95±282.26	6.91±0.44^{C}	93.83±4.76	294.03±11.52^{b}	22.35±0.56
Medium	45	2700.48±486.56	5.00±0.16^{AB}	128.60±16.13	257.20±6.52^{ab}	18.90±0.65
Narrow	45	1888.27±78.95	4.534±0.25^{A}	90.92±4.51	247.50±13.19^{a}	19.62±0.94
Udder depth						
Deep	65	3029.00±381.35	6.29±0.33^{B}	109.00±10.61	294.03±11.37^{B}	20.83±0.71
Medium	60	2602.81±112.88	5.72±0.22^{AB}	114.67±12.19	271.26±6.37^{AB}	20.44±0.75
Shallow	25	2010.97±317.11	4.50±0.40^{A}	89.62±6.76	233.46±13.29^{A}	19.60±0.95
Udder attachment						
High	115	2494.82±197.64	6.47±0.23^{B}	103.07±6.72	283.48±6.53^{b}	22.07±0.54^{B}
Low	35	2600.31±464.96	4.50±0.38^{A}	105.83±19.01	249.00±14.57^{a}	18.51±0.67^{A}
Udder folds						
Few	90	2648.29±291.93	6.20±0.26^{B}	108.37±7.83	286.84±8.79^{B}	20.95±0.46
Many	60	2446.85±146.86	4.77±0.23^{A}	100.53±12.27	245.64±6.97^{A}	19.63±0.89
Overall mean	**150**	**2265.09±182.56**	**6.44±0.18**	**122.25±6.77**	**271.90±6.03**	**23.87±0.45**

LSM showing different superscript in upper case letters in a column differ significantly (P<0.01) & lower case letter (P<0.05).

Table 2: Milk ability in Murrah buffaloes according to teat characteristics and distance between teats (Mean ±SE)

Parameter	N	Lactation milk yield (kg)	Daily milk yield (kg)	Milk let-down time (sec)	Milking time (sec)	Flow rate (gm/sec)
Shape of teat						
Cylindrical	70	2853.14±392.74	7.64±0.27^{C}	130.60±10.90	336.23±11.32^{C}	22.85±0.63^{BC}
Bottle	55	2567.53±67.84	2.75±0.26^{A}	90.28±4.77	211.76±13.03^{A}	14.52±0.96^{A}
Funnel	25	2222.03±241.25	6.05±0.25^{B}	92.47±5.09	250.74±7.17^{AB}	23.50±0.75^{C}
Tip of teat						
Round	105	2818.59±468.22	6.76±0.46^{B}	106.59±5.41	288.61±12.12^{b}	22.42±0.82^{B}
Pointed	45	2276.54±171.09	4.20±0.15^{A}	102.31±9.38	243.87±6.56^{a}	18.16±0.54^{A}
Distance between front teats (DFF)						
Far	45	2663.88±538.31	7.67±0.49^{b}	91.66±14.73	281.41±13.62^{b}	26.45±0.79^{C}
Moderate	75	2046.50±135.89	6.45±0.20^{ab}	114.19±10.12	249.05±6.45^{a}	25.81±0.70^{BC}
Close	30	2197.74±109.67	5.35±0.17^{a}	135.83±4.82	297.55±14.40^{ab}	18.96±0.59^{A}
Distance between rear teats (DRR)						
Far	65	2565.82±450.09	5.89±0.42^{a}	114.47±12.45	268.85±11.82	22.29±0.90^{a}
Moderate	45	2069.72±145.50	6.49±0.16^{ab}	143.42±13.25	296.67±9.13	22.91±0.59^{ab}
Close	40	2272.59±172.44	7.08±0.28^{b}	83.78±4.71	262.49±8.69	26.03±0.82^{b}
Distance between left front and rear teats (DLFR)						
Far	30	2204.84±324.36	6.93±0.16	87.60±4.01	277.88±14.30	25.49±0.81
Moderate	55	2462.94±123.33	6.29±0.43	111.35±4.83	268.32±11.38	22.72±0.74
Close	65	2240.34±411.81	6.24±0.21	142.72±14.99	281.81±7.33	23.02±0.73
Distance between right front and rear teats (DRFR)						
Far	40	2501.75±411.81	5.86±0.30^{a}	138.98±23.84^{b}	255.56±8.10	23.27±0.88^{ab}
Moderate	45	2144.15±123.33	7.33±0.15^{b}	73.64±3.66^{ab}	286.45±7.76	25.79±0.74^{b}
Close	65	2262.22±324.36	6.27±0.36^{ab}	129.05±4.49^{a}	286.00±11.60	22.16±0.69^{a}
Overall mean	**150**	**2265.09±182.56**	**6.44±0.18**	**122.25±6.77**	**271.90±6.03**	**23.87±0.45**

LSM showing different superscript in upper case letters in a column differ significantly (P<0.01) & lower case letter (P<0.05).

Table 3: Correlation among various udder and teat traits with milkability in Murrah buffaloes

Traits	Milk yield	Milk let-down time	Milking time	Milk flow rate
Udder length	0.47**	0.15	0.40*	0.31
Udder width	0.40*	0.10	0.25	0.35
Udder depth	0.21	0.08	0.16	0.11
Udder attachment	0.05	0.11	0.02	0.08
Udder folds	0.10	-0.21	0.02	0.19
Shape of teat	0.11	0.06	0.14	0.21
Tip of teat	0.07	0.10	0.11	0.13
DFF	0.13	0.06	0.08	0.07
DRR	0.24	0.06	0.12	0.11
DLFR	0.13	0.04	0.14	0.07
DRFR	0.18	0.03	0.19	0.09

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

than those having pointed teat tips (Table 3). The results of present study were similar to reports of Bharadwaj *et al.* (2007) in Murrah buffaloes. On the contrary, Bharadwaj (1991) found no difference in milk yield based on teat shape and teat tips. However, Moore *et al.* (1981) found significantly higher milk yield in exotic cows with funnel shaped teats than in those with cylindrical teats. The milking time and milk flow rate from teats of different shapes were significantly ($P<0.05$) greater for cylindrical teats and teats having rounded teat ends. This means that buffaloes with cylindrical teats and round tips possess ease in milking due to uniform pressure applied on teats. Kumar (1993a) in a similar study observed that milking time was significantly affected by different shape of teats in Murrah buffaloes and crossbred cows. However, Kumar (1993b) and Kumar (1997) could not found significant effect of shape of teats on the actual milking time in buffaloes. Kumar (1993b) reported that average milk yield per milking and milk flow rate to be highest in buffaloes with pear shaped teat. The daily milk yield and milk flow rate based on distance between the front teats (DFF) and rear teats (DRR) for close, moderately close and far teats were significantly ($P<0.05$) affected in Murrah buffaloes without affecting the milk let-down time. However, reverse trend was noticed in both these teats. There was no significant difference ($P>0.05$) due to left lateral distance between the teats (DLFR), may be due to most milking operation being practiced from the left side of the animals, providing ease to both milker as well as the animal. The results of our study were in agreement to the Lavania *et al.* (2011) in Surti buffaloes and Singh *et al.* (2010) in Vrindavani cattle. They reported that distance between the teats is also affected by their lactation order which had significant effect on milk yield. Prasad *et al.* (2010) reported no significant effect of distance between teats on milk yield. The correlation of udder and teat traits showed that there was positive and significant correlation of udder length with the milk yield and milking time of the animal. Similarly udder width correlated with the milk yield significantly ($P<0.05$). Singh *et al.* (2010) reported positive and significant correlation ($P<0.05$) between milk yield with udder length, udder width and udder depth in Vrindavani cows. Prasad *et al.* (2010) reported that although positive correlation existed between the daily milk yield with the various teat measurements such as teat length, teat diameter and the distance between the front and hind teats, the correlation was significant ($P<0.01$) only with the average teat diameter. The results are also in agreement with Rahman and Gill (1992) in Murrah buffaloes, Akhtar *et al.* (1999) in swamp buffaloes and Tilki *et al.* (2005) in Brown Swiss cows.

CONCLUSION

The study revealed that Murrah buffaloes having greater udder length, width and depth with cylindrical teats and rounded teat ends showed better milk ability than other animals. These criteria may be used as a reliable method in selection and purchase of Murrah buffaloes.

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Socio-economic and Technological Impact of IARI-Post Office Linkage Extension Model

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ABSTRACT

The need for strengthening frontline extension for wider outreach and effective technology dissemination has been felt widely across the nation. In this context, the ICAR-Indian Agricultural Research Institute (IARI) conceived an innovative approach called IARI-Post office linkage extension model to disseminate improved technologies to remotely located farmers in collaboration with postal department. The present study made an attempt to investigate the socio-economic and technological impact of the technologies disseminated through this model based on *ex-post facto* research design. Sitapur and Buxar districts were selected purposively from Uttar Pradesh and Bihar, respectively as the study locale. Hundred beneficiaries and sixty non beneficiaries along with ten Branch Post Masters and ten KVK scientists of both the districts were taken as respondents. All beneficiary farmers were found to be aware of involvement of Post office in technology dissemination and more than 50 per cent were aware of IARI improved rice and wheat varieties. The small farmers have adopted IARI improved wheat varieties more than the medium and large farmers. Average yield of IARI improved rice and wheat varieties for beneficiaries were also found to be higher than local check varieties. Average profitability of rice was significantly higher for beneficiaries than non-beneficiaries. However, no significant difference was found in case of wheat. It may be concluded that the model intervention had some significant change in socio-economic scenario of farmers which would help in designing appropriate strategy for up-scaling and out-scaling of the model in similar context. It would also help the researchers and policy makers in devising suitable policy framework in future.

Keywords: Extension, Linkage, Model, Socio-economic, Technological

INTRODUCTION

The huge pressure to produce more food from limited land with shrinking natural resource is a difficult task for farmers. The key challenges to be addressed at present are weak input delivery mechanism and building linkage among diverse local agro-governance systems; growing marketing inefficiencies and limited employment opportunities in non-farm sector. The efficiency of public extension system is under critical review from different policy corners for last few years. The state extension service is already paralyzed with multiple issues like low extension workers to farmers ratio (1:5000) (Ragasa *et al.*, 2013), multiple role of extension agency, no motivation for promotion and only 6.8% farmers receive extension service from state extension agency in India (GFRAS, 2012).

Making timely availability of quality seeds of major crops in rural India is often a difficult task for any existing technology delivery system. To supplement and complement the public extension system, there is a need for strengthening frontline extension for wider outreach and effective technology dissemination widely across the nation. With this point of view, an alternate extension approach was conceived by ICAR-Indian Agricultural Research Institute (ICAR-IARI) in collaboration with Postal department. The rationale behind post-office as partner organisation was because of wider coverage of post offices 1,39,144 out

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of 1,55,015 Branch post offices are in the rural areas across the country with the coverage of 21.21 sq. km and a population of 7175 people per one branch post office (Dubey *et al*., 2012). A sharp decline (about 50%) in the mail and delivery of ordinary post during last decade has also been reported.

The rural branch post office (BPO) caters to 5-15 villages and the branch postmaster (BPM) belongs to the same cluster of villages or its neighbourhood with knowledge of local farming situation and farmer's plight. The Branch post masters could act as *para*–extension workers to bridge the gap between clients and change agent system. To utilize the potential of postal services, ICAR-IARI initiated an innovative extension model using village post masters as change agents for information sharing and disseminating technology to the farmers. The IARI-Post Office Linkage Extension Model was tested on pilot basis in *rabi* season of 2009 with IARI improved crop varieties in Sidhauli and Kasmanda blocks in collaboration with seven post offices of Sitapur district in UP. The model was then extended and validated in four districts viz., Sirohi (Rajasthan), Sheopur (Madhya Pradesh), Buxar (Bihar) and Jammu (Jammu & Kashmir) since 2012-13.

Under this model, village level post masters and farmers were trained in improved farm practices with the help of local KVKs (KrishiVigyan Kendra). Demonstration of improved IARI varieties on the farms of village postmasters became the place of learning for other farmers. It was reported that the high quality seed disseminated under the model helped to increase in the crop yield and seed replacement rate due to timely awareness and access of farmers or stakeholders about IARI technologies through this model. The programme helped in overall development of stakeholders by minimizing the knowledge and skill gap and capacity building by strengthening their linkages with local KVKs, state department and other agencies.

Hence, it was imperative to study the socio-economic and technological impact of this innovative model in livelihood security and assessing its viability as a potential alternate extension model. The output of the study would help in understanding the impact of the model in bringing socio-economic up-lift and agricultural development in remote areas.

MATERIALS AND METHODS

The present study followed an ex-post-facto research design. A with-without research design was employed for comparative assessment of beneficiaries and non-beneficiaries of the model. Sitapur district of Uttar Pradesh was selected purposively as the project was continuing since 2009. Buxar district of Bihar was also selected purposively as the project expanded in 2012-13 where technologies related to both low volume and high volume crops were disseminated through this model and similar agro-ecological conditions prevail in these two districts. From Sitapur district of Uttar Pradesh, seven villages namely Amberpur, Manwa, Dakhinawa, Chauriya, Gandhauli, Neelgaon and Rehua and from Buxar district of Bihar, three villages namely Kukuda, Chhuni and Unwas were purposively selected as the locale of study where ten respondents out of total enlisted beneficiaries of each village were selected (total of hundred beneficiary farmers) by simple random sampling technique. Thirty non-beneficiary farmers from each district (total of sixty non-beneficiaries) were also selected randomly as control sample. Ten officers of both of the KVKs Sitapur and Buxar were selected by stratified random sampling. Ten Branch Post Masters from ten Branch Post Offices (7 in Sitapur and 3 in Buxar) were selected purposively. Thus, the sample comprised of total 180 respondents including officials. Both primary and secondary data have been utilized for the study. The primary data were collected through survey method using pretested interview schedules (structured and semi-structured),focused group discussion, and observation as major tools. The secondary data were collected through annual reports of respective KVKs, literature published by various Government/ non-government agencies and reference materials available on websites. Appropriate descriptive and inferential statistics were used to analyze the data. Socio-economic impact of IARI-Post office linkage extension model was assessed on indicators like change in yield, profitability, rate of adoption of improved technologies and awareness of farmers and branch postmasters about the mechanism of the model. The social awareness regarding post office linkage in farming system among the beneficiaries was analysed through descriptive statistics using prepared awareness statements in interview schedule.

RESULTS AND DISCUSSION

Awareness of farmers: Awareness is considered to be the first phase of innovation dissemination and act as vital role in decision–making process. Awareness is a function of an innovation decision process, which has been demarcated as "the individual comes to know of something which is related to one's own need or arouses the need' (Rogers, 2003). As we know the awareness is pre-requisite to adoption, there were several studies to find out awareness level of stakeholders for facilitating the adoption process of improved technologies. Ghanghas *et al.* (2015) had studied on extension scientists' awareness on climate change revealed that majority of extension scientists belonged to medium and low category level of awareness. It might be due to lack of access to information and communication facilities like internet and poor co-ordination between various organizations/ institutions working on climate change.

Here, the level of awareness of the two groups of beneficiary farmers was obtained from personal interviews based on administration of ten pre-determined statements reflecting IARI-Post office linkage extension model and its mechanism. Table 1 showed that both the groups had 100 per cent awareness about involvement of BPM in technology dissemination as they were involved with the model for a notable period of time. Majority of farmers knew IARI improved wheat varieties like HD-2987, HD-2733, HD-2985, HD-2967 whereas half of the respondents were aware of rice varieties like P 44, PS-5, and PRH-10.The possible cause behind higher awareness was sensitization of improved varieties by BPMs and KVK scientists through regular training and demonstration on field of BPM and progressive farmers. The participatory discussion revealed that the farmers were interested to adopt improved wheat and rice varieties with high yielding, good cooking quality and marketability as major criteria of preference in addition to drought tolerance in two villages namely Manwa and Amberpur in Sitapur. In this regard, IARI varieties were able to cater the demand of farmers in their location mainly due to post office and KVK seeds distribution, which might be awareness spread through model intervention. It was well supported by previous findings by Burman *et al.* (2015) that IARI-Post office linked extension model impacted very highly to increase the awareness about IARI varieties perceived by majority of the respondents (45.5%).

In case of mustard, there were less than half of respondents were aware about IARI improved mustard varieties like Pusa Jaikishan and Pusa Mustard 26.Mustard growers had comparatively more preference towards thickness of seed and oil which was catered by other varieties like Varuna (T-59). In Buxar, more farmers were mainly aware about the rice variety, *Pusa Sugandh-5* and wheat variety HD-2967. *Pusa Sugandh* was well-known because of the long and scented grain. From focused group discussion, it was found that HD-2967 variety was more familiar and spread over 50-60

Table 1: Awareness of farmers about the mechanism of the model and the technologies disseminated through the model

Statements	Sitapur (n=70) *f* (%)	Buxar (n=30) *f* (%)
Involvement of BPM in Technology dissemination	70 (100)	30 (100)
IARI improved rice varieties HYVs (P 44, PS 5 and PRH 10)	35 (50)	16 (53.33)
IARI improved wheat varieties (HD-2987, HD-2733, HD-2985, HD- 2967)	45 (64.29)	20(66.67)
IARI improved mustard varieties like Pusa Jaikishan, Pusa Mustard 26	30 (42.86)	10 (33.33)
IARI improved Bottle gourd varieties Pusa Naveen	30 (42.86)	6 (20)
Seed multiplication is the main purpose of seed distribution	38 (54.28)	16 (53.33)
Selection of beneficiaries by BPM	45 (64.29)	20(56.67)
Model demonstration plot in the Branch Postmaster's field	30 (42.86)	10 (33.33)
Information about postal charge in seeds dispatched	30 (42.86)	12 (17.14)
Role performed by the KVK scientists in the model	30 (42.86)	10 (33.33)

(Figures in parentheses denote percentage)

per cent of Kukuda village in Buxar because of seed quality, regular demonstration and training of varieties by KVK Scientists.

Level of awareness of the two groups of beneficiary farmers was studied based on administration of ten predetermined statements reflecting IARI-Post office linkage extension model and its mechanism. The chi square test had given a clear cut difference between the two groups based on their awareness level. It was interesting to note that both the groups had nearly equal score on level of awareness on IARI-Post office linkage extension model, but the gap existed between the groups on the concepts and mechanism of linkage extension model. The results of chi square test were depicted in Table 2.

However, there was somewhat less awareness regarding mechanism of the model due to low sensitization. The difference of the level of awareness between farmers of Sitapur and Buxar was an indication of more intensity of the project activities undertaken in Sitapur district than Buxar.

Extent of adoption of IARI improved varieties: Adoption is a decision to make full use of an innovation as the best course of action available (Ray, 2013). Certain factors affecting adoption are relative advantage, compatibility, complexity; trialability and observability as perceived characteristics of innovation. The adoption process starts from awareness about an innovation, interest in it; evaluating mentally as future anticipation of result, then trial in a small scale and finally adoption on a full scale. Hence educating farmers for awareness on improved technologies through regular extension contact and capacity building by training and scientific orientation contributed towards increase in knowledge and its application in the field led to increased adoption of the technology reported by Anavrat (2015).

Farmers had been categorized into small, marginal and large categories according to their land holding on specific crop like rice. In Sitapur there was no large farmer having land >4 ha of rice. From findings depicted in Table 3, it was seen that the small rice growers in Sitapur had extent of adoption of 0.81 and their adoption rate was 33 per cent which was comparatively higher than medium farmers whose extent of adoption was 0.6 and adoption rate was 19 per cent. In case of Buxar, the small farmers of rice had extent of adoption of 0.82 and their adoption rate was 64 per cent which is comparatively more than medium farmers whose extent of adoption is 0.32 and adoption rate was 17 per cent. Large farmers had extent of adoption of 0.22 and adoption rate of 7 per cent. Extent of adoption and adoption rate were higher in small farmers as comparatively less amount of seeds and less unit time to cover unit land were required than medium and large farmers. Also small farmers were regularly in contact with Branch Postmasters easily for better information about the improved technology that ultimately led to higher adoption. Here, medium and large holders had low adoption rate in case of IARI rice

Table 2: Chi square test to compare awareness level of farmers of both districts

	Observed N	Expected N	Residual	Chi square	Degree of freedom	P value
Sitapur	70	50.0	20.0	16	1	0.01
Buxar	30	50.0	-20.0			
Total	100					

Table 3: Extent of adoption of IARI improved rice varieties Sitapur (SF) (n=49), Buxar (BF) (n=26)

Farmer categories	Frequency (*f*)		Average total rice area (ha)		Area of rice under IARI varieties (ha)		Extent of adoption (EA= Area under IARI varieties/ TA)		Adoption rate (EA/ Number of years)*100	
	SF	BF	SF	BF	SF	BF	SF	BF	SF	BF
Large farmer (>4 ha)	-	4	-	6.62	-	1.5	-	.22	-	7%
Medium farmer (1-4 ha)	15	12	1.45	2.60	.92	.78	.6	.32	19%	17%
Small farmer (<1 ha)	34	10	.52	.52	.40	.40	.81	.82	33%	64%

varieties due to their easy access to different sources for timely and adequately input procurement. In Buxar, small farmers and large farmers of rice had comparatively more adoption rate than Sitapur because there was a sole crop rice belt area with conducive agro-climate in Buxar where as in Sitapur various factors like sugarcane belt with multiple cropping pattern was major reason behind low adoption of rice.

Table 4 depicted that the small farmers of wheat in Sitapur had more extent of adoption (0.76) than medium farmers. Their adoption rate was also more (33%) than medium farmers (15%). Large farmers had extent of adoption of 0.54 and adoption rate of 25 per cent. In case of Buxar also, the small farmers of wheat had more extent of adoption (0.84) and adoption rate (45 %) than medium farmers whose extent of adoption and adoption rate were found to be 0.50 and 19 per cent respectively. Large farmers had extent of adoption of 0.14 and adoption rate of 6per cent. Hence, more small farmers adopted IARI improved varieties which was a major impact of the model. In case of large farmers of Sitapur comparatively more adoption rate of wheat was found than those of Buxar because of huge market opportunities of quality wheat in Sitapurthan Buxar. But in case of small and medium farmers, Buxar had more adoption rate than Sitapur because they were unable to avail quality seeds from other sources at crucial time but accessibility of the same through the model. Findings supported previous studies where it was found that timely delivery of seed to the remotely located, small and poor farmers who otherwise were left in other public extension systems were effectively and efficiently covered through this approach (Burman *et al.*, 2015).

There was a small approach by researcher to find out the seed replacement pattern in previous seasons through focus group discussion and interview. It was found that IARI seeds had been continuously substituting traditional and local check varieties due to their higher yielding, other criteria remaining same with the later ones. They were also interested for changing the seeds with improved ones for better output. Among rice varieties, there was a shift in varieties and increased choice for adoption like Pusa Sugandh-5 in place of NDU 369, Sona Masoori whereas Pusa-44 in place of Sanyog 52, Narendra, Sampoorn, MTU-7029, Pooja, Sonam etc. Similarly, wheat varieties namely HD-2967 as a popular highly adopted seed in place of PBW-154, PBW-550, PBW-502, Molby contributed a remarkable technological changes in the project areas. Not all but some farmers in Manwa and Amberpur having irrigation problem had adopted drought resistant and low water requiring wheat like HD-2985, HD-2987 in place of LOk-1, Kundan, and Raj like traditional varieties.

It was quite interesting that a spillover effect was observed in improved seeds spreading in the location and nearby location by multiplication and sharing of seeds among fellow farmers.

Besides previous said factors like high yielding, marketable, good cooking quality there were major factors behind higher adoption rate of IARI improved varieties were higher trust and expectation from improved seeds received through post office, timely availability of quality inputs, demonstration and training from KVK scientists along with Branch Post master, visualizing the result from progressive farmers and BPM in preceding season, enthusiasm for improved seeds etc.

Comparison of beneficiaries and non-beneficiaries with economic indicator: Quality inputs basically seed along with improved technologies are the vital factors behind higher yield and profitability of farmers produce.

Table 4: Extent of adoption of IARI improved wheat varieties Sitapur SF (n=66), Buxar BF (n=26)

Farmer categories	Frequency (*f*)		Average total rice area (ha)		Area of rice under IARI varieties (ha)		Extent of adoption (EA= Area under IARI varieties/ TA)		Adoption rate (EA/ Number of years)*100	
	SF	BF	SF	BF	SF	BF	SF	BF	SF	BF
Large farmer (> 4 ha)	1	4	5.6	5.12	3	.625	.54	.14	25%	6%
Medium farmer (1-4 ha)	17	14	1.44	1.95	.8	.96	.56	.50	15%	19%
Small farmer (<1 ha)	44	8	.54	.52	.39	.41	.76	.84	33%	45%

Table 5: Comparison of beneficiaries and non-beneficiaries with economic indicator

Economic Indicators	District	Parameters	Average yield of beneficiaries	Average yield of non-beneficiaries	*t* stat	*P* -value (two tail)
Yield	Sitapur(n=70)	Rice	56	48.8	4.22	0.00009
		Wheat	55	49.73	3.70	0.0005
	Buxar(n=30)	Rice	54.6	45.1	3.32	0.00162
		Wheat	43.72	38.41	2.59	0.01229
Profitability	Sitapur(n=70)	Rice	57673	42524	2.05	0.04310
		Wheat	68453	59664	0.79	0.42789#
	Buxar(n=30)	Rice	173935	154096	4.87	0.00003
		Wheat	121507	116534	0.194	0.84640#

(Significant at *P*- value < 0.05); # (Non significant)

Here, Table 5 was interpreted that average yield of rice and wheat of beneficiaries were significantly different than that of non-beneficiaries in Sitapur and Buxar because of accessibility of quality high yielding seeds, quality of seeds retained through the postal delivery, timely availability of seeds and strengthening of farmers through advisory services from the model. The result is also supported by Kumar and Prajapati (2015) based on impact assessment of frontline demonstration on pigeon pea where it was found that improved varieties and balanced fertilization increased yield to the tune of 15.44% and 10.41%, respectively while both the factors in combination were responsible for 25.81% increase in yield. In demonstration plots B: C ratio was also higher as compared to control ones.

In case of rice, average profitability of beneficiaries and non-beneficiaries were significantly different in both the districts because of high yield and increased market price of produce in comparison to local varieties. Also, cost effectiveness of delivery mechanism in comparison to conventional method enhanced the profitability. But in case of wheat, profitability of the beneficiaries and non-beneficiaries were not at all significantly different in both the districts as there was little difference of market price of IARI wheat with other wheat varieties.

The majority of small and medium farmers covered through the model were economically secure at the time of sowing of seeds because they could divert their time and resources for other potential investments rather searching for improved seeds in market and line departments. The several issues regarding economic insecurity like frustrations coming out of cost of unsure travelling several times, depositing advance money in line department, and exploitation of local dealers for input purchase were observed/explored from non-beneficiaries which were negligible in beneficiaries. Also, the farmers were more sensitized through technology backing which facilitate them for adopting scientific recommendation in cultivation. Thus the farmers were benefited through the linkage program avoiding unnecessary cost. Besides yield and profitability, there were a lot of direct and indirect factors behind economic empowerment of farmers linked in the model.

CONCLUSION

From the findings it can be concluded that, as an instrument for innovative agricultural system, IARI-Post office linkage extension model had managed to imprint its positive and intended consequences on various dimensions affecting farmers and his surroundings. The intervention was able to make the beneficiary farmers stand a step forward towards accessing quality seeds in remote villages. Apart from technological implications, this intervention led to development in social and economic aspects. The implication of the study will provide feedback to the institutions engaged in dissemination of IARI technologies through IARI-Post office linkage extension model for further redesigning the interventions in order to improve its output and outcome which would help in designing appropriate strategy for up-scaling and out-scaling of the model in similar context. It would also help the researchers and policy makers in devising suitable policy framework for future.

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An Investigation of Yield Gaps in Wheat and Maize Crops

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ABSTRACT

The present study estimated yield gap I and yield gap II for wheat and maize in major producing states based on FLD data it showed that despite higher irrigation, there exists significant yield gaps in wheat during the recent years (periods 2009-11 and 2012-13). The yield gap I has shown a decreasing tendency in majority of the states included in the study except for Madhya Pradesh and Rajasthan. In contrast, in comparison to the base period (2009-11) all the states have shown significant increase in yield gap II except Madhya Pradesh and Rajasthan. In case of *rabi* maize in Uttar Pradesh, yield gap II still accounts for 60.22 per cent in current period (2011-13) which shows slight increase over the base period by 2 per cent. The yield gap I has also considerably reduced in Uttar Pradesh (-5.14%) and Bihar (-14.16%), which is a good indication for productivity enhancement of this crop. Similarly, yield gap II in *kharif* maize has significantly reduced in the case of majority of the states included in the study such as Madhya Pradesh (-14.33) with moderate decline in Bihar (-4.64) and Uttar Pradesh (-1.10). In contrast to this Rajasthan having second highest area under maize shows considerable increase in yield gap II (2012-14) over 2009-11. The results shows the need to disseminate new technology widely to wheat and maize systems at the farmer level in major states and ensure effective extension management and dissemination strategy to reduce the existing yield gaps.

Keywords: Yield gap I, Yield gap II, Wheat, Investigation

INTRODUCTION

Despite the focus on industrialization, agriculture remains a dominant sector of the Indian economy both in terms of contribution to gross domestic product (GDP) as well as a source of employment to millions across the country. Over 58 percent of the rural households depend on agriculture as their principal means of livelihood. As per the estimates released by Central Statistics Office, the total Share of Agriculture & Allied Sectors (Including agriculture, livestock, forestry and fishery sub sectors) in terms of percentage of GDP is 15.35 percent during 2015-16 at 2011-12 prices (IBEF, 2014). Also as per the 3rd advance estimates India's food grain production has increased marginally to 252.23 million tons (MT) in the 2015-16 crop year.

From a perpetual food deficit situation, India became self sufficient due to adoption of modern science and technology that created what is called as the first "Wheat Revolution" in India (Nagarajan, 2005). From a mere 12 million tons (MT) in the year 1965 India produced around 76 MT of Wheat in 2000 and swelled the buffer stock reaching to 94.04 MT in 2015-16, but still there exists fall in production of wheat due to stagnation and large gaps in yield across the major states, thus raising serious concern over India's ability to meet the projected demand of 109 MT of wheat by 2020.

Due to increased industrial use as well as commercialization, today maize has occupied a prominent role in the cropping pattern. The production of maize has picked up the momentum in the country since the last decade after rice and wheat with maize production reaching to 21 MT in 2015-16. To meet the projected demand in the year 2020, India must attain a per hectare yield of 2.7 tonnes for rice, 3.1 tonnes for wheat, 2.1 tonnes for maize. But there are concerns that yields may be stagnating or declining for three key

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crops- maize, rice and wheat, which together constitute 57 percent of the global cropped area. A review of data of the regional statistics, agronomists' experiments, long-term field trials, breeders' variety evaluation trials and simulation studies also showed stagnation of yields in rice, maize and wheat in northern India (Aggarwal *et al.*, 2000). As the possibilities of area expansion are minimal, future increase in the production of these cereals will have to be essentially achieved through increase in productivity alone. For this yield gap analysis acts as a powerful method to reveal and understand the lacuna and the opportunities to meet the projected increase in demand for agricultural products towards the end of the century, it also supports decision making on policies, research, development and investment that is needed.

MATERIALS AND METHODS

The present study estimated yield gap I and Yield gap II both for wheat and maize in major producing states. Realizable Potential yield i.e. (PY) also called as the breeder's yield was obtained from Front line demonstration data of All India Coordinated Research Projects related to wheat and maize. State level farmers average data was collected from Directorate of Economics and Statistics (DES).

$$\text{Yield gap I} = PY - IV$$

$$\text{Gap I (\%)} = \frac{PY - IV}{PY} \times 100$$

Similarly, Yield gap II is the difference between the average yield of improved variety at the FLD station and at farmers 'field, i.e.

$$\text{Yield gap II} = IV - FV$$

$$\text{Gap II (\%)} = \frac{IV\text{-}FV}{IV} \times 100$$

Where,

PY=Highest yield obtained in the Front Line Demonstration fields from the improved variety of each crop

IV=Average yield of improved variety in the Front Line Demonstration fields for each crop

FV= Average yield at farmers' field.

The study was conducted for two different periods namely the base period for which available data from 2009 to 2011 was considered and year 2012-13 was used as the current period for comparison with the base period for major wheat and maize growing states and the percentage change over the base period to current period was computed. In order to remove the year-to-year variations, analysis was carried out by averaging the data pertaining to the years 2009-10 and 2010-11. Besides computing yield gap I and yield gap II, states were also classified according to their yield potential and yield gaps. Accordingly states were classified into four different categories: (1) High potential, high gap, (2) High potential, low hap, (3) Low potential, high gap, (4) Low potential, low gap.

RESULTS AND DISCUSSION

Assessment of yield gap in wheat and maize

Wheat: Wheat is the most important crop of food security component in the country next to rice. In the present scenario of food grains it occupies the second position next to rice with 98 million tonnes production in 2014. But yield gap analysis made for wheat shows that, yield gap I has shown a decreasing tendency in majority of the wheat growing states included in the study except for Madhya Pradesh and Rajasthan (Table 1).

In contrast to this, in comparison to the base period (2009-11) all the states have shown significant increase in yield gap II except Madhya Pradesh and Rajasthan. Uttar Pradesh having the highest area under wheat still has exhibited 30% of yield gap II, followed by Gujarat (28%) and Punjab (10%). Though Madhya Pradesh has shown decrease in yield gap II in current period (2012-13) over the base period (2009-11) by 10.18%, but still the yield gap in current period is higher than that of Uttar Pradesh. Rajasthan showed decline in yield gap II (26.34%) in current period over the base period by -7.09%. It shows the need to disseminate technology and new improvements to be made in wheat systems at the farmer level in major states so as to bridge the large gaps existing in wheat through extension services and local guides.

In view of the classification according to potential yield and yield gaps (Table 2), all the major states such as Uttar Pradesh, Madhya Pradesh, Rajasthan and

Table 1: State-wise estimated yield gap I and yield gap II in wheat

States	Period-I (2009-11)		Period-II (2012-13)		% Increase	
	Yield gap I (%)	Yield gap II (%)	Yield gap I (%)	Yield gap II (%)	Yield gap I (%)	Yield gap II (%)
Uttar Pradesh	27.87	29.73	17.83	30.46	-10.04	0.72
Gujarat	20.58	26.63	5.01	27.89	-15.57	1.26
Madhya Pradesh	25.69	44.96	25.84	34.78	0.15	-10.18
Punjab	10.49	7.4	7.64	10.26	-2.85	2.87
Rajasthan	10.41	33.43	15.72	26.34	5.31	-7.09
Haryana	11.56	9.89	5.34	12.82	-6.22	2.93

Table 2: Classification of states according to potential yield and yield gap in wheat

Gap	State	High potential		State	Low potential	
		Potential yield (q/ha)	Yield gap (%)		Potential yield (q/ha)	Yield gap (%)
High gap	Uttar Pradesh	52.93	30.46	-	-	-
	Madhya Pradesh	50.75	34.78	-	-	-
	Rajasthan	49.28	26.34	-	-	-
	Gujarat	44.55	27.89	-	-	-
Low gap	Punjab	58.76	10.26	-	-	-
	Haryana	55.58	12.82	-	-	-

Gujarat fall under the category of high potential yield and high gap except Punjab and Haryana having high potential as well as low gap and no state fall in any other category, these results are in conformity with the findings of Aggarwal *et al.* (2004), with these states having high potential yield of 35-50 q/ha. The wide gaps shows the urgent need to disseminate effectively the improved technologies in wheat to these areas through extension services so as to bridge the gaps down in states having quite high potentials.

Maize: The production of maize has picked up the momentum in the country since the last decade after rice and wheat. Since maize is a drought tolerant crop adoption of this crop to dry regions and non-traditional areas has taken place in the recent times, with Rajasthan having the second largest area (1.09 million ha.) under maize after Karnataka (1.2 million ha.). Maize is grown in two seasons *rabi* as well as *kharif*, and most of the area falls under *kharif* maize but the yield obtained during *rabi* season outweighs the yield of *kharif* maize. In case of *rabi* maize results indicates that (Table 3), in Uttar Pradesh, yield gap II still accounts for 60.22 per cent in current period (2012-13) which shows slight increase over the base period by 2 per cent. Andhra Pradesh has shown a decline in yield gap II in the current period (8.72%) over the base period (16.97%) by 8.24%. The yield gap I has also considerably reduced in Uttar Pradesh (-5.14%) and Bihar (-14.16%), which is a good indication for productivity enhancement of this crop.

Table 3: State-wise estimated yield gap I and yield gap II in *rabi* maize

States	Period-I (2009-11)		Period-II (2012-13)		% Increase	
	Yield gap I (%)	Yield gap II (%)	Yield gap I (%)	Yield gap II (%)	Yield gap I (%)	Yield gap II (%)
Uttar Pradesh	26.1	58.33	20.96	60.22	-5.14	1.89
Andhra Pradesh	5.81	16.97	9.35	8.72	3.54	-8.24
Bihar	16.57	25.44	2.41	30.59	-14.16	5.15
Rajasthan	-	15.02	-	-	-	-
Karnataka	7.87	46.91	-	-	-	-

Table 4: Classification of states according to potential yield and yield gap in *rabi* maize

Gap	State	High potential		State	Low potential	
		Potential yield (q/ha)	Yield gap (%)		Potential yield (q/ha)	Yield gap (%)
High gap	Uttar Pradesh	67.30	60.22	-	-	-
	Karnataka	67.5	46.91	-	-	-
	Bihar	61.44	30.59			
Low gap	Rajasthan	69.71	15.02	-	-	-
	Andhra Pradesh	77.91	8.72	-	-	-

In case of *kharif* maize, as we can see in the table below (Table 5) yield gap II has significantly reduced in majority of the states included in the study such as Madhya Pradesh (-14.33) with moderate decline in Bihar (-4.64) and Uttar Pradesh (-1.10). However Rajasthan and Karnataka having highest area under maize showed an increasing tendency in yield gap during the study period. Rajasthan with second highest area under maize shows considerable increase in yield gap II (2012-14) over 2009-11. Similar to *rabi*, yield gap I has considerably reduced in Uttar Pradesh (-11.64%) and Bihar (-2.32%) even in case of kharif maize indicating good productivity.

Even in maize both for *rabi* as well as *kharif*, all the major states such as Karnataka, Uttar Pradesh, Andhra Pradesh and Bihar fall under the category of high potential and high gap except Andhra Pradesh in *kharif* and Rajasthan in *rabi*, having high potential as well as low gap (Table 4&6). It shows the potential of improved maize hybrids and calls attention of policy and extension needs to reach the farmers to reap the benefits of improved maize hybrids. Providing farmers with location specific improved technology and information will help them to fill the wide gaps in yield due to location specific constraints in many areas (Sendhil *et al*., 2014).

CONCLUSION

The analysis of yield gap I and yield gap II based on FLD data shows that though yield gap I has increased

Table 5: State-wise estimated yield gap I and yield gap II in *kharif* maize

States	Period-I (2009-11)		Period-II (2012-13)		% Increase	
	Yield gap I (%)	Yield gap II (%)	Yield gap I (%)	Yield gap II (%)	Yield gap I (%)	Yield gap II (%)
Uttar Pradesh	33.06	66.70	21.41	65.60	-11.64	-1.10
Andhra Pradesh	-	21.64	27.78	15.27	27.78	-6.37
Bihar	16.29	42.10	13.97	37.46	-2.32	-4.64
Madhya Pradesh	10.95	70.93	13.02	56.59	2.07	-14.33
Rajasthan	14.37	43.84	30.48	58.25	16.11	14.40
Karnataka	3.48	50.78	10.98	52.58	7.50	1.80

Table 6: Classification of states according to potential yield and yield gap in *kharif* maize

Gap	State	High potential		State	Low potential	
		Potential yield (q/ha)	Yield gap (%)		Potential yield (q/ha)	Yield gap (%)
High gap	Uttar Pradesh	61.03	65.60	-	-	-
	Karnataka	63.40	52.58	-	-	-
	Bihar	50.62	37.46			
	Madhya Pradesh	47.29	56.59	-	-	-
	Rajasthan	59.14	58.25	-	-	-
Low gap	Andhra Pradesh	50.54	15.27	-	-	-

in some states yield gap II has decreased considerably in most states in case of maize and wheat. In case of maize Rajasthan and Karnataka having largest area showed an increasing tendency in yield gap during the study period. An effort to bridge the yield gaps not only increases the yield and production, but also improves the efficiency of labour and land and also reduces production costs and increases sustainability. The Implication of states classified under potential yield and yield gaps shows that for the states under the category high potential low gap have to sustain the present level of technology dissemination with efforts for adoption of improved technologies by the farmers of the grey areas. While low potential and high gap states require concerted extension efforts to enhance adoption level of crop-specific technologies among of the farmers. Similarly location specific varieties and technology along with strong extension efforts must be adopted for bridging these gaps.

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Effectiveness of Climate Resilient Technologies in Building Resilience of Farmers: Development of Resilience Index and Measurement of Resilience

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ABSTRACT

Climate change and its impacts are pushing the agriculture sector to a new normal. The sustenance of a system thus requires updating of technologies and practices consistently. Resilience at individual level and society level has an important say in satisfying these requirements. The technologies offering resilience to the changing contexts of agriculture became an imperative to keep the sector and its dependents secured. The need is to measure resilience of farmers after implementation of the technologies. A composite index measuring resilience is developed after rigorous procedures to meet this objective, with four major domains - self confidence, problem solving skills, preparedness for contingency and optimism-and 18 items under these domains. The comparison of two groups of farmers (NICRA beneficiaries and non- Beneficiaries) from rainfed agro-ecosystem based on the index score revealed that NICRA beneficiaries have high score (.52) on index which is 2.7 times higher than non-NICRA beneficiaries score (.14). A significant difference on most of the items between the two groups was obtained with high mean rank for NICRA farmers. The data was tested using independent t-test with unequal sample size and Kruskal-Wallis one way ANOVA. The index can be used to measure resilience in similar agro-ecological area. The high resilience of NICRA farmers indicates the effectiveness of climate resilient technologies in building resilience.

Keywords: Climate resilience, Climate resilient technology, Resilience index

INTRODUCTION

Climatic variability and unpredictability are expected to exacerbate the problem of food security by exerting pressure on agriculture (Pathak *et al.,* 2012). Response of cropping system to far fluctuating climatic parameters can well define its degree of success under a given condition. The conventional farming practices to a great extent were a failure in this aspect. That made the farmers the regular victims of catastrophic impacts of climate aberrations. The paucity of technology options due in particular to varying agro-climatic situations and meager resources base of farmer were the major bottlenecks in small holder adaptation. There exist a grave mismatch between the knowledge required for local action and global efforts to generate knowledge about climate change, its impacts, and responses (Wilbanks and Kates, 1999). The need for concerted efforts for mitigation and adaptation to weaken the vulnerability of agriculture to the adverse impacts of climate change and making it more resilient are obvious (Pathak *et al.*, 2012). Howden *et al.* (2007) stated that climate change will be expressed via changes in variability at several temporal ranges, enhancing the capacity to manage climate risk is a core adaptation strategy which can be developed through climate knowledge of decision makers. The coping mechanisms and adaptive strategies of the farming community must be well developed so as to equip them with need based solutions. According to Berkes and Jolly (2001) adaptive

strategies are the ways in which individuals, households, and communities change their productive activities and modify local rules and institutions to secure livelihoods while coping mechanisms are the bundle of short-term responses to situations that threaten livelihood systems, and they often take the form of emergency responses in abnormal seasons or years. Coping mechanisms are relevant at individual and the household level and at smaller spatial scales, on the other hand slow changing variables like culture are related to adaptive strategies hence it is pertinant at large spatial scales (Berkes and Jolly, 2001). The IPCC defined resilience as 'the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change' (IPCC, 2007). Resilience building as a strategic approach has many advantages over conventional system management for complex social-ecological systems that are dynamic and facing high uncertainty (Walker *et al.,* 2002). Thus building resilience of system through planned adaptation strategies paves path for a climate smart system meaningfully. Resilience must be build at individual level, community level and organizational level including local government and community organizations (Satterthwaite *et al*., 2009) inorder to tackle the climatic imbalances and it depends essentially on the socially differentiated capacities of various groups and individuals (Tyler and Moench, 2012). A stock of asset on which individuals depend for their wellbeing encompass the capacities (Moser, 2006) and any climate catastrophes typically erode their multiple assets to make them gravely impoverished (Moser and Satterthwaite, 2010; Pelling, 2003). Thus an agricultural system can be made climate resilient with incorporation of a basket of adaptive technologies which can with stand a considerable variation of climate from the normal lines. NICRA had identified location specific technological options after consultations discussions and revisions, which were implemented in 100 most vulnerable districts across the country (Venkateswarlu *et al*., 2012). Sarkar (2014) found that the adaptive capacities of the farmers were enhanced through different technological intervention and through capacity building program of NICRA. This study has undertaken with the objective to unveil the impact of these technologies in building resilience of the farmers in various domains.

MATERIALS AND METHODS

Composite index development for resilience: Resilience is the ability of a system to absorb shocks and recover as quickly as possible to normal conditions when external environment improves. Four dimensions of resilience have been identified after rigorous literature review, and discussion with expert from extension, environmental sciences and statistics. The dimensions were self confidence, problem solving skills, preparedness for contingency and optimism which represent technological and psychological variables. These dimensions were then given to 30 experts to give their weightage based on their salience in measuring resilience. A total 27 items under all dimensions were identified with same procedure of literature review, expert opinion, and from researcher's insight. Then 18 items were finally chosen after the expert scoring of relevancy of items on five point Likert scale (1= highly irrelevant, 2= irrelevant 3= undecided, 4= relevant and 5= highly relevant). Based on four identified dimensions and corresponding items, resilience index was calculated by the following formula:

$$\text{Resilience index} = \frac{R_1xW_1 + R_2xW_2 + R_3xW_3 + R_4xW_4}{W_1 + W_2 + W_3 + W_4}$$

R_1: Mean score obtained on self confidence

R_2: Mean score obtained on problem solving skills

R_3: Mean score obtained on preparedness for contingency

R_4: Mean score obtained on optimism

W_1: Weightage given by judges forself confidence

W_2: Weightage given by judges forproblem solving skills

W_3: Weightage given by judges forpreparedness for contingency

W_4: Weightage given by judges foroptimism

Data collection and analysis: Following an interview method, the index was administered on two independent samples of farmers, i.e. 80 farmers from NICRA project villages- Gunia and Durgada Naganahalli of Gumla and Tumkur districts of Jharkhand and Karnataka respectively, and 40 farmers from two control villages- Arangi and Chigaranahalli of Gumla and Tumkur respectively, where NICRA interventions were not implemented. Thus study followed an *expost facto* research design. The NICRA

villages were selected purposively since NICRA has been implemented in these locations since its inception. The non-NICRA villages were selected by simple random sampling. The respondents were selected following simple random sampling without replacement technique.

The respondent were asked to give their score on each item based on their agreement on 5 point continuum (1= strongly disagree and 5= strongly agree). The responses of two groups on individual items were then compared using Kruskal-Wallis one way ANOVA. The composite index on resilience of two groups was analyzed using independent t-test with unequal samples.

RESULTS AND DISCUSSIONS

Comparison of two farmer groups on resilience: The responses obtained on eighteen statements framed under resilience indicators were rated by respondents and based on their ratings, Resilience index was calculated. Resilience index of the two groups of farmers was then tested using Kruskal-Wallis one way ANOVA to find the statistical significance of difference between the groups. The test statistics and its level of significance were given in Table 1 NICRA farmers gained a higher score on majority of the statements. The test statistics revealed that the higher mean rank scored by NICRA farmers over non-NICRA farmers on first twelve statements was of statistical significance at $p < 0.05$ and the rest six statement failed to meet the criteria of statistical significance. These six statements were related to self-confidence. The role of social variables in influencing resilience was reported by Carbonell *et al.* (2001). The study says examination of the phenomenon of resilience among the at-risk adolescents with no diagnosis revealed that family cohesion and social support are associated with resilience

Table 1: Comparison of farmer groups on resilience as per Kruskal-Wallis test

Statements	NICRA farmer Mean rank	Non-NICRA farmers Mean rank
Optimism		
Are you hopeful about future events	69.09[a]	43.35[b]
Do you think, things can be better off, even at the very last moment	73.96[a]	33.54[b]
Do you believe in god and destiny	73.14[a]	35.23[b]
Do you agree with the statement 'failure is the first step to success	75.80[a]	30.30[b]
Are you very much annoyed by your failure	77.18[a]	27.15[b]
Do you believe in luck factor	70.58[a]	40.38[b]
Preparedness for contingency		
I usually formulate alternate plan for all my major plans in order to meet contingency	73.15[a]	35.20[b]
I am mentally prepared to face any emergency	71.17[a]	39.16[b]
I try to make my plans more flexible	73.84[a]	33.81[b]
Problem solving skills		
I seek all the methods to solve a problem	77.30[a]	26.90[b]
I agree with the statement 'god won't give problem without solution'	77.40[a]	26.70[b]
I am confident enough to overcome a problem	73.65[a]	34.20[b]
Self confidence		
I feel that there is no any difficulty in achieving my goal/target	63.01[a]	62.70[b]
Generally I am confident about my abilities	59.41[a]	62.68[b]
I am suspicious about my inferiority	62.41[a]	56.68[a]
I do the activity on own accord rather than taking guidance from others	63.00[a]	55.50[a]
I easily get depressed	61.50[a]	58.50[a]
I feel tension in life for number of occasions	59.28[a]	62.95[a]

Groups with same alphabet superscripted on each item indicate the groups are not significantly different on the particular item

Categorization of farmers based on resilience indicators

a. Optimism: Categorization of farmers based on optimism resulted in 11.25 per cent of NICRA farmers in low optimism category, 45 percent of them in medium category, and 43.75 in high category (Table 2). The members of non-NICRA comprise 42.5 percent in low category, 50 percent in medium and 7.5 percent in high optimism category.

Table 2: Categorization of farmers based on optimism

Category	NICRA farmers (n=80)		Non-NICRA farmers (n=40)	
	F	%	*f*	%
Low (<2.59)	09	11.25	17	42.5
Medium (2.59-3.29)	36	45	20	50
High (>3.29)	35	43.75	03	7.5

b. Self confidence: The Table 3 showed that only 8.75 per cent NICRA farmers was in low self-confidence group, while 48.75 per cent and 42.5 per cent were in medium and high categories, respectively. Near to quartile (22.5) of non-NICRA farmers were in low category. Majority (67.5%) of them constitute medium category and only 10 per cent in high self-confidence category.

Table 3: Categorization of farmers based on self confidence

Category	NICRA farmers (n=80)		Non-NICRA farmers (n=40)	
	F	%	*f*	%
Low (<3.18)	07	8.75	09	22.5
Medium (3.18–3.86)	39	48.75	27	67.5
High (>3.86)	34	42.5	04	10.0

c. Preparedness to contingency: The Table 4 conveyed that 13.75 per cent of beneficiaries are in low category of preparedness, 52.5 per cent in medium and 33.75 in high category of preparedness. Similarly, 17.5 per cent of non-beneficiaries are in low category, whereas 60 per cent and 22.50 per cent in medium and high category.

Table 4: Categorization of farmers based on preparedness

Category	NICRA farmers (n=80)		Non-NICRA farmers (n=40)	
	F	%	*f*	%
Low (<2.56)	11	13.75	07	17.50
Medium (2.56–4.14)	42	52.50	24	60.00
High (>4.14)	27	33.75	09	22.50

d. Problem solving skills: Categorization of farmers based on their problem solving skills provided a low group with 18.75 per cent of NICRA and 40 per cent of non-NICRA farmers (Table 5), medium group with 51.25 per cent of NICRA and 52.50 per cent of non-NICRA members, and a high group with 30 per cent of NICRA and 7.5 per cent of non- NICRA farmers.

Table 5: Categorization of farmers based on problem solving skills

Category	NICRA farmers (n=80)		Non-NICRA farmers (n=40)	
	F	%	*f*	%
Low (<2.88)	15	18.75	16	40.00
Medium (2.88–4.38)	41	51.25	21	52.50
High (>4.38)	24	30.00	03	7.50

Resilience index score: Based on the mean score obtained in each category as per respondents rating and weightage given to each category by experts (optimism-1, problem solving skills-4, preparedness- 3, self-confidence-2), resilience index score for NICRA and non-NICRA farmers were computed (Table 6) using formula given in previous section. NICRA beneficiary farmers had a higher resilience index score (0.52), than non-NICRA farmers (0.14). T-test was applied to prove null hypothesis that both groups have same resilience and it was found that there was significant difference in resilience among the NICRA beneficiary farmers and non-NICRA farmers at less than five per cent level of significance by rejecting the null hypothesis (Table 7). The high score of NICRA farmers on resilience index may be due to an increase in their psyco-social adaptation derived from experience of benefits and risk while adopting climate resilient technologies. The findings of Narayan (2008) show that high resilience group is having lesser impulsivity and greater cognitive structure than the low resilience group.

Table 6: Resilience index score

Category	Index score
NICRA	0.52
NON-NICRA	0.14

Table 7: t-test for resilience index and its significance

Statistics	Value
t-test	8.01
df	118
Asymp. Sig. (2-tailed)	0.031

CONCLUSION

Resilience of a system to adverse external and internal factors is critical for the survival and success of the system in a sustainable manner. Resilience can be build both at individual and social level. The lack of adequate methodologies to measure the resilience was a major obstacle in this aspect. The study developed a composite index to measure resilience of farmers towards climate change. After development process, the same tool has been used to measure resilience of farmers by comparison method. The groups compared were NICRA farmers and non-NICRA farmers selected from NCRA and non-NICRA village. The results indicated that there exists a significant difference between the two groups on resilience index score after testing them with t-statistics. The comparison of group on individual statement also came out significant differences of the two farmer group on most of the statements. This reveals that NICRA technologies have succeeded in imparting resilience both in general terms and specific to climate change. There present a immense scope in out scaling and outstretching these technologies for tapping its benefits on wide geography.

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Constraints Faced by Farmers in Adoption of Indigenous Technical Knowledge Associated with Indigenous Cattle Dairy Farming in Rajasthan

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ABSTRACT

An indigenous cattle farming is predominant in Rajasthan state. There is need to analyze the constraints faced by farmers in adoption of Indigenous Technical Knowledge (ITK) practices associated with indigenous cattle dairy farming so to improve the health condition and enhance the milk production in the region. A total of 180 respondents from three districts i.e. Bikaner, Jodhpur and Sri-Ganganagar district of Rajasthan were selected randomly and interviewed to get the desired information. The major constraints associated with the adoption of indigenous technical knowledge for management of indigenous cattle as perceived by the respondents was that, lack of proper ITK documentation was ranked first (79.4%) followed by young farmers are not interested in adoption of ITKs (75.5%) ranked as second and thirdly, lack of complete knowledge on use of ITKs practices (72.2%). In order to promote the use of ITKs there is a dire need for proper documentation and creating interest among youth for adoption and conservation of indigenous technical knowledge and conceive suitable policy framework at government level for its conservation, promotion and use.

Keywords: Constraints, Indigenous technical knowledge, Indigenous cattle farming

INTRODUCTION

Indigenous Technical Knowledge (ITK) also referred to as local or traditional knowledge is the cumulative body of knowledge generated and evolved over a long period of time and generations of experience (Grenier, 1998). Indigenous knowledge is the local knowledge that is unique to a culture or society. It is otherwise is also known as; 'local knowledge', 'folk knowledge', 'people's knowledge', 'traditional wisdom' or 'traditional science'. This knowledge is passed from generation to generation, usually by word of mouth and cultural rituals, and has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world. It includes the skills, beliefs, norms, practices and behaviour patterns handed down from one generation to the next. A variety of traditional practices were observed being followed for treatment of various ailments and diseases of the dairy animals with the use of locally available material, herbs etc. (Sah and Dubey, 2010). Today, there is a grave risk that much indigenous knowledge is being lost and, along with it, valuable knowledge about ways of living sustainable is at great risk. The judicious use of the indigenous knowledge base can stabilize the farmer's livelihood by removing cost of the dairy farming enterprise. Based on the assumption that the indigenous cattle dairy farmers in Thar Desert of Rajasthan were facing the many constraints in adoption of the indigenous technical knowledge, the paper has focussed to get an insight into the constraints and the gravity of these factors affecting the dairy farmers of this region.

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MATERIALS AND METHODS

The farmer-respondents from Bikaner, Sri-Ganganagar and Jodhpur districts of Rajasthan State were selected purposively for the present study as it is native tract three important indigenous cattle breeds of Rajasthan. From each district two blocks were selected and two villages from each block and thirty indigenous cattle holder-farmers were selected from each village randomly. Thus a total of 180 respondents were contacted to elicit the major constraints faced by the farmers in adoption of indigenous technical knowledge practices. The selected respondents were interviewed personally with the help of a semi-structured interview schedule in order to get relevant information. The collected data were tabulated and analysed using Garret ranking technique to interpret the result.

Garrett's ranking technique: To find out the most significant factor which influences the respondent, Henry Garrett's (1969) ranking technique was used. As per this method, respondents have been asked to assign the rank for all factors and the outcome of such ranking has been converted into score value with the help of the following formula:

$$\text{Percent position} = \frac{100\ (Rij - 0.5)}{Nj}$$

Where;

Rij = Rank given for the i^{th} variable by j^{th} respondents

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

With the help of Garrett's table, the percent position estimated is converted into scores. 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.

RESULTS AND DISCUSSION

Constraints faced by the respondents in adoption of ITKs: In the present study a total of ten major constraints (Table 1) were identified based on available literature, expert suggestions and respondents opinion in adoption of indigenous technical knowledge practices associated with indigenous cattle farming. This includes;

- ***There is no written document about ITK practices available*:** By the course of time, ITKs nature vitiates through improper application of those techniques and thus, it loses its validity. This constraint was ranked as first and 79.4 per cent of the respondents perceived it as a major constraint. Seeralan *et al.* (2004) also reported that there is no written documents on ITKs are available.

- ***Young farmers are not interested in adoption of ITKs:*** Younger generations mostly rely on modern techniques and their preferences are towards immediate results. Majority of the respondents (75.5 %) perceived it as a major constraint and ranked as second in order. Similar findings were also reported by Yadav *et al.* (2014) and Ponnusamy *et al.* (2009) that many ITKs become extinct due to not practiced by the younger generation.

- ***Lack of complete knowledge on use of ITKs:*** Most of the respondents did not have complete knowledge regarding use of ITKs. Only few of them had a complete knowledge on its use. About 72.2 per cent of the respondents perceived it as a third major constraint. Rahman *et al.* (2012) and Seeralan *et al.* (2004) also reported that lack of complete knowledge on practices related to management of indigenous cattle.

- ***Seasonal availability of many medicinal plants:*** It was perceived as an important constraint by majority (71.6%) of the respondents. As most of the medicinal plants availability is seasonal in nature, they are not available round the year. Balakrishnan *et al.* (2009) found that seasonal availability of many medicinal plants was also perceived as an important constraint by the majority of the respondents.

- ***ITK takes long time to cure the ailments:*** While, the present need is to use the practices which have immediate effect. ITKs lack in time and because its effect is mostly delayed. Hence, ITKs may not help during emergency conditions as most of the herbs or plants used for treating the diseases may not be available readily. This was perceived as a constraint by majority of the respondents (70.5%). Yadav *et al.* (2014) and Seeralan *et al.* (2004) also revealed that ITKs take long time to cure the animal's diseases.

- ***Vagueness in treatment:*** There was no standard schedule of ITK application like quantity of ingredients, time of administration, post treatment care to betaken

Table 1: Constraints in adoption of ITKs

S.No.	Constraints	Frequency*	Percentage	Ranking
1	ITK has no written document	143	79.4	1
2	Young farmers are not interested in adoption of ITKs	136	75.5	2
3	Lack of complete knowledge on use of ITKs	130	72.2	3
4	Seasonal availability of many medicinal plants	129	71.6	4
5	ITK takes long time to cure the ailments	127	70.5	5
6	Vagueness in treatment	118	65.5	6
7	Non-availability of traditional local healers	115	63.8	7
8	Non-availability of medicinal plants/ingredients used for ITKs in local market/shops	110	61.1	8
9	Lack of extension support for adoption of ITKs	102	56.6	9
10	ITK is not a complete solution in all the situations	80	44.4	10

*Multiple responses were collected

etc., Hence there is no standardization for the proportion and quantity of plants and their products to be given for cattle. Around 65.5 per cent of the respondents perceived it as a important constraint. Seeralan *et al.* (2004) also reported that there is no standardization for the proportion and quantity of plants and their products to be given for cattle.

• ***Non-availability of traditional local healers:*** At village level, timely access to local healers for treatment of animals was perceived as a constraint by 63.8 per cent of the respondents by in using ITKs. Hassan *et al.* (2014) and Balakrishnan *et al.* (2009) also found that many herbs and local healers are in extinct.

• ***Non availability of medicinal plants/ingredients used for ITKs in local market/shops:*** Medicinal plants/ingredients are not easily available in local market and many time people not able to identifying right plants or ingredients for treatment of cattle. Hence, majority (61.1%) of the respondents perceived it as constraints as access to raw plant material/parts were the major challenge. Devi *et al.* (2014) also revealed that lack of ability to identify the right medical plants/ ingredients was the major constraint perceived by majority of the respondents.

• ***Lack of extension support for adoption of ITKs***: Most of the extension agencies did not believe in ITKs due to inadequate know-how about the ITK practices and its use. Majority of (56.6%) of the respondents perceived it as a constraint. Devi *et al.* (2014) and Ponnusamy *et al.* (2009) also reported similar kind of findings that, lack of extension support for adoption of ITKs was the major constraint perceived by the respondents.

• ***ITK is not a complete solution in all the situations***: ITKs might need complimentary effect from other substitutes and hence it cannot alone be deemed fit in all the situations. Hence farmers resort to practicing of alternative methods of using traditional methods alone or traditional practices blended with modern practices as well. Around 44.4 per cent of the respondents perceived it as a constraint. Seeralan *et al.* (2004) also reported that ITK is not a complete panacea for maintaining animals.

CONCLUSION

The constraints analysis related to adoption of ITKs practices revealed that, though majority of farmers find usefulness of ITK practices in their indigenous cattle farming, there are certain constraints which hampers the adoption of ITK practices. Hence in order to utilize the fullest potential benefits of ITKs, the much needed attention should to be given for its identification, documentation, scientific validation and dissemination of those proven practices for the benefit of our farming community. Further, it requires integration with modern scientific knowledge to generate a wide range of new ideas and practices for the betterment of mankind (Mishra *et al.*, 2011). Further, there is an urgent need to identify, educate and train the extension agents and local healers, who has got the specialized knowledge in practicing ITKs and strategies to use them as a local extension agents to popularize further these indigenous technical knowledge practices throughout our country.

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Genetic Variability, Heritability and Genetic Advance in Karan Rai (*Brassica carinata* A. Braun)

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ABSTRACT

The present investigation was undertaken to evaluate the performance of eight genotypes of Karan rai (*Brassica carinata*) and to estimate the variability, heritability and genetic advance of agronomic traits of these genotypes. A high degree of significant variation was observed for all the characters studies. Maximum genotypic and phenotypic coefficients of variation (GCV and PCV) were found in seed yield/plant followed by days to 50% flowering, number of siliqua/plant and 1000 seedweight. High heritability estimates with genetic advance as percent of mean were observed for days to 50% flowering followed by seed yield/plant, number of siliqua/plant and plant height. The study showed that there are variation in the extent of genetic variability, heritability and genetic advance in traits under study which can facilitate selection for further improvement of important traits of karan rai.

Keywords: *Brassica carinata*, Heritability, Genetic advance, Variability, Agronomic traits

INTRODUCTION

The amphidiploid *Brassica carinata* (n=17) is originated from cross between *Brassica nigra* (n=8) and *Brassica oleracea* (n=9) (Morinaga, 1934). *Brassica carinata* called as Karan rai or Ethiopian mustard is presently grown in limited areas in India. It is the source of edible oil, vegetable and fodder crop of Ethiopia. It has both yellow and brown seeded types and oil content varies from 38 to 43%. Karan rai is an important source of condiment in sub-tropical region of the world. It is cultivated as an option to the traditional mustard especially for low rainfall areas of the world. In its area of adoption, it possesses acceptable yield levels as well as resistant to diverse biotic and abiotic stresses. It has special nutritional components like vitamins, minerals, traces elements, dietary fiber and protein. It also gives zest and flavor of diets. Additional advantages of Karan rai are also immense in the farming systems, as a potential rotational-crop for cereals and pulses.

The breeding strategy to derive high yielding cultivar depends upon the nature and magnitude of variation for different yield components, the assessment of genetic parameters like phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h^2) and genetic advance (GA%) is a pre-requisite for making effective selection. Yield is a complex trait, polygenic in inheritance, more prone to environmental fluctuations than ancillary traits such as branches/plant, seeds/siliqua, main shoot length and 1000-seed weight. Thus, comprehensive selection based on seed yield vis-à-vis component traits is more effective. Hence, the present investigation is carried out to assess the magnitude of genetic variability, heritability and genetic advance between days to 50% flowering, plant height, 1000-seed weight and contribution towards seed yield to generate high yielding recombinants for the development of high yielding cultivar(s) in seven genotypes of Indian mustard adapted to this region for the benefit of farmers.

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MATERIALS AND METHODS

The experimental material consisted of eight diverse genotypes of Karan raiviz. Kranti-(check), MLT 2-1, MLT 2-2, MLT 2-3, MLT 2-4, MLT 2-5, MLT 2-6and MLT 2-7 which were laid out in randomized block design (RBD) with three replications at the instructional farm of Krishi Vigyan Kendra, Post Graduate College, Ghazipur Uttar Pradesh during *rabi* 2012-13 and 2013-14. Each plot comprised of five rows of four meter length spaced 45 cm apart with plant to plant spacing of 15 cm. Data on the basis of five randomly taken competitive plants were recorded on nine quantitative characters viz. days to 50% flowering, days to maturity, plant height (cm), primary branches/plant, secondary branches/plant, number of siliquae/plant, number of seeds/siliqua, seed yield/plant (g) and 1000-seed weight (g). Analysis of variance was done based on RBD for each of the characters separately. The genotypic and phenotypic coefficient of variation (GCV & PCV) and heritability in broad sense was estimated. Analysis of variance (ANOVA) in Table 1 revealed that highly significant differences among the genotypes for all the characters under study in seven genotypes. Recommended cultural practices like weeding, hoeing was performed during the growing season when required.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among treatments for all the characters of genotypes are presented in (Table 1). The genotypic and phenotypic coefficient of variability, heritability and genetic advance in per cent of mean are presented in (Table 2). A considerable amount of variation was observed in most of characters. The range of mean values was observed for days to 50% flowering (47.53-109.53), days to maturity (115.16-142.11), plant height (158.30-240.10 cm), primary branches (4.46-7.00), secondary branches (6.96-8.93), number of siliqua/plant (325.13-707.25), number of seeds/siliqua (12.71-17.65), seed yield/plant in gm (4.38-14.40) and thousand seed weight in gm (2.00-4.08). The characters showing wide range of variation provide and ample score for selecting the desirable genotypes. Genetic variability for many of these characters has also been reported earlier by Belete *et al.* (2012), Ahmad *et al.* (2013) and Kumar *et al.* (2013).

In the study, estimates of phenotypic coefficient of variation (PCV) were comparable with respective genotypic coefficient of variation (GCV) for all the characters, however, the estimates of PCV were in general higher than the corresponding estimates of GCV for all the characters. This may results due to the involvement of environment and genotypic environment effects in the expression of characters. The respective PCV and GCV were found maximum for seed yield/plant (38.62 and 38.51g) followed by days to 50% flowering (36.14 and 36.14) and number of siliqua/plant (23.40 and 22.86) whereas, minimum being for days to maturity (7.77 and 7.76) followed by secondary branches/plant (9.89 and 9.03). Other characters have low to moderate estimates of PCV and GCV. This result is in agreement with the findings of Delesa (2006) who reported high GCV and PCV for seed yield per plot and oil yield per plot in Ethiopian mustard. Tripathi *et al.* (2015) reported that high PCV and GCV in case of secondary branches/plant, biological yield/plant and seed yield/plant in both the normal condition (NS) and saline/alkaline condition (SS) while moderate PCV and GCV was observed in case of number of primary branches/plant, length of main raceme, seeds/ siliqua and harvest index in both the conditions (NS and SS). Days to 50% flowering, days to maturity in NS and in SS, days to 50% flowering, days to maturity and plant height showed lower PCV and GCV. These findings suggested that selection can be effective based on phenotypic along with equal probability of genotypic values. With the help of GCV alone, it is not possible to determine the extent of variation that is heritable. Hence, the knowledge of heritability helps the plant breeders in prediction. The genetic advance for quantitative characters aids in exercising necessary selection procedure.

The high heritability in broad sense was recorded for all the character except primary branches/plant (77.24%) and number of seeds/siliqua (96.13%). Similar findings were reported by Ali *et al.* (2013). Lodhi *et al.* (2014) also reported high heritability in conjunction with high genetic advance were observed for seed yield/ plant, number of secondary branches/ plant, 1000- seed weight, number of seeds/ siliqua, primary branch angle, number of primary branches/plant, siliqua angle, siliqua on main shoot and siliqua length suggesting predominant role of additive gene action for expression

Table 1: Analysis of variance (ANOVA) for nine characters of eight genotypes of *Brassica carinata*

Source of variation	df	Days to flowering	Days to maturity	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of siliqua per plant	No. of seeds per siliqua	1000 seed weight (g)	Seed yield/ plant
Replication	2	0.442	1.736	0.986	0.6133	3.924	8083.78	1.3054	0.0743	0.154
Treatment	7	2001.697**	317.201**	3134.45**	1.677*	1.684**	39414.77**	10.8113**	1.2369**	42.761**
Error	14	0.120	0.248**	0.146	0.1499	0.106	503.005	0.1428	0.0315	0.0234

*=Significant at 5% level; **=Significant at 1% level

Table 2: Estimates of mean, range, variance components and genetic parameters for different characters

SN	Character	Mean	Range		PCV	GCV	Heritability (%)	Genetic advance	Genetic advance as % of mean
			Minimum	Maximum					
1	Days to 50% flowering	71.48	47.53	109.53	36.14	36.14	99.98	53.20	74.43
2	Days to maturity	132.45	115.16	142.11	7.77	7.76	99.76	21.15	15.97
3	Plant height (cm)	196.76	158.30	240.10	16.43	16.43	99.98	66.57	33.84
4	Primary branches/plant (no.)	5.85	4.46	7.00	13.89	12.21	77.24	1.29	22.10
5	Secondary branches/plant (no.)	8.03	6.96	8.93	9.89	9.03	83.26	1.36	16.98
6	Number of siliqua/plant (no.)	498.09	325.13	707.25	23.40	22.86	99.26	230.17	46.21
7	Number of seeds/siliqua	14.62	12.71	17.65	13.15	12.89	96.13	3.81	26.05
8	Seed yield/plant (g)	9.78	4.38	14.40	38.62	38.51	99.83	7.77	79.44
9	1000-seed weight (g)	3.16	2.00	4.08	20.84	20.06	92.71	1.26	39.81

of these traits. The high heritability denotes high proportion of genetic effects in the determination of these traits and can be adopted for improving grain yield in mustard.

Genetic advance as per cent of mean was maximum for seed yield/plant (79.44) followed by days to maturity (74.43), number of siliqua/plant (46.21) and plant height (33.84), whereas, it was minimum for days to maturity (15.97%) and secondary branches/plant (16.98%). Synrem *et al.* (2014) reported that high estimates of heritability coupled with high genetic advance as per cent of mean was observed for number of secondary branches per plant followed by seed yield per plant and number of primary branches per plant. In the present investigation, high heritability estimates coupled with high genetic advance observed for 1000-seed weight, seed yield/plant, number of siliqua/plant and plant height is due to large gene effects, which revealed that the selection criteria based on these traits would improve the seed yield. These observations are in conformity with finding of Belete *et al.* (2013) and Tripathi *et al.* (2015)

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Impact of Resource Conservation Technologies in Haryana

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ABSTRACT

The study was conducted in Panipat district of Haryana during 2013-14 crop season including purposively selected 120farmers adopting resource conservation technologies (RCTs). The adoption pattern of resource conservation technologies revealed that 84.17% of the farmers had adopted zero tillage, 38.33% rotary tillage, 88.33% laser land leveler, 26.67% zero tillage + rotary tillage, 72.5% zero tillage + laser land leveler, 34.17% rotary tillage + laser land leveler and 22.5% zero tillage + rotary tillage + laser land leveler. A majority of the farmers reported saving of time, used the same quantity of seed rate and found same germination under both zero tillage and rotary tillage sowing. , Farmers adopted zero tillage observed reduction in overall weed population, cost saving, harvested similar yield,, no change in crop duration, increased soil fertility, increased organic carbon in the soil, increased moisture retention capacity of soil, less lodging and avoiding of terminal heat in case of zero tillage . Most of the farmers (91.30%) told that there is a decrease in cost of cultivation and 56.52% got more yield under rotary tillage. The average time for leveling of one acre of land was 1.86 hours but it ranged from 1 hour to 3.5 hours depending on the condition of the field. All the farmers observed that there was 2-3% increase in area under cultivation with the adoption of laser land leveler. All the farmers observed one-third time and 30-40% water saving in irrigation after laser leveling. Almost all the farmers (97.17%) recorded more yield and less lodging due to even distribution of water in laser leveled fields.

Keywords: Adoption, Conservation, Fertility, Organic carbon, Resource, Technology, Terminal heat

INTRODUCTION

Wheat is the second most important crop in terms of area and production in India. The total area under wheat is hovering around 30 million hectares and the production has been estimated at 92.29 million tonnes during 2015-16.Despite record production in the recent past, traditional agriculture has been blamed for its exploitation of natural resources (Bhan and Behera, 2014). Therefore, conservation agriculture practices become crucial for the future productivity gains on sustainability front and currently it is being practiced in about 125 million hectares including USA (26.5 million hectares), Brazil (25.5 million hectares) and Argentina (25.5 million hectares). However in India, the practice has been gaining its momentum and cover about 1.5 million hectares (Jat *et al*., 2012; www.fao.org/ag/ca/6c.html). In recent years, Resource Conservation Technologies (RCTs) have proved their utility under rice-wheat system in the Indo-Gangetic Plains. There has been a significant increase in area under zero tillage, rotavator and laser land leveler. The adoption of RCTs have ensured better yield and saving of critical inputs, like labour, time, money, water, and wear and tear of machinery (Singh *et al*., 2007). It also ensured environmental protection due to burning of straw by the farmers. Kumar *et al.* (2006) reported that the farmers can plant wheat crop using zero tillage machine and need not to burn crop residue. Further, zero tillage improves the soil health. In Haryana, the adoption of zero tillage technology had shown an increasing trend in initial years but its adoption was more in rice-wheat crop rotation compared to pearl millet-wheat, cluster bean-wheat and cotton-wheat (Coventry *et al*., 2015).

Since beginning, extension agencies have made more efforts to popularize zero tillage machines in the rice-wheat crop rotation. The rotary tillage technology has got a good momentum and is being popularized under food security mission across the country. In recent years, realization about leveling of fields with laser land leveler has been given high priority for efficient water usage. In the realm of increased adoption and popularity of RCTs, the study aims at assessing its impact on farmers' field so that policy makers could be convinced for up scaling the technology.

MATERIALS AND METHODS

The study was conducted in Panipat district of Haryana during 2013-14. Five villages namely Baupur, Karad and Nain from Israna block and Urlana Khurd and Nara villages from Matloda block were selected purposively. A total of 120 farmers were selected purposively from these villages who have adopted either of the three resource conservation technologies *viz.* zero tillage, rotary tillage and laser land leveler or in combination.

RESULTS AND DISCUSSION

Socio personal profile: A majority of the farmers (62.5%) who have adopted RCTs were from middle age group (Singh *et al.*, 2008) followed by young (23.33%) and old (14.17%) farmers (Table 1). Involvement of young farmers was observed in the study area which clearly indicates that they are more inclined to adopt latest technologies in agriculture. Literacy is one of factors that influence largely the adoption of any technology. In the study area, it was found that around 93 per cent of the respondents were literate and is a clear indication for higher rate of adoption. Out of the total respondents 41.67% were matric, 21.67% were middle, 11.67% were intermediate, 10% were graduate and 2.5% were post graduate and above. Agriculture was the main occupation of all the farmers and dairying was subsidiary occupation for 74.17% of the farmers (Singh *et al.*, 2008) and some farmers cultivated vegetables (8.33%), business (4.17%) and floriculture (2.5%) to supplement their income.

Land holding: Categorization of the farmers was done on the basis of owned and total land holding. It was found that on owned land holding basis 20.83%, 40%, 25.83% and 7.5%, farmers were lying under small, medium, large and very large categories, respectively (Table 2). But on total land holding (owned + leased-in) basis under the respective categories 18.33%, 33.33%, 31.67% and 13.33% of the farmers were lying. It clearly indicates that taking land on lease basis is very common practice in Haryana for growing wheat. RCTs have been adopted by all categories of the farmers.

Table 1: Socio personal profile of the farmers

Categories	Frequency	Percentage
Age		
Young (<33 years)	28	23.33
Middle (33-55 years)	75	62.5
Old (>55 years)	17	14.17
Educational status		
Illiterate	9	7.5
Can read only	0	0
Can read and write	2	1.67
Primary	6	5
Middle	26	21.67
Matric	50	41.67
Intermediate	14	11.67
Graduate	12	10
Post graduate and above	3	2.5
Occupation		
Main Agriculture	120	100
Subsidiary Dairying	89	74.17
Business	5	4.17
Floriculture	3	2.5
Vegetable	10	8.33

Extension contact is the indicator for different sources of information sought by the farmers to acquire information related to agriculture. In the study area, a majority of the farmers (74.17%) were found to be under medium category (Table 3). Their mass media exposure was also good and 69.17% of the farmers were under medium category and 16.67% were under high category.

Table 2: Distribution of farmers based on land holding

Category of farmers	Owned Frequency	Total (owned + leased in) Frequency
Marginal (<2.5 ha)	7 (5.0)	4 (3.33)
Small (2.6-5.0 ha)	25 (20.83)	22 (18.33)
Medium (5.1-10 ha)	48 (40.0)	40 (33.33)
Large (10.1-25 ha)	31 (25.83)	38 (31.67)
Very large (>25 ha)	9 (7.5)	16 (13.33)

Figures in parenthesis (column 2 and 3) indicate percentage

Table 3: Distribution of farmers on the basis of communication

Category	Frequency	Percentage
Extension contact		
Low (<13.8)	15	12.50
Medium (13.8 to 19.4)	89	74.17
High (>19.4)	16	13.33
Mass media exposure		
Low (<12.84)	17	14.16
Medium (12.84-21.22)	83	69.17
High (>21.22)	20	16.67

For performing agricultural operations, farmers have to acquire different farm machines. It was found that a majority of the farmers (61.67%) were under medium category (Table 4). Only 2.5% of the farmers were categorized under high category in possession of farm machinery. A large chunk (35.83%) of the farmers were grouped under low material possession category which clearly indicated the prevalence of custom hiring services in the villages of Haryana, especially for resource conservation technologies where cost of machines is a concern for small and medium farmers. The use of demonstration across the state has been ongoing and the opportunity to purchase subsidized ZT machines has helped in popularizing this technology (Coventry *et al.*, 2015). Custom hire agents have also played a key role in adoption of RCTs as they are expert in using these machines which helps in better crop establishment and ultimately good productivity.

Table 4: Distribution of farmers on the basis of material possession in agriculture

Category	Frequency	Percentage
Low (<0.79)	43	35.83
Medium (0.79-6.13)	74	61.67
High (>6.13)	03	2.5

Tube well was the main and only source of irrigation in the area (Table 5). The quality of water was normal in all the villages under study. The soil type varied from heavy to light in all the villages and it was found that a majority of the farm (46.67%) had light soil followed by medium (39.67%) and heavy soils (14.16%) indicating that the RCTs have been adopted in all farms irrespective of type of soils.

Fertility status of the soil in the study area varied from high (73.33%) to medium (26.67%) and none of the farmer's field was reported to be low in soil fertility (Table 5).

Table 5: Source of irrigation, quality of water, soil type and fertility status

Sources	Frequency	Percentage
Tube well	120	100
Quality of irrigation water		
Normal	120	100
Type of soil		
Heavy	17	14.16
Medium	47	39.17
Light	56	46.67
Fertility status		
High	88	73.33
Medium	32	26.67

Adoption of RCTs among the farmers: The adoption pattern of resource conservation technologies was studied and it was found that 84.17% of the farmers had adopted zero tillage, 38.33% rotary tillage, 88.33% laser land leveler, 26.67% zero tillage + rotary tillage, 72.5% zero tillage + laser land leveler, 34.17% rotary tillage + laser land leveler and 22.5% zero tillage + rotary tillage + laser land leveler (Table 6).

Table 6: Distribution of farmers according to adoption of RCTs

Technology	Frequency	Percentage
Zero Tillage	101	84.17
Rotary Tillage	46	38.33
Laser Land Leveler	106	88.33
Zero Tillage+Rotary Tillage	32	26.67
Zero Tillage+Laser Land Leveler	87	72.50
Rotary Tillage+Laser Land Leveler	41	34.17
Zero Tillage+Rotary Tillage+ Laser Land Leveler	27	22.50

The surveyed farmers had adopted the RCTs but possession of rotavator (13.04%) was low and none of them had laser land leveler (Table 7). Majority of the farmers (64.36%) had zero tillage machines and the Government policy to provide subsidy on zero tillage machines played an important role (Coventry *et al.,* 2015). Subsidy was available for rotavator too but only for limited number of equipments and its higher price made it difficult for most of the farmers to purchase. Similar conditions were for laser land leveler but custom hire service provider made it easy for the farmers to

Table 7: Possession of RCT machines

Machine	Possessed		Availed subsidy		Hired	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Zero tillage	65	64.36	23	22.77	36	35.64
Rotary tillage	06	13.04	05	10.87	40	86.96
Laser land leveler	00	00	00	00	106	100

adopt these technologies. Custom hire service was very common, all the farmers hired laser land leveler, while 86.96% hired rotavator and 35.64% hired zero tillage. The average rate of custom hiring for zero tillage was Rs. 600/acre and it ranged from Rs. 400-700across villages, for rotary tillage it was Rs. 1100/ acre and the range was Rs. 800-1100. In the case of laser land leveler, the average rate was Rs. 600/hour and it ranged from Rs. 500-700/hr in the study area. A majority of the farmers (85.15%) told that the state department of agriculture is making efforts to popularize resource conservation technologies but some (14.85%) of the farmers were not satisfied with the lottery system of selecting the farmers for subsidy of rotavator.

The availability of ZT machine and financial grant of 50% subsidy from the state department of agriculture for ZT, rotavator and laser land leveler have been the driving force to popularize these technologies (Coventry *et al*., 2015). There are about 21000 ZT machines in the rice-wheat cropping system following districts of Haryana. The second generation zero tillage machine, turbo/happy seeder has also been made available to the farmers on subsidy under anchored stubble situation (Barry *et al*., 2011).

Average area per farmer under zero tillage was 6.22 acres while under conventional tillage it was 5.03 acres. In a study on impact of zero tillage under Institute Village Linkage Programme in Karnal the average area per farmer under ZT was 5.1 acres and under conventional tillage it was 7.03 acres (Kumar *et al*., 2006a). During this period, zero tillage technology was getting popular among the farmers of Haryana. But the present study shows more area under ZT per farmer as compared to conventional agriculture indicating a shift from conventional method of wheat sowing to the zero tillage. A majority (64.36%) of the farmers used zero tillage for timely sowing and 35.64% used for both i.e. timely and late sown conditions (Table 8).A majority of the farmers (94%) were convinced about the benefits of zero tillage and desired to continue. More than one-third of the farmers burnt crop residue which needs immediate attention. About 48% of the farmers used reaper before the operation of zero tillage machine (Table 8).

Table 8: Area under zero tillage

Technology	Average area (acres/farmer)
Zero tillage	6.22
Conventional tillage	5.03

Perusal of Table 8 indicated that the availability of zero tillage machines during sowing time was in abundance as reported by 68.32% of the respondents while 31.68% felt scarcity during sowing. Those who had to hire the machine found it difficult to get the machine when they needed it.

Impact of zero tillage technology on wheat cultivation: A majority of the farmers (95.06%) reported saving of time under zero tillage sowing (Kumar *et al*., 2006a, Singh *et al*., 2006) while a few

Table 9: Information on zero tillage

Response	Frequency	Percentage
Efforts made by state department of agriculture		
Yes	86	85.15
No	15	14.85
Availability of machine		
Abundance	69	68.32
Scarce	32	31.68
Continued adoption of zero tillage		
Yes	95	94.06
No	06	5.94
Sowing conditions for use of ZT		
Timely sown	65	64.36
Both late and timely sown	36	35.64
Burning of straw		
Yes	37	36.63
No	64	63.37
Use of reaper		
Yes	48	47.52
No	53	52.48

(4.94%) told that it takes same time as compared to conventional tillage in one operation (Table 10). Most of the farmers (84.16%) used the same quantity of seed rate as in conventional method but 10.89% of the farmers used 5 kg more and only 4.95% used less seed rate. About 32% of the farmers found more germination under zero tillage while 13.86% observed less and 54.44% did not find any difference. Almost all the farmers used recommended dose of fertilizer under zero tillage sown wheat and it was similar to conventional tillage. A majority of the farmers (61.39%) told that there was an increase in broad leaf weeds under zero tillage (Kumar *et al*., 2006a; Singh *et al*., 2005, 2009; Chhokar *et al*., 2005; Sharma *et al*., 2005; Chhokar *et al*., 2007, 2008) and reduction in narrow leaf weed population (Chhokar *et al.,* 2005, Franke *et al*., 2007, Singh *et al.,* 2005). Around 64% of the farmers observed reduction in overall weed population (Singh *et al.,* 2016) but 28% of the farmers observed increase and 7.92% found no change in weed population as compared to conventional wheat production (Table 10).

All the farmers agreed that there was cost saving under zero tillage technology (Malik *et al*., 1998; Nagarajan *et al*., 2002; Yadav and Malik, 2005; Singh and Kumar, 2005, Sharma *et al*., 2005; Singh *et al.,*2002, 2005, Sharma *et al.,* 2004, 2007; Sharma *et al*., 2005, 2007; Chauhan *et al.,*2002 and Hobbs *et al.,* 2002.). A majority (55.46%) told that they got similar yield as compared to conventional sowing but at the same time 43.56% recorded more (Coventry *et al*., 2011; Kumar *et al*., 2006a,) and 1.98% got less yield under zero tillage wheat (Table 10). Most of the farmers (94.06%) observed no change in crop duration, increased soil fertility (81.19%) (Kumar, 2006a), increased organic carbon in the soil (82.18%) (Chhokar *et al*., 2005) and increased moisture retention capacity of soil (59.41%), less lodging (68.32%) and avoiding terminal heat (46.53%) (Kumar *et al*., 2006a).

Rotary Tillage: Year wise adoption pattern of rotary tillage technology indicates that it started in 2002 with 2.17% farmers and continuously increased to 21.74% during 2008. The adoption pattern of rotavator was very much similar to the stages of adoption curve. Despite the efforts of the State Department of Agriculture, Haryana to popularize this technology, some farmers were not satisfied with lottery system of subsidy. They desired that it should be open to all the farmers but the state officials mentioned that it is not possible to provide subsidy to all due to paucity of funds. A majority of the farmers (60.87%) told that machine is available in abundance but 39.13% of farmers faced scarcity when they needed it for sowing (Table 11).

Table 10: Impact of zero tillage technology on wheat cultivation

Indicators	Increase	Same	Decrease
Time taken in sowing	00 (0.0)	05 (4.94)	95 (95.06)
Seed Rate	11 (10.89)	85 (84.16)	05 (4.95)
Germination	32 (31.68)	55 (54.46)	14 (13.86)
Fertilizer requirement	05 (4.95)	95 (94.06)	01 (0.99)
Weed population			
Broad	62 (61.39)	19 (18.18)	20 (19.80)
Narrow	29 (28.71)	12 (11.88)	60 (59.41)
Both	28 (27.72)	08 (7.92)	65 (64.36)
Water requirement	03 (2.97)	53 (52.48)	45 (44.55)
Cost of cultivation	00 (00)	00 (00)	101 (100)
Yield	44 (43.56)	55 (54.46)	2 (1.98)
Crop duration	06 (5.94)	95 (94.06)	0 (00)
Fertility of soil	82 (81.19)	19 (18.81)	0 (00)
Organic carbon content of soil	83 (82.18)	18 (17.82)	0 (00)
Moisture retention capacity of soil	60 (59.41)	37 (36.63)	4 (3.96)
Lodging	02 (1.98)	30 (29.70)	69 (68.32)
Avoidance of terminal heat	47 (46.53)	54 (53.47)	00 (00)

Figures in parenthesis indicate percentage

Table 11: Information on rotary tillage

Availability of machine	Frequency	Frequency
Abundance	28	60.87
Scarce	18	39.13
Efforts made by state department of agriculture		
Yes	37	80.43
No	09	19.57
Time taken in sowing with rotary tillage		
40	04	8.7
45	02	4.35
50	01	2.17
60	37	80.43
90	02	4.35
Continued adoption of rotary tillage		
Yes	44	95.65
No	02	4.35

The average area per farmer was 7.38 acres under rotavator as compared to conventional tillage which was 2.9 acres. Most of the farmers (95.65%) were willing to continue rotavator for sowing of wheat where as 4.35% of them to give it up.

Impact of rotary tillage on wheat cultivation: All the farmers agreed that there was cost saving under rotary tillage in wheat sowing. The tillage operation saves time and it ranged from 40 minutes to 90 minutes per acre. However, a majority (80.43%) told that it takes one hour for one acre area. This is one of the reasons of popularity of rotary tillage technology because it prepares the field just like conventional. It was also recorded that most of the small farmers opted this technology for wheat sowing. Almost all the farmers used similar quantity of wheat seed under rotary tillage as compared to conventional tillage. Around 65% of the respondents observed a similarity in germination whereas 34.78 recoded better germination under rotary tillage (Table 12). All the farmers applied same quantity of fertilizer and also observed a similar type of weed flora, similar water requirement as in conventional. Most of the farmers (91.30%) told that there is a decrease in cost of cultivation and 56.52% got more yield under rotary tillage while 43.48% recorded similar yield as compared to conventional tillage indicating a divided opinion about yield advantage.

There was no effect of rotary tillage on crop duration as reported by 97.83% farmers (Table 12). There was positive impact of rotary tillage on fertility of soil (86.96%), organic carbon content of soil (82.61%) and moisture retention capacity of soil (45.65%). About 65% of the farmers agreed that there was no change in lodging of crop under rotary tillage but 26% of them observed more lodging as compared to conventional tillage. Only 23.91% of the farmers agreed that this technology helps in avoidance of terminal heat in wheat.

Impact of laser land leveler on wheat cultivation: The average area under laser leveling was estimated at

Table 12: Impact of rotary tillage technology on wheat cultivation

Indicators	Increase	Same	Decrease
Time taken in sowing	00 (00)	00 (00)	46 (100)
Seed Rate	01 (2.17)	45 (97.83)	
Germination	16(34.78)	30 (65.22)	
Fertilizer requirement		46 (100)	
Weed population			
Broad	03 (6.52)	42 (91.30)	01 (2.17)
Narrow	00 (00)	45 (97.83)	01 (2.17)
Both	00 (00)	45 (97.83)	01 (2.17)
Water requirement		42 (91.30)	04 (8.70)
Cost of cultivation		04 (8.70)	42 (91.30)
Yield	26 (56.52)	20 (43.48)	
Crop duration	01 (2.17)	45 (97.83)	
Fertility of soil	40 (86.96)	06 (13.04)	
Organic carbon content of soil	38 (82.61)	08 (17.39)	
Moisture retention capacity of soil	21 (45.65)	25 (54.35)	
Lodging	12 (26.09)	30 (65.22)	04 (8.70)
Avoidance of terminal heat	11 (23.91)	34 (73.91)	01 (2.17)

Table 13: Particulars on laser land leveling area leveled (acres)

Avg. area leveled/farmer	Remaining area	Complete leveling (frequency)
10.9	2.85	71
Would you like to continue?		
Response	**Frequency**	**Percentage**
Yes	106	100
Time taken to level the field		
Time taken(hours/acre)	**Range**	
1.86	1-3.5	

Table 14: Impact of laser land leveling on wheat cultivation

Indicators	Increase	Same	Decrease
Time taken infield preparation	46(43.4)		60(56.60)
Area brought under cultivation	106(100)		
Time taken to irrigate the crop			106(100)
Water requirement			106(100)
Cost of cultivation	46(43.4)	51(48.11)	09(8.50
Yield	103(97.17)	03(2.83)	00(00)
Lodging	00(00)	45(42.45)	61(57.55)

10.9 acres per farmer (Table 12) and the remaining area was under conventional practice (2.85 acres). It means most of the farm land in the study area had been leveled. All the farmers were very keen to talk about this technology and willing to adopt/continue whenever required.

A majority of the farmers (56.60%) felt that there was decrease in time required for field preparation when they adopt laser land leveler but 43.4% felt that there was an increase in time (Table 14). The average time for leveling of one acre of land was 1.86 hours but it ranged from 1 hour to 3.5 hours depending on the condition of the field. All the farmers observed that there was 3-5% increase in area under cultivation when they adopted laser land leveler. All the farmers observed that there was reduction to a tune of one third to half in time taken to irrigate the crop after laser land leveling (Jat *et al*., 2012). All the farmers recorded water saving to a tune of 30-40% percent after adoption of laser land leveler in wheat and rice crop. Majority (48.11%) felt that cost of cultivation was same even you adopt laser land leveler but 43.4% felt that during first year of adoption it increases the cost of cultivation. Most of the farmers (97.17%) recorded more yield after leveling their field and also observed reduction in lodging of crop due to even distribution of water.

CONCLUSION

The study clearly indicated the yield and economic advantages of RCTs in the short-run and overall improvement of soil health in long run. In rice-wheat crop rotation, adoption of resource conservation technologies have proved their utility in many ways but still the adoption of these technologies need to be increased. The potential benefits and established principles of RCTs have to be upscale and out scaled among the farming community for sustainable agriculture development of the country.

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Participatory Varietal and Adoption Appraisal on Summer Vegetables Cultivation among Tribal Farmers of Odisha

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ABSTRACT

A study was conducted at Krishi Vigyan Kendra, Semiliguda in Koraput district of Odisha from 2009-14 to evaluate the performance of improved cowpea and cauliflower varieties *Utkal Manik* and *Sarita* on farmers' field. The average increase in yield under cowpea demonstrations was 31% for variety *Utkal Manik* over local cultivars. The additional cost of cultivation in off-season cowpea demonstration plots was higher (Average Rs. 2873/ha) in comparison to FP. This in turn gave additional net returns to the tune of Rs. 10,600-18,900/ha. Adoption behaviour analysis showed that 40% of the recommended practices like lime application, sowing time, critical irrigation and grading were adopted by the respondents mediocrely; with AQ of 70.0, 71.1, 69.4 and 68.9 respectively. Cauliflower cultivar *Sarita* recorded increase in yield to the tune of 65 to 70% (2012-14) over local cultivars. Off-season cauliflower cultivation escalated the cost of cultivation by Rs. 3816/ha. Net returns to the tune of Rs. 3,23,484/ha were obtained which is 88% higher than the FP. Scientifically recommended practices for off-season cauliflower cultivation showed that sowing time, critical irrigation, boron application and curd packing scored AQ values to the tune of 64.4, 69.4, 57.8 and 63.3, respectively. Form the demonstration trial it can be inferred that extension agency contacts with farmers should be reinforced for higher adoption of improved production technologies and cultivars for off-season summer vegetable cultivation.

Keywords: Cauliflower, Cowpea, Extension gap, Front line demonstration, Technology gap

INTRODUCTION

Cowpea (*Vigna anguiculta* [L.] Walp.) is commercially grown for its long green pods as a vegetable, for its seeds as pulse and for its foliage as fodder. As one of the food legumes, it is an important source of nutrients and provides high quality, inexpensive protein to diets based on cereal grains and starchy foods. The mature cowpea seed contains 24.8% protein, 63.6% carbohydrate, 1.9% fat, 6.3% fiber, small amount of thiamine, Riboflavin and Niacin (Davis *et al.,* 2000). Cauliflower (Brassica oleracea var. *botrytis* sub var. *cauliflora*) is an important vegetable crop of India. The edible curd is a rich source of protein, minerals and vitamins which protects human from certain cancers and heart diseases (Keck, 2004).

There is a great demand of cauliflower as well as cowpea all around the year. And particularly during summer season these vegetables have high demand fetching farmers' good remuneration. Off-season (summer) cultivation of crops like cowpea and cauliflower has great potential by taking advantage of the perennial stream water and lesser temperature in hilly regions like Koraput district of Odisha. But require special attention towards selection of variety, method of sowing, proper plant protection measures, proper handling and packing. Selection of the best technologies for farmers cannot be based solely on research station trials but should in fact be based on farm trials in which the new technology is compared with the farmer's existing practices under the growing conditions of his farm. Frontline demonstrations (FLD) are one of the

suitable approaches for disseminating technology generated in the research center to farmers' field.

Therefore creating awareness among the farmers; efforts have been made to popularize the off-season high yielding varieties of cowpea and cauliflower along with their production and protection technologies though community approaches (Table 1). These recommended technologies have been demonstrated through FLD with an objective to evaluative the yield performance of improved varieties *Sarita* of cauliflower and *Utkal Manik* of cowpea with the existing cultivars at farmers field. During vegetable deficit summer season (March- May). These high yielding, high value and nutritional qualities of the varieties intended KVK-Koraput to conduct FLD's on off-season cultivation of cowpea and cauliflower with objectives 1) to evaluate the performance of high yielding varieties of cowpea and cauliflower under off-season (summer) conditions. 2) To study the economics, extension gaps and adoption behavior for making appropriate agro-techniques *vis-à-vis* extension methodologies for higher adoption.

MATERIALS AND METHODS

A number of FLD's were conducted in different villages of Koraput district (latitude 19^0 45´ 30´´ N, longitude 82^0 56´ E and altitude 950 m above mean sea level) of Odisha. Climate of the study area is sub-tropical and sub-humid type with mean annual maximum and minimum temperature of 30.6 and 17.0 °C, respectively. Mean annual rainfall of the area is 1450 mm. KVK conducted an investigation in the target area on assessing the performance of summer vegetable cultivation on low and medium lands. First of all the constraints in summer vegetable (cowpea and cauliflower) cultivation were identified through participatory rural appraisal (PRA), farmer meetings, training programmes. Field diagnostic visits and questionnaires were conducted. Thus based on the farmers' demand for a good variety 60 FLD's were conducted in 6 villages of the Koraput district of Odisha during 2010-14. Each FLD was piloted in an area of 400-800 m^2 in *summer* season (February-May) along with farmers practice (FP) in same area. Cauliflower nursery was raised in 150m^2 for 25 days (March) under irrigated conditions and 25 days old seedlings were transplanted in during March every year. Before planting in the main field granular insecticide (phorate 10 G) was applied to reduce the incidence of the weevil and termite.

Before execution of FLD, each year training programmes were organized for the selected village farmers to impart the technological know-how on summer cowpea and cauliflower cultivation. All other steps like site selection, layout of demonstrations, farmers' participation *etc.* were followed as suggested by Choudhary (1999). The data was collected through survey method and major tools used were exhaustive village survey, interview schedules (structured and semi-structured), in-depth discussion and secondary data sources. Taking into consideration the scope and objectives of the study, a well-structured interview schedule was prepared. Based on the result of pre-test, suitable modifications were made and a final interview schedule was prepared. The yield of demonstrations as well as FP (local check) were recorded and analysed according to different parameters suggested by Chauhan *et al.* (2013). On the basis of prevailing market prices; income, technological and adoption gaps were calculated as following given details:

1. Extension Gap = Demonstration yield - FP yield
2. Technology Gap = Potential yield - Demonstration yield
3. Technology Index = (Pi - Di)/ Pi X 100

Where,

Pi = Potential yield of i^{th} crop
Di = Average demonstration yield of i^{th} crop.

4. Additional Return = Demonstration return -FP return
5. Effective Gain = Additional return (Ar) -Additional cost (Ac)
6. Increment B: C ratio = Additional return (Ar)/ Additional cost (Ac)

The adoption quotient was determined as Adoption Quotient (AQ) = Sum of obtained score/ maximum possible adoption score * 100. The rainfall data was collected form annual reports of IISWC, Research Center- Sunabeda (Anonymous, 2014).

RESULTS AND DISCUSSION

Rainfall pattern and crop establishment: On an average (2009-14) 11.1, 21.9, 81.3 and 55.1 mm rainfall

was received during February, March, April and May months, respectively. Raising cabbage nursery during water deficit summer season is a challenge. Hence nursery was raised under shade conditions in proximity to perennial stream. Moisture deficiency in nursery affects the main crop yield with seedling mortality leading to poor plant stand. Adequate soil moisture availability was ensured with an average rainfall of 9 mm during seedling transplanting, which paved the way for healthy crop establishment in the field. During the moisture stress conditions deficit was met through perennial stream of water. At later stage of crop growth from March to May; an average rainfall of 75.4 mm was received. During the grand growth period the moisture demand was met through irrigation. For cowpea no nursery was raised as crop was directly sown in field.

Knowledge level of farmers: The knowledge level and perception of farmers for off-season vegetable cultivation was analysed in different villages. Farmers' feedback was categorized into low, medium and high categories based on the score. The total adoption score for each farmer was computed by adding up the scores of all 10 point package of practice (Table 2). For cowpea cultivation majority of the cultivators were under category of low score (45%) closely followed by medium category (40%). The reason attributed for low adoption of off-season cowpea cultivation is lack of suitable variety for off-season and technical knowledge. For off-season cauliflower cultivation maximum cultivators are in medium category (55%). As there is year round market demand for cauliflower, it is widely raised in the off-season to fetch higher price. Form this analysis it can be established that off-season vegetable cultivation has boosted confidence level of the cultivators in this area. This is an encouraging finding and further efforts should be made to bring the cultivators in high adoption category.

Yield and gap analysis: Pod yield of improved variety *Utkal Manik* was higher under demonstrations in comparison to existing FP (Table 3), however in comparison to potential yield only 52-55% yield was achieved. The increase in yield under demonstrations was in the range from 23 to 38% for variety *Utkal Manik* over local cultivars (Pandey *et al.,* 2006). Improved variety has enhanced photosynthetic efficiency and disease tolerance characters which have led to increased production, accumulation of protein and yield (Anonymous, 2012). An extension gap ranging

Table: 2 Distribution of the off-season vegetable growers according to their adoption behaviour (N=60)

Adoption behaviour	*Utkal Manik* (Cowpea)	*Sarita* (Cauliflower)
High (> 60)	9 (15)	17 (27)
Medium (40 to 59)	24 (40)	31 (55)
Low (< 40)	27 (45)	12 (18)
Total	60 (100)	60 (100)

Note: Figures within the parentheses are % to total farmers

Table 1: Demonstration package and farmers' practice under FLD

Technology component	Utkal Manik (Cowpea)		Sarita (Cauliflower)	
	Demonstration plot	Farmer practice	Demonstration plot	Farmer practice
Variety	Open Pollinated	Any variety not confirming to season	Hybrid	Any variety not confirming to season
Seed rate	30-40 kg ha^{-1}	60 kg ha^{-1}	300 g ha^{-1}	600 g ha^{-1}
Seed treatment	Bavistine @ 2 g kg^{-1} seed + rhizobium inoculation @ 10g kg^{-1} seed	Nil	Bavistine @ 2g kg^{-1} seed + Streptocycline @ 1 g kg^{-1}	Nil
Nursery management/	—	—	Shade Net/ hut	Open conditions
Sowing technique	Line sowing	Broadcasting	Flat bed, line sowing	Broadcasting
Fertilizer dose	FYM @ 10 t/ha + NPK kg ha^{-1} (20:40:20)	Partial	FYM @10 t/ha + NPK kg ha^{-1} (150-80-60)	Partial
Micronutrient	Lime 5 q ha^{-1}	Nil	Boron @ 6 kg ha^{-1}, Lime 5 q ha^{-1}	Nil
Technical guidance	Time to time	Nil	Time to time	Nil

Table 3: Yield and gap analysis under front line demonstrations in farmers' fields

Variety	Year	Yield (q/ha)			Increase over FP (%)	Extension gap (t/ha)	Technology gap (t/ha)	Technology index (%)
		Potential	Demonstration	Farmer practice (FP)				
Utkal Manik (Cowpea)	2009	90	48	39	23	9	42	47
	2010	90	51	37	38	14	39	43
	2011	90	50	38	32	12	40	44
	Mean	**90**	**50**	**38**	**31**	**12**	**40**	**45**
Sarita (Cauliflower)	2012	250	179	106	70	74	71	28
	2013	250	182	110	65	72	68	27
	2014	250	184	108	70	76	66	26
	Mean	**250**	**182**	**108**	**68**	**74**	**68**	**27**

from 9-12 q ha^{-1} in yield was perceived between FLD and FPs through years. Highest extension gap of 14 q ha^{-1} was obtained in 2010 which points towards poor yields due to aphid and viral disease under FP. Overall such gaps are attributed to improved seed material, intercultural operations and adoption of improved production technology in the demonstrations. Technology gaps were observed during the course of demonstrations. The average technology gap of total 60 FLD's for tested variety was 40; which is 44% of variety's potential yield. This may be attributed mainly to ill distribution of rainfall, variation in soil fertility, variations in biotic and abiotic stresses observed across different growth stages. Technology index designates the feasibility of the evolved technology in the farmers' field. Lower the value of technology index, higher is the viability of the improved technology. Technology index spun around 45% during the years of FLD's. Higher technology index to the tune of 43-47% reflected inadequate extensions services for transfer of technology. Efforts should be made to bridge this gap with more demonstration of improved technology in farmers' field.

Cauliflower cultivar *Sarita* recorded higher head yield under demonstrations in comparison to existing FP (Table 3). The increase in yield under demonstrations was in the range from 65 to 70% for variety *Sarita* over local cultivars. Similar are the findings of Chatterjee and Mahanta (2013) for offseason cauliflower cultivation in North Bengal. A high extension gap to the tune of 72-76 q ha^{-1} in yield was perceived between FLD and FPs throughout years. This can be attributed to low adoption of cultivation practices like protected nursery, micronutrient application, disease pest management etc. Technology gaps to the tune of 66-71% were observed during the course of demonstrations. The average technology gap of total 60 FLD's for tested varieties was 68; which is 24% of variety's potential yield. Average technology index was 27% during the FLD's. Lower technology index (26-28%) reflected satisfactory extensions services for transfer of technology. Location-specific crop management recommendations are needed to bridge the gap in potential and demonstration yields (Singh *et al* 2013).

Economics analysis: Economics of off-season cowpea and cauliflower cultivation under FLD's was appraised on the then market prices. All the variable costs were considered in calculating the cost of cultivation and the detailed economic returns with incremental benefit cost ratio (IBCR) are presented in Table 4. It imitates that owing to improved variety, seed treatment, fertilizers and other inputs; the additional cost of cultivation in off-season cowpea demonstration plots was higher (Average Rs. 2873/ha) in comparison to FP. This in turn gave additional net returns to the tune of Rs. 10,600-18,900/ha. This marks that with a small hike in cost of cultivation, worthy net returns were obtained provided there is better market projections. Highest IBCR (8) was obtained in year 2010 and average values analysed was 6. Enhanced fiscal returns in terms of gross, net and additional returns through improved farm technology have also been reported by Anonymous (2012a).

Off-season improved cauliflower cultivation escalated the cost of cultivation by Rs. 3816/ha which

Table 4: Economic analysis of front line demonstrations in farmers' fields

Variety	Year	Cost of cultivation (Rs. ha^{-1})		Net returns (Rs. ha^{-1})		Add. cost in demo. (Rs. ha^{-1})	Effective gain (Rs. ha^{-1})	Incremental B:C ratio (IBCR)	Wholesale market price (Rs. q^{-1})
		Demons-tration	FP	Demons-tration	FP				
Utkal Manik	2009	32,400	29,500	39,600	29,000	2,900	10,600	5	**1,500**
(Cowpea)	2010	33,000	30,200	46,050	27,150	2,800	18,900	8	**1,550**
	2011	33,420	30,500	45,580	29,540	2,920	16,040	6	**1,580**
	Mean	**32,940**	**30,067**	**43,743**	**28,563**	**2,873**	**15,180**	**6**	
Sarita	2012	54,338	50,600	3,03,662	1,60,400	3,738	1,43,262	39	**2,000**
(Cauliflower)	2013	55,060	51,200	3,27,140	1,79,800	3,860	1,47,340	39	**2,100**
	2014	55,950	52,100	3,39,650	1,80,100	3,850	1,59,550	42	**2,150**
	Mean	**55,116**	**51,300**	**3,23,484**	**1,73,433**	**3,816**	**1,50,051**	**40**	

can be attributed to improved variety, protected nursery and other inputs in comparison to FP. Net returns to the tune of Rs. 3,23,484/ha were obtained which is 88% higher than the FP. Adoption of improved technology gave additional net returns to the tune of Rs. 15,180/ ha. With a small hike in cost of cultivation, worthy net returns were obtained with IBCR of 40. Enhanced fiscal paybacks in terms of gross, net and additional returns through improved farm technology have also been reported by Anonymous (2014). Overall, economic analysis showed that transfer of improved technology of off-season cultivation and its adoption can substantially enhance the productivity and farmers' profitability (Singh *et al.,* 2014).

Adoption behavior: Adoption of ten nos. of scientifically recommended practices of improved cowpea cultivation was accessed on the feedback of respondents and based on adoption quotient (AQ) ranking was done (Table 5). Data signposts that 40% of the recommended practices like lime application, sowing time, critical irrigation and grading were adopted by the respondents mediocrely; with AQ of 70.0, 71.1, 69.4 and 68.9 respectively. Critical practices like seed treatment, line sowing, and fertilizer dose scored low in cowpea cultivation. The low adoption of critical practices may be due to fact that pesticides and rhizobium is costly for resource poor tribal farmers and their availability is scarce. The result of this table indicates that there is need to refine the technology and fill the extension gaps in off-season cowpea cultivation.

For summer cauliflower too, the scientifically recommended practices were accessed and it was found that sowing time, critical irrigation, boron application and curd packing scored AQ values to the tune of 64.4, 69.4, 57.8 and 63.3, respectively. This can be attributed to availability of perennial stream of water and boron application as popularized technology by the state govt. agencies. Use of shade nursery and use of improved variety exhibited poor adoption. The reason attributed is that shade nursery requires technical guidance and

Table 5: Distribution of respondents on the basis of adoption score for off-season cowpea cultivation (N=60)

Recommended scientific practices	Adoption (%)			Total score obtained	Adoption quotient	Adoption category	Adoption rank
	Full	Partial	None				
Use of improved varieties	15	20	45	80	44.4	Low	VI
Lime application @ 5q ha^{-1}	30	92	4	126	70.0	Medium	II
Time of Sowing	39	84	5	128	71.1	Medium	I
Seed treatment (Bavistine @ 0.2% + Rhizobium)	3	6	56	65	36.1	Low	X
Line sowing and spacing (60 x 30 cm)	9	10	52	71	39.4	Low	VII
NPK-20-40-20	24	24	40	88	48.9	Low	V
Critical irrigation	30	90	5	125	69.4	Medium	III
Pest mgt. (Aphids, Borer)	6	12	52	70	38.9	Low	VIII
Disease mgt. (Mosaic, Fusarium wilt)	3	12	53	68	37.8	Low	IX
Shorting and grading	42	72	10	124	68.9	Medium	IV

Table 6: Distribution of respondents on the basis of adoption score for off-season cauliflower cultivation (N=60)

Recommended scientific practices	Adoption (%)			Total score obtained	Adoption quotient	Adoption category	Adoption rank
	Full	Partial	None				
Shade net nursery	6	10	53	69	38.3	Low	VIII
Use of improved varieties	18	24	42	84	46.7	Low	V
Time of Sowing	24	80	12	116	64.4	Medium	II
Seed treatment (Bavistine @ 0.2%)	3	6	56	65	36.1	Low	X
Critical irrigation	30	90	5	125	69.4	Medium	I
Boron application @6 kg ha^{-1}	6	80	18	104	57.8	Medium	IV
NPK (150-80-60)	18	22	43	83	46.1	Low	VI
Pest mgt.(Diamond back moth, Borer)	6	16	50	72	40.0	Low	VII
Disease mgt. (Black rot, Fusarium wilt)	3	8	55	66	36.7	Low	IX
Curd packing	24	76	14	114	63.3	Medium	III

lack of suitable off-season variety led to their poor adoption. Likewise in cowpea cultivation, use of disease and pest management practice is too low in summer cauliflower cultivation. Hence innovation of cheap IPM practices is needed for higher adoption and management of off-season summer vegetable cultivation. The results corroborate the findings of Yadav *et al.* (2014) and Pal *et al.* (2015).

CONCLUSION

From the results of frontline demonstrations in tribal region of Odisha it can be inferred that, off-season summer vegetable cultivation raised with improved varieties Utkal Manik (cowpea) and Sarita (cauliflower) with scientific production technologies led to an increase of yield by 31% and 68% over existing FP, respectively. The increase in cost of cultivation was to the tune of Rs. 3000-4000 ha^{-1} which the small (progressive) and marginal farmers can afford. Poor adoption of scientific package practices in both the crops is a matter of concern as AQ did not crossed 71.0 and no practice was adopted in high score category. Extension agency contacts with farmers should be reinforced for higher adoption of improved production technologies for off-season summer vegetable cultivation. Rural youth and young farmers should be given enough support by training and education so as to they can adopt scientific cultivation for better livelihood prospects. Extension agency contacts with farmers should be reinforced for higher adoption of improved production technologies for off-season summer vegetable cultivation.

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Constraints Perceived by Officials and Non-officials associated with Mahatma Gandhi National Rural Employment Guarantee Programme

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ABSTRACT

The present study was carried out at Milkipur block in Faizabad district of Uttar Pradesh. A sample of16 officials and 108 non-officials, thus a total of 124 respondents associated with Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS) were considered to assess the barriers which hinder the effective implementation and management of scheme. The constraints which are faced by most of the officials are non-performance of village panchayat in discharging duties as per guidelines of officials, delay in getting budget from top consequently delayed allocation of budget at panchayat level, lack of cooperation between gram panchayat and gram sabha on site selection, plan preparation and implementation under monopoly of village panchayat. Similarly non-officials mostly indicated that village panchayat does not receive budget in time. Social pressure hinders the work. The suggestions of the officials to mitigate the constraints are better coordination among beneficiaries, officials and non officials and timely release of budget to avoid time lag in distribution. Similarly the suggestions from non-officials are equipping panchayat with more funds for effective implementation of the scheme and equal distribution of budget to each panchayat.

Keywords: MGNREGS, Constraints, Suggestions, Officials and Non-officials

INTRODUCTION

Mahatma Gandhi National Rural Employment Guarantee Act is really a boon for the rural people. If it is implemented transparently, corruption will be eradicated and certainly it would have the potential to enhance the standard of living of the rural people. The involvement of the local self government *i.e.,* PRIs in this programme implementation are not satisfactory everywhere. While, assessing the success of any employment generation programme; social audit is nearly absent for plugging the loopholes (Sanyal, 2011).Social audit is the governance instrument meant for raising transparency and accountability for minimizing corruption (Pattnanaik and Lal, 2011). MGNREGA is not free from implementation problem at the ground level. The desired level of success of MGNREGS depends on strengthening of the existing implementation and monitoring mechanism while also ensuring financial and operational sustainability, with greater coordination at block level, towards resolving issues like promoting the involvement of PRIs and covering the benefits of MGNREG programme (Tripathi and Tripathi, 2008). There was no focus on guaranteeing a minimum quality of assets that are sought to be created through the programme. Labour-intensive employment programmes are responsible for creating low- quality output. The emphasis seems to be on providing work opportunities to unskilled labour and no attempt is being made to upgrade the skills of rural youth and enable them to earn more (Sharma, 2009).

The only way corruption can be controlled by proactive people's involvement in the implementation

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process. People should start questioning the officials for transparency in the process and get proper information about creation of muster rolls and disbursement of funds (Maulic, 2009). There should be a clear layout of priorities of work which are being undertaken by MGNREGA, correct and tight estimates of workers and regular payment at prescribed rate, release of funds to village panchayat under MGNREGA should be in time to avoid time lag in it, disbursement of wages has to be on weekly basis, providing worksite facilities and employment should be given within 15 days of application for work (Patel, 2008). Sankari and Murugan (2009) has suggested that (1) there should be better coordination between the block level bureaucracy and panchayat to providing technical support to the gram panchayat in the formulation, implementation and monitoring of the scheme (2) community participation through PRA is essential (3) a technical assistant must be placed at the panchayat for providing technical support in the formulation of projects, identification and estimation of expenditures (4) there should have been some weightage for BPL and land less families in providing job opportunities.

MATERIALS AND METHODS

The present study was conducted in Milkipur block of Faizabad district in Uttar Pradesh during 2010-11. A list of villages was collected from the block head quarter in which the MGNREGS was running. The villages were arranged (basis of fund utilization) in decreasing order in which the first five villages were selected. The officials (N=16) i.e. permanent or adhoc staff and non-officials (N=108) i.e. Village Panchayat (elected body) at panchayat and block levels associated with MGNREGA were also contacted and data were collected regarding their opinion on MGNREGA. An interview schedule was prepared in the light of decided objectives and variables as per consultations with researchers, scientists, extension personnel and informal discussion with officials and non-officials. The responses were collected on personal interview basis as open responses in form of constraints as well as their suggestions about functioning (loopholes and improvement) of MGNREGS. The appropriate statistics was used to calculated frequency, mean values, rank order was given and the inferences were drawn accordingly.

RESULTS AND DISCUSSION

Constraints perceived and faced by officials: The constraints perceived by officials were studied on various aspect *viz.*, general, budget allocation and distribution as well as monopoly of village panchayat. The Table 1 presents various general constraints like 'village panchayat not discharging duties as per guidelines of officials, 'false complaints by village

Table 1: Distribution of officials according to their perceived constraints (N=16)

Constraints	Frequency of officials	Percen-tage	Rank orders
General			
Illiteracy among beneficiaries.	6	37.50	IV
Village panchayat does not discharge duties as per guidelines of officials.	8	50.00	I
Poor linkage and coordination of village panchayat.	5	31.25	V
False complaints by village panchayat, gram sabha and beneficiaries are done which yield confusion and confliction.	8	50.00	II
Banks and panchayat adopt malpractices with the help of ghost beneficiaries.	4	25.00	VII
Misutilization of social as well as political influence.	7	43.75	III
Budget allocation and distribution			
Delay in getting budget from top consequently delay allocation of budget at panchayat level.	14	87.50	I
Partiality in budget allocation to the blocks.	8	50.00	II
Involvement of more officials in budget allocation.	7	43.75	III
Monopoly of village panchayat			
Gram panchayat handles the rozgar sevak according to its way.	8	50.00	II
Lack of cooperation between gram panchayat and gram sabha on site selection, plan preparation and implementation.	9	56.25	I

panchayat, gram sabha and beneficiaries yielding confusion and confliction', 'mis-utilization of social as well as political influence', 'illiteracy among beneficiaries', 'poor linkage and coordination of village panchayat' and 'banks and panchayats adopt malpractices with the help of ghost beneficiaries'. Under budget allocation and distribution aspect, 'delay in getting budget from top consequently delaying allocation of budget at panchayat level', 'partiality in budget allocation to the blocks', and 'involvement of more officials in budget allocation' were ranked at I, II and III respectively. Under monopoly of village panchayat aspect, 'lack of cooperation between gram panchayat and gram sabha on site selection, plan preparation and implementation' was ranked I, 'gram panchayat handling of the rozgar sevak according to its way' was ranked II.

The most serious constraint under general aspect was 'village panchayat not discharging duties as per guidelines of officials'. Village panchayat is the supreme body at village level from planning to execution of scheme. Therefore, it is largely responsible for success or failure of the scheme at village levels. The allotted budget to village panchayat which should have gone towards beneficiaries was not given to them, because village panchayat i.e. village pradhan registered those fake name and make the muster roll of persons as well as opened the bank account on their name, who have migrated from village and the wages of these fake beneficiaries are withdrawn by the village pradhan with the help of bank. Under budget allocation and distribution aspect, the most serious constraint was 'delay in getting budget from top consequently delaying in allocation of budget at panchayat level'. Budget release under the scheme flowing from central government to village panchayat involve steps of intermediaries offices, which were responsible in delay the budget at block level consequently delay at village level. As the number of officials was involved in distribution of budget at panchayat levels, they should require strong communication and coordination for proper flowing of budget. Under monopoly of village panchayat aspect the fist ranked constraint was 'lack of cooperation between gram panchayat and gram sabha on site selection, plan preparation and implementation'. Delay in execution of work at village level due to lack of cooperation, coordination and help between gram panchayat, gram sabha in site selection, plan preparation and its implementation and constraint 'gram panchayat handling the rozgar sevak according to its way' was last ranked. Rozgar Sevak did not discharge his duties because they handled by gram pradhan accordingly they were liable to misuse.

Constraints perceived and faced by non-officials: The constraints perceived by non-officials were studied on two aspect *viz.*, budget allocation and distribution as well as social pressure as mentioned in the Table 2. As far under budget allocation and distribution aspect is concerned, 'village panchayat does not receive budget in time' was ranked I, 'budget is provided in installments

Table 2: Distribution of non- officials according to their perceived constraints (N=108)

Constraints	Frequency of officials	Percen-tage	Rank orders
Budget allocation and distribution			
Village panchayat does not receive budget in time.	94	87.04	I
Monopoly and biasness in distribution of budget to panchayat.	87	80.55	IV
No proper guidance is given relating to budget utilization	47	43.52	VI
Corruption among officials of MNREGS.	92	85.18	III
Budget is provided in installments consequently delay in payment.	93	86.11	II
Officials demand bribery.	70	64.81	V
Social pressure			
Social pressure hinders the work.	77	71.30	I
Conflictions are created regarding workplace and time.	73	67.60	II
False complaints are made which hinders the planning/ implementation of work.	52	48.15	V
Over aged and under aged people are pressurize for getting job cards and work.	59	54.63	IV
False family members are sent for work.	40	37.04	VI
The beneficiaries do not want to do work.	73	67.60	III

consequently delay in payment', 'corruption among officials of MGNREGS', 'monopoly and biasness in distribution of budget to panchayat', 'officials demand bribery' and 'no proper guidance is given relating to budget utilization' were ranked at II, III, IV, V and VI respectively. Under social pressure aspect, 'social pressure hinders the work' was ranked I, 'conflictions are created regarding workplace and time', 'the beneficiaries do not want to do work', 'over aged and under aged people are pressurized for getting job cards and work', 'false complaints are made which hinders the planning / implementation of work' and 'false family members are sent for work' were ranked at II, III, IV, V and VI respectively.

Under budget allocation and distribution aspect, the most serious constraint was 'village panchayat does not receive budget in time'. If the budget is not reach on time at village level the work cannot be started on the demand of beneficiaries on time or in lean month whether they had immediate need of wages and the last constraint was 'no proper guidance is given relating to budget utilization'. Village panchayat had not received guidelines or training about proper utilization of budget like purchasing of materials and wages distribution under the scheme. Under social pressure aspect the most serious constraint was 'social pressure hinders the work'. The dominant families and relatives of gram pradhan at village level hinder in proper site selection for work and the last constraint was 'false family members are sent for work'. The registered beneficiaries had not come on work site but in place of the non registered family member sent on work place which created problem in ongoing work.

Suggestions as perceived by the officials: The Table 3 indicates the suggestions raised by officials. The suggestion 'there should be better coordination among beneficiaries, officials and non-officials' was ranked I followed by 'release of budget should be timely to avoid time lag in distribution', 'Rozgar sevaks should discharge their duties properly', 'some institutional mechanisms for making complaints or seeking redresses of grievances must be evolved', 'punishment procedures should be strong' and 'the single line of command should be there regarding budget allocation and distribution', which were ranked II, III, IV, V and VI respectively.

The most of officials have suggested that 'there should be better coordination among beneficiaries, officials and non-officials'. The coordination is the necessary among beneficiaries, officials and non-officials where confliction, registration of genuine beneficiaries, timely disbursement of wages, avoiding time lag in execution of plan and 'the single line of command should be there regarding budget allocation and distribution'. If the budget is directly available to village panchayat by the central government, then timely distribution of budget could be ensured and it allures the beneficiaries for more participation in programme.

Suggestions as perceived by the non-officials: The Table 4 shows the rank order of suggestions raised by non-officials. The suggestion 'panchayat should be equipped with more funds for effective implementation of the scheme' was ranked I. The suggestions like 'distribution of budget to each panchayat should be equal', 'budget should be provided in one installment for proper payment' and 'panchayat should hold a sustainable relation with officials for taking proper guidance about budget utilization' were ranked at II, III and IV respectively.

The most of non-officials have perceived the suggestions i.e. 'panchayat should be equipped with

Table 3: Suggestions given by the officials (N=16)

Suggestions	Frequency of officials	Percen-tage	Rank orders
Release of budget should be timely to avoid time lag in distribution.	14	77.50	II
Some institutional mechanisms for making complaints or seeking redressed of grievances must be evolved.	10	62.50	IV
Punishment procedures should be strong.	10	62.50	V
There should be better coordination among beneficiaries, officials and non officials.	15	93.75	I
Rozgar sevaks should discharge their duties properly.	12	75.00	III
The single line of command should be regarding budget allocation and distribution.	7	43.75	VI

Table 4: Suggestions given by the non-officials (N=108)

Suggestions	Frequency of officials	Percen-tage	Rank orders
Panchayat should be equipped with more funds for effective implementation of the scheme.	104	96.30	I
Distribution of budget to each panchayat should be equal.	103	95.38	II
Budget should be provided in one installment for timely and proper payment.	90	83.33	III
Panchayat should hold a sustainable relation with officials for taking proper guidance about budget utilization.	83	76.85	IV

more funds for effective implementation of the scheme'. As the population of country is continue to increase with increasing in number of single families and cost of commodities, thus there would be increase in demand of employment. Therefore, the government has increased the budget at village level so that, MGNREGS could be effectively implemented. Every village panchayat should maintain a healthy relation with block level officials so that they may be regularly updated on recent trends and changes in scheme.

CONCLUSION

In implementation of MGNREGS, the most serious constraints faced by officials are 'village panchayat does not discharge duties as per guidelines of officials', 'delay in getting budget from top consequently delay allocation of budget at panchayat level' and 'lack of cooperation between gram panchayat and gram sabha on site selection, plan preparation and implementation' and they have suggested that 'there should be better coordination among beneficiaries, officials and non officials' and 'release of budget should be on time to avoid time lag in distribution'. The most serious constraints faced by non-officials are 'village panchayat does not receive budget in time', 'budget is provided in installments consequently delay in payment' and 'social pressure hinders the work' and they suggested that 'panchayat should be equipped with more funds for effective implementation of the scheme' and 'distribution of budget to each panchayat should be equal'. MGNREGS is unique programme in the history of India and has got popularity. The coordination and cooperation to be maintained among the officials, non-officials, village panchayat, gram sabha, banks, cooperative societies, expert of rural development, NGOs and extension personnel, for effective and successful implementation of the MGNREGA.

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Surface and Groundwater Irrigation Systems' Performance as Perceived by the Farmers in West Bengal

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ABSTRACT

Present study was conducted in Birbhum district of West Bengal covering 40 farmers each represented from river lift, groundwater lift and canal irrigation command areas, respectively. In canal irrigation command, farmers perceived irrigation service utility best during *kharif* season with an overall performance score 4.10 on a 5-point continuum scale. However, the farmers perceived overall irrigation service utility less than average in *rabi* season (mean perception score 1.90). However, farmers perceived irrigation service utility better in summer season with overall mean perception score of 3.00 that may be attributed to the fact of irrigation availability for *boro* rice cultivation. Farmers in both river lift and groundwater irrigation commands perceived the irrigation service utility higher in all three seasons *kharif* being the best with overall mean perception score >4.00 followed by *rabi* (>3.50) and summer season (>3.00). Infrastructure scenario of river lift and groundwater irrigation systems are perceived better as compared to canal irrigation system due to better control mechanism, conveyance efficiency with water supply through field channels, etc that may be attributed to the fact of farmers' participation in irrigation management under water user associations in case of both river lift and groundwater irrigation systems, where better cropping scenario was also observed.

Keywords: Farmers' perceptions, Groundwater irrigation, Irrigation performance, Surface irrigation, Water user associations

INTRODUCTION

Irrigation development in India has been quite remarkable with an increase in irrigation potential from 22.6 M ha in 1950–1951 to about 123 M ha at present. Even though the irrigation has made profound impacts on agrarian dynamism, the same has yet to be visible in eastern India, where it is needed having abundant water resources to sustain intensive irrigation. Performance of irrigation and agriculture has been better in Northern region of India, while eastern region has been lagging behind inspite of rich water resources and average annual rainfall of more than 1000 mm (Srivastava *et al*., 2014). There is an increasing concern about the performance of irrigation schemes. The bottleneck for good performance of any scheme is often found in the water delivery system (Mateos *et al*., 2002; Malano *et al*., 1999). Evaluation of performance of irrigation water delivery system by conventional methods depends on the availability of reliable flow data at various levels and points of the irrigation system (Clemmens and Bos, 1990; Pitts *et al*., 1996). Field assessment of irrigation system performance and application of statistical methods for water delivery performance evaluation is common. In most of the cases, evaluation criteria for success or failure have relied on large-scale input and output indicators (Sam-Amoah and Gowing, 2001). However, among different stakeholders in irrigation system, farmers are the producers of agricultural outputs through the utilization of irrigation services provided to them. In spite of being the most fundamental stakeholder, farmers often receive the least attention for assessment of performance. It is important to consider irrigation as a service provided to farmers. Moreover, there are not sufficient studies

which have tried to reveal the utilities of groundwater vis-à-vis surface water irrigation service and the impact on cropping scenario. On this backdrop, surface and groundwater irrigation system performance was assessed as perceived by thefarmers in West Bengal.

MATERIALS AND METHODS

West Bengal to this date remains primarily an agricultural state, where Birbhum district was randomly selected for present study. Out of 19 blocks in Birbhum district, three blocks i.e. Labpur, Illambazar and Suri-II (Purandarpur) block was randomly selected. In Labpur block, two villages each under Labpur-I and Kurunnahar Gram Panchayats, in Illambazar block, two villages each under Illambazar and Ghurisha Gram Panchayats and in Suri-II (Purandarpur) block, two villages under Domdama Gram Panchayats were selected following simple random sampling method. A sample of 20 farmers from each of the selected villages was randomly chosen as the respondents for present study. The farmers from Labpur and Illambazar blocks represent river lift and groundwater lift irrigation areas, respectively; while farmers from Suri-II (Purandarpur) block were from surface irrigation (canal) areas. Thus, a total of 40 farmers each from river lift, groundwater lift and canal irrigation command areas became the respondents in this present study making overall 120 farmers as sample in present study.

Efficiency/utility of surface water and groundwater irrigation were assessed from the farmers' perspective on various parameters, *viz.* quantity of water supply / adequacy (no. of irrigations requested and those actually received), point of water delivery (distance of field from the outlet), stream size, flow rate of water, control mechanism to regulate the flow in outlet, timeliness of irrigation (no. of irrigations requested and those received on time), timing of water arrival, duration of water supply, frequency of getting water (interval between two irrigations), knowledge of water supply roster / advance water supply roster, management decisions / farming operations influenced by water supply, certainty of water availability, etc. The above-mentioned variables will be studied through survey of sample of farmers. Farmers' responses were taken on a 5-point continuum scale (1-very poor to 5 - excellent) with the help of an interview schedule.

RESULTS AND DISCUSSION

The assessment of irrigation performance considered the farmers' perceptions on irrigation infrastructure and irrigation service utility in case of both surface and groundwater irrigation systems. Cropping scenario under respective irrigation commands was also studied to understand the impact of irrigation service.

Farmers' Perceptions on Irrigation Infrastructure and Irrigation Service Utility: Canal, river lift and groundwater lift irrigation infrastructure scenario in Birbhum district of West Bengal was evaluated from the perspectives of selected farmers. It is evident from Table 1 that most of the selected farmers' fields (>60%) are located at head reach in river lift and groundwater lift irrigations' commands while about 48% and 36% farmers' fields are located in head and middle reach of canal irrigation command area.

The average distance of fields from the irrigation source is found 126 m, 139 m and 130 m in case of canal, river lift and groundwater irrigated areas. Irrigation water from source to fields of farmers reaches through field to field flooding method in canal irrigation command area while all the farmers both in river lift and groundwater irrigation command receive irrigation water in their fields through field channels assuring better irrigation conveyance efficiency in river lift and groundwater lift irrigation as compared to canal irrigation with relative less loss of water.

Most of the farmers opined about the presence of control mechanism in case of river lift and groundwater irrigation while the same is not there in case of canal irrigation. The size of outlet in case of the selected irrigation systems varied as in case of canal, it is small to large. However in case of river lift and groundwater irrigation, it is either large or medium.

On an average at a time from a given outlet three farmers' fields receive irrigation in case of all the systems as opined by the sampled farmers-respondents in present study. They also mentioned that quantity of land holding has been the basis of water distribution in the selected irrigation systems.

While night irrigation is prevalent in canal irrigation system as responded by more than 80% of the farmers; about 75% of the farmers in river lift and groundwater

Table 1: Farmers' perceptions on canal, river lift and groundwater lift irrigation infrastructure scenario in Birbhum district of West Bengal

Particular	Canal irrigation (n=40)		River lift irrigation (n=40)		Groundwater lift irrigation (n=40)	
	f(%)	μ(SD)	f(%)	μ(SD)	f(%)	μ(SD)
Location of the field						
Head reach	19(47.5)		24(60)		25(62.5)	
Middle reach	15(37.5)		10(25)		8(20)	
Tail reach	6(15)		6(15)		7(17.5)	
Distance of field from source(meter)		126(79.3)		138.9(129.8)		129.7(113.3)
Conveyance of irrigation from source to field						
Through field channels			40(100)		40(100)	
Through field to field by flooding	26(65)					
Partially by field channel and field to field flooding	14(35)					
Presence of control mechanism						
Yes	6(15)		38(95)		33(82.5)	
No	34(85)		2(5)		7(17.5)	
No. of farmers applying irrigation at a time from a given source size of outlet		3(1)		3(1)		3(1)
Very large			1(2.5)		2(5)	
Large	15(37.5)		18(45)		9(22.5)	
Average	11(27.5)		20(50)		29(72.5)	
Small	14(35)		1(2.5)			
Very small						
Basis of water distribution						
Types of crop grown	3(7.5)		4(10)		14(35)	
Quantity of land	37(92.5)		36(90)		26(65)	
Availability of irrigation water during night time						
Yes	33(82.5)		10(25)		10(25)	
No	7(17.5)		30(75)		30(75)	
Awareness beforehand about the schedule of irrigation water						
Yes	40(100)		40(100)		40(100)	
No						
Irrigating crop even at time when it is not in need						
Yes	39(97.5)		-			4(10)
No	1(2.5)		40(100)			36(90)

Note: f, μ and SD indicate frequency, mean and standard deviation values

lift irrigation systems mentioned non-existence of night irrigation.

It is worth mentioning that in all three types of irrigation systems, farmers used to aware about irrigation schedule that led to avoidance of unnecessary irrigation by the farmers as they have mentioned that they do not irrigate the crops when it is not required even in case of availability of water in case of river lift and groundwater irrigation. However, in canal command, farmers used to irrigate whenever water is available in the command irrespective of crop water requirements. The prevalence of WUAs in river lift and groundwater irrigation systems might have ensured better control and application of irrigation as compared to canal irrigation systems.

It can be concluded from the aforesaid results that river lift and groundwater irrigation systems are having better infrastructure scenario as compared to canal irrigation system in Birbhum district of West Bengal.

Efficiency/utility of canal, river lift and groundwater irrigation was assessed from the farmers' perspective. The farmers' responses were taken to

analyse tractability, convenience and predictability of irrigation service on eight parameters *viz.* sufficiency of water, duration of supply, frequency of supply, point of delivery of water, stream size of water, timeliness of water supply, equity of water supply and functioning of irrigation system below the outlet level. Each of the parameter was measured separately for *kharif, rabi* and summer seasons with the help of a 5-point continuum scale. Overall performance of the irrigation service utility was measured with pooled mean score.

In canal irrigation command, farmers perceived irrigation service utility best during *kharif* season as all eight parameters perceived highly with an overall performance score 4.10 in a 5-point continuum scale with maximum and minimum possible score is 5 and 1, respectively (Table 2). However, the farmers perceived all the parameters less than average (<2.50) in *rabi* season, where duration of water supply and equity of supply perceived lowest (mean perception score 1.90). Overall irrigation service utility is found less than average (2.10) in *rabi* season with varied perceptions of the farmers (standard deviation 1.00). It is interesting to find that the farmers perceived irrigation service utility better in summer season with overall mean perception score of 3.00. The relative better performance in summer may be attributed to the fact of frequent canal supply catering the need of irrigation for *boro* rice cultivation. Thus, canal irrigation service utility is found to be best in *kharif* season followed by summer season and *rabi* season.

A perusal of Table 3 indicates that farmers in river lift irrigation command perceived the irrigation service utility higher in all three seasons *kharif* being the best with overall mean perception score 4.31 followed by *rabi* (3.90) and summer season (3.40). Farmers perceived all the parameters of irrigation performance highly (with mean score >4.0) in *kharif* season. It is worth mentioning here that perceptions of farmers regarding frequency of water supply was more favourable during *rabi* and summer seasons as compared to *kharif* season although rest seven parameters were perceived more favourable in *kharif* season. This underlines the importance of frequency of water supply as one of the crucial parameters during dry season as compared to wet (*kharif*) season when rainfall occurs. Therefore, farmers used to perceive irrigation during *kharif* season as the protective irrigation. In contrast, irrigation during dry season (*rabi* and summer) is viewed as productive irrigation.

Groundwater lift irrigation in Birbhum district was assessed in term of irrigation service utility from the farmers' perspectives. It is evident from Table 4 that farmers in groundwater irrigation command area perceived most of the parameters highly with mean perception score ≥4.0 except the frequency of supply (3.50) lead to overall mean perception score 4.10 in *kharif* season. In contrast, farmers perceived three parameters highly and rest five above average (>2.50) during *rabi* season resulted to overall mean perception score 3.90 during *rabi* season. However, the overall perception of farmers regarding groundwater irrigation service in summer is relatively low (3.60) but above average (>2.50) as except two parameters viz. frequency of supply and timeliness other six parameters perceived

Table 2: Irrigation service utility as perceived by the farmers with respect to canal irrigation in Birbhum district of West Bengal

Particular	Mean Perception Score (n=40)		
	***Kharif* season**	***Rabi* season**	**Summer season**
Sufficiency of water	3.90(0.69)	2.00(0.93)	2.90(0.92)
Duration of supply	3.90(0.57)	1.90(0.86)	2.90(0.88)
Frequency of supply	4.00(0.58)	2.40(1.35)	3.80(1.39)
Point of delivery of water	4.20(0.43)	2.10(1.06)	2.90(0.83)
Stream size of water	4.10(0.59)	2.00(0.93)	2.90(0.61)
Timeliness of water supply	4.20(0.46)	2.03(1.06)	3.10(0.90)
Equity of water supply	4.05(0.45)	1.90(0.93)	2.90(1.02)
Functioning of irrigation system below the outlet level	4.10(0.39)	2.00(1.00)	2.80(0.82)
Overall performance	**4.10(0.52)**	**2.10(1.00)**	**3.00(0.90)**

Note: Figures in parenthesis indicate standard deviation values; maximum and minimum possible score is 5 and 1, respectively

Table 3: Irrigation service utility as perceived by the farmers with respect to river lift irrigation in Birbhum district of West Bengal

Particular	Mean Perception Score (n=40)		
	***Kharif* season**	***Rabi* season**	**Summer season**
Sufficiency of water	4.50(0.55)	3.80(0.56)	3.30(0.76)
Duration of supply	4.40(0.62)	3.80(0.65)	3.20(0.83)
Frequency of supply	4.00(0.73)	4.60(0.49)	4.50(1.09)
Point of delivery of water	4.30(0.65)	3.80(0.67)	3.40(0.86)
Stream size of water	4.10(0.44)	3.70(0.53)	3.20(0.73)
Timeliness of water supply	4.70(0.47)	4.20(0.50)	3.40(0.77)
Equity of water supply	4.40(0.48)	4.00(0.56)	3.30(0.90)
Functioning of irrigation system below the outlet level	4.30(0.44)	3.70(0.53)	3.20(0.71)
Overall performance	**4.31(0.49)**	**3.90(0.57)**	**3.40(0.83)**

Note: Figures in parenthesis indicate standard deviation values; maximum and minimum possible score is 5 and 1, respectively

lowly - just above average level (between 2.50 and 3.0). Therefore, groundwater irrigation also like river lift irrigation is found best in *kharif* season followed by *rabi* and summer season. As depicted in Figure 1, the irrigation service utility varied across the irrigation sources as well as season. Groundwater irrigation and river lift irrigation have better service in dry season (*rabi* and summer season) as compared to the canal irrigation while all three performed equally well in *kharif* season.

Ghosh *et al.* (2005) assessed the utility of irrigation water supply schedule on the basis of three factors i.e. tractability, convenience and predictability and 10 sub-factors under three factors in a major canal irrigation in Khurda district of Odisha. The analyses revealed that farmers' level of satisfaction with the factors in an increasing order was predictability, convenience and tractability. The most important factor is found to be predictability followed by tractability and convenience. Ghosh *et al.* (2016) in their study in amedium (canal) irrigation Project in Nayagarh district of Odisha reported that irrigation performance found better in *kharif* season as compared to *rabi* season which is in similarity of the findings of present study. Mishra *et al.* (2011) reported that farmers perceived adequacy of irrigation water and overall performance of minor irrigation system relatively better. Present study also suggests that irrigation performance is relatively better in case of minor irrigation systems (river lift and groundwater lift) in Birbhum district of West Bengal.

Differential Cropping in Surface and Groundwater Irrigated Area: The rice based cropping is followed by the farmers in the selected canal irrigation command

Table 4: Irrigation service utility as perceived by the farmers with respect to groundwater lift irrigation in Birbhum district of West Bengal

Particular	Mean Perception Score (n=40)		
	***Kharif* season**	***Rabi* season**	**Summer season**
Sufficiency of water	4.10(0.63)	3.70(0.70)	3.40(0.50)
Duration of supply	4.00(0.60)	3.70(0.69)	3.40(0.55)
Frequency of supply	3.50(0.71)	4.70(0.57)	4.60(0.50)
Point of delivery of water	4.00(0.62)	3.70(0.72)	3.60(0.59)
Stream size of water	4.20(0.62)	3.60(0.74)	3.40(0.49)
Timeliness of water supply	4.50(0.55)	4.20(0.52)	3.50(0.55)
Equity of water supply	4.50(0.64)	4.18(0.75)	3.50(0.55)
Functioning of irrigation system below the outlet level	4.10(0.63)	3.70(0.74)	3.30(0.50)
Overall performance	**4.10(0.60)**	**3.90(0.70)**	**3.60(0.50)**

Note: Figures in parenthesis indicate standard deviation values; maximum and minimum possible score is 5 and 1, respectively

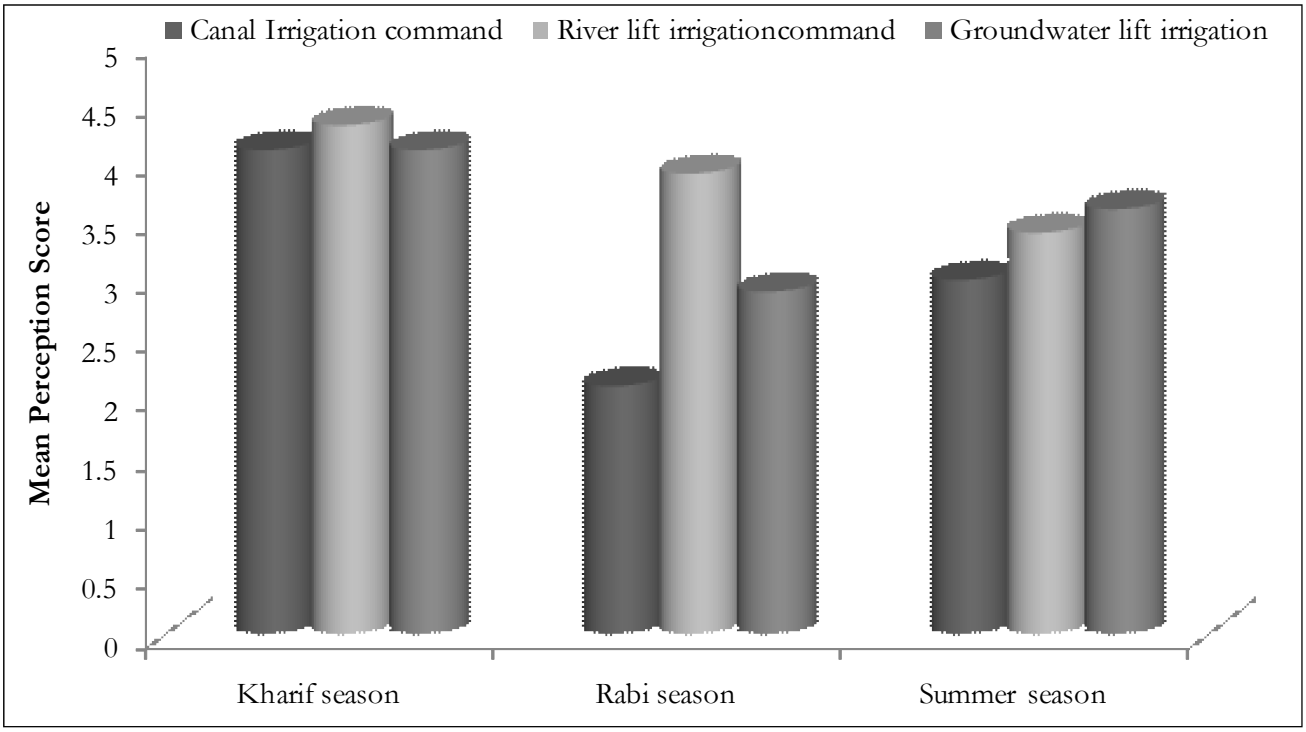

Figure 1: Comparative irrigation service utility in canal, river lift and groundwater lift irrigation commands during different cropping seasons in Birbhum district of West Bengal

area in Birbhum district of West Bengal (Table 5). The paddy is predominant crop in *kharif* season with mean area of 2.03 acre and productivity of about 4t/ha. Farmers used to grow oilseeds, potato and wheat crop with mean area of 0.38 acre, 0.26 acre and 0.21 acre, respectively that shows more than half of the area uncultivated. It may be observed that irrigation performance is rated less than average in *rabi* season by the farmers. The productivity of oilseeds crops, wheat and potato is found to be 1.26 t/ha, 2.10 t/ha and 19.50 t/ha, respectively. *Boro* rice is predominant during summer season covering mean area of 1.8 acre with productivity of 5.6 t/ha. The lack of cultivation in more than half of the cultivable area by the farmers in canal irrigation command area warrants necessary action to bridge the gaps between availability of irrigation service in different seasons.

The predominant cropping pattern in the selected river lift irrigation command area of Birbhum district in West Bengal is presented in Table 6. Paddy occupies on an average 1.59 acre area during *kharif* season with productivity of 4.97 t/ha. During *rabi* season, farmers varied in their preferences of growing crops like potato, oilseeds and wheat crops, which are grown in a mean area of 0.50 acre, 0.40 acre and 0.36 acre, respectively. The average productivity of potato, oilseeds and wheat as mentioned by the farmers is 19.60 t/ha, 1.31 t/ha and 2.13 t/ha, respectively. Paddy is grown in an average area of 1.41 acre during summer season with productivity of 5.63 t/ha. It is interesting to note that more area is cultivated in *rabi* and summer season under river lift irrigation command as compared to canal irrigation command area. However, still there is scope to bring more area under cultivation during *rabi* and summer season with proper crop planning and growing of water economy crops. The presence of WUAs may be attributed to comparatively better cropping scenario with better irrigation management but further improvement is needed to bring more area under cultivation with the objective of more crop per drop.

Evidently from the Table 7, groundwater irrigation command areas have more diversified cropping, especially during *rabi* season. However, paddy is dominated crop both in *kharif* and summer season with mean area of 1.40 acre and 1.16 acre, respectively. The productivity of paddy is better in summer season (6 t/

Table 5: Predominant cropping pattern in canal irrigation command areas in Birbhum district of West Bengal

Crops	Mean area and productivity of different crops in different seasons in canal irrigation command (n=40)					
	***Kharif* season**		***Rabi* season**		**Summer season**	
	Area (acre)	**Productivity (t/ha)**	**Area (acre)**	**Productivity (t/ha)**	**Area (acre)**	**Productivity (t/ha)**
Paddy	2.03(1.54)	4.06(1.58)			1.80(1.50)	5.60 (2.10)
Wheat			0.26 (0.13)	2.10(0.29)		
Oilseeds				0.38 (0.19)	1.26 (0.53)	
Potato			0.25 (0.11)	19.50 (7.56)		

Note: Figures in parenthesis indicate standard deviation values

Table 6: Predominant cropping pattern in river lift irrigation command areas in Birbhum district of West Bengal

Crops	Mean area and productivity of different crops in different seasons in river lift irrigation command (n=40)					
	***Kharif* season**		***Rabi* season**		**Summer season**	
	Area (acre)	**Productivity (t/ha)**	**Area (acre)**	**Productivity (t/ha)**	**Area (acre)**	**Productivity (t/ha)**
Paddy	1.59(0.57)	4.97(0.71)			1.41(0.50)	5.63(1.43)
Wheat			0.36(0.14)	2.13(0.07)		
Oilseeds			0.40(0.22)	1.31(0.42)		
Potato			0.50(0.32)	19.60(4.57)		

Note: Figures in parenthesis indicate standard deviation values

Table 7: Predominant cropping pattern in groundwater irrigation command areas in Birbhum district of West Bengal

Crops	Mean area and productivity of different crops in different seasons in groundwater irrigation command (n=40)					
	***Kharif* season**		***Rabi* season**		**Summer season**	
	Area (acre)	**Productivity (t/ha)**	**Area (acre)**	**Productivity (t/ha)**	**Area (acre)**	**Productivity (t/ha)**
Paddy	1.40(0.90)	4.50(1.00)			1.16(0.60)	6.00(1.00)
Wheat			0.28(0.38)	2.65(0.21)		
Pulses			0.26(0.19)	0.81(0.23)		
Oilseeds			0.30(0.24)	1.32(0.50)		
Potato			0.50(0.36)	20.50(6.20)		

Note: Figures in parenthesis indicate standard deviation values

ha) as compared to *kharif* season (4.5 t/ha). During *rabi* season, potato is predominant with mean area of 0.50 acre and productivity of 20.50 t/ha. The other crops grown during *rabi* season are oilseeds (0.50 acre), wheat (0.28 acre) and pulses (0.26 acre) with average productivity of 1.32 t/ha, 2.65 t/ha and 0.81 t/ha. Thus, the cropping scenario in groundwater irrigation is also found to be better as similar to river lift irrigation command and contrast to canal irrigation command. The farmers participation in irrigation management under the umbrella of WUS must have managed irrigation in a better manner in both groundwater and river lift irrigation command resulting into better crop production. However, there is still possibility of bringing more area under cultivation during dry season through better crop planning and irrigation management.

Evidently from Figure 2, paddy is the major crop in the command areas of selected all three types of irrigation systems during both *kharif* and summer season with more area in the former as compared to the later. During *rabi* season potato is grown in larger areas followed by oilseeds and wheat in both river lift and

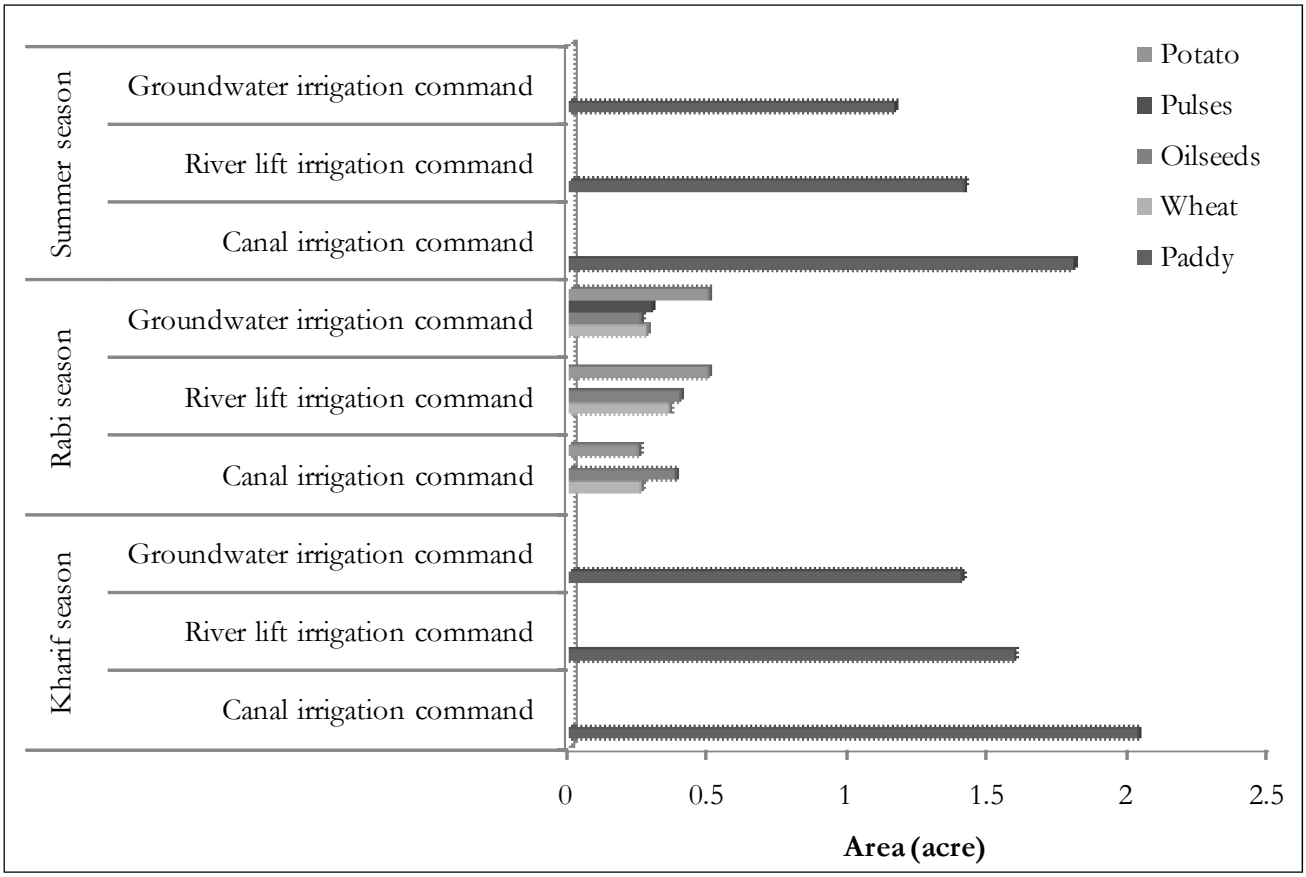

Figure 2: Comparative area under various crops in canal, river lift and groundwater lift irrigation commands during different cropping seasons in Birbhum district of West Bengal

groundwater irrigation commands. Oilseeds have occupied more areas in canal command during *rabi* season. Pulses are also grown in groundwater irrigation command resulting to more crop diversification.

Similar to findings of present study, Nanda *et al.* (2005) mentioned that predominance of paddy crop under major irrigation (canal irrigation) projects was some time ascribed to uncontrolled continuous supply throughout the crop season. It is evident that better crop productivity is realized in groundwater irrigation command. In this context, Srivastava *et al.* (2009) reported that the buyer category (small and marginal farmers with small landholdings) farmers in groundwater irrigation in central Uttar Pradesh realized more productivity of irrigation water in wheat, sugarcane and potato crops as they applied less amount of water as they were engaged in intensive cultivation with proper utilization of resources. Ghosh and Kumar (2012) mentioned that the effect of participatory irrigation management on agricultural performance realized through an increase in irrigation intensity, cropping intensity and yield with spatial and temporal variations. However, it is debated that the shift from government-managed to farmers-managed irrigation system may be one of the contributing, but not the only factor responsible for better agriculture performance. Non-rice producing irrigation systems can be more productive than the rice producing irrigation systems. The effect is found to be varied between sources of irrigation as well as across the command areas of different irrigation systems in the world. There is scope for further improvement through drawing lessons from the experiences in the states like Maharashtra, where Pharande (2015) revealed the direct and indirect benefits of minor irrigation in the command area during the year 2004-2014 by using the both primary as well as secondary data. Cropping pattern showed a shift towards cash crops from food grain crops. Farmers were growing cash crops like, sugarcane, turmeric,

wheat, soyabean and vegetables, etc. instead of cereals. Present study also indicated more diversified cropping pattern in minor irrigation (river lift and groundwater) command areas as compared to major and/or medium irrigation (canal) command areas.

CONCLUSION

The present study revealed performance of canal irrigation, river lift irrigation and groundwater lift irrigation systems in Birbhum district of West Bengal. The irrigation service utility from the perspective of farmers was studied that revealed a better performance of minor irrigation systems (river lift and groundwater irrigation systems) as compared to the surface (canal irrigation) irrigation systems. The farmers' participation in irrigation management in both river lift and groundwater irrigation system has helped in better water management in the minor irrigation command areas. The crop diversification has been witnessed in the minor irrigation command areas with better productivity. Therefore, presence of water user associations (WUAs) is found as potential option to bring better irrigation and cropping scenario in minor irrigation command. The same policy would be effective even in major and medium irrigation command areas.

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Sustainability of Hill Agriculture in North Eastern Himalaya: Evidence from Manipur, India

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ABSTRACT

In India, rice farming is an important occupation and its sustainability is important for ensuring the livelihood of the country. This study examined economic, social and ecological sustainability at district level and found out the factors contributing to sustainability. It has estimated that in economic and social sustainability, 44% and 90% were moderately sustainable. Ecologically, 60% were highly sustainable. Per capita income (0.347), literacy level of women (0.442) and forest area covered (0.233) had maximum direct positive effect on economic, social and ecological, respectively. Hence, it can be stated that the state performed well ecologically which is due to better performance of hill districts.

Keywords: Ecological, Economic, India, Sustainability, Social

INTRODUCTION

The issue of sustainability in agriculture came into the forefront after the publication of Brundtland Commission Report (WECD, 1987). The sustainable agriculture is the main pillar for sustainable livelihoods and food security. It integrates three main goals *i.e.,* environmental health, economic profitability and social equity. It implies responsible and proactive decision-making and innovation that minimizes negative impact and maintains balance between social, environment and economic growth to ensure a desirable planet for all species now and in the future (Magee *et al.,* 2013). Economic efficiency is essential to guide the use of resources both in human and natural under technological conditions to meet the developmental needs of the society. Social sustainability vis-à-vis agriculture deals with the quality of life of the farmers who depends on agriculture for their livelihood. Social equity is fundamental to ensure a more broad based distribution of economic benefits both in present and future in the form of secured livelihood and ecological security to maintain and improve the resource base of the economy. The social dimension shifts the emphasis from individual rights and economic wealth to community right and social welfare of all human beings. The environmental or ecological dimension represents a system for providing integrity and preservation of ecosystem (Sadler, 1990) and is concerned with the continued productivity and functioning of ecosystem (Brown *et al.,* 1987). And environmental perspective represents a scientifically oriented outlook towards sustaining the biological and ecological conditions that make development possible (Shearman, 1990). It also recognizes that flora and fauna might have value outside their abilities to satisfy the social and economic need of individuals and societies.

These three dimensions of agricultural sustainability are often discussed together as their goals overlaps, impact and influence each other. It approaches the agriculture in a way where production process continues without or leastly impairing the ecology and the livelihood of the people in the society. But always the social and ecological benefits of sustainable agricultural practices do not translate into immediate economic gains. There are trade-offs between these dimensions. Looking at the issue of sustainability of agriculture at macro level is about analyzing the indicators of sustainability at district or state or country level which are central to the provisioning of the condition at which the farms operate. The macro studies on agricultural

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sustainability have largely focused on rice farming as agriculture in India is a rice-based system. Hence, the present study is on attempt to answer the questions i) whether the rice farming is economically, socially and ecologically sustainable at macro level? ii) How the three dimensions of sustainability are interrelated? iii) And what are the variables that affect sustainability and which variable contribute most to maintain agricultural sustainability of the state?

MATERIALS AND METHODS

Manipur is one of the North Eastern States of India located in between 95°58´E to 94°45´E longitudes and 23°50´N to 25°42´N latitudes. It consists of nine districts *i.e.,* five hill districts and four valley districts. Secondary data pertaining to different sustainability indicators of the districts were collected from the various publications of the Directorate of Economics and Statistics, Department of Agriculture, and Directorate of Settlement and Land Revenue, Government of Manipur, India.

Sustainability of different districts were assessed based on the three dimensions *i.e.,* economic, social and ecological indicators. Each of the dimensions was studied through measurement of different indicators (Table 1). The selection of indicators under each of the dimensions was based on the ability to measure each of the dimensions and the ability of the dimensions to influence the level of indicators.

Sustainability Index: The sustainability index (SI) for each of the three dimensions was constructed based on the Human Development Index (HDI) developed by UNDP (1990).Weights of the indicators were calculated based on the method of Iyenger and Sudarshan (1982) (Annexure 1). The overall sustainability of the districts was assessed by constructing composite sustainability index (CSI) by averaging of the three sustainability indices. Based on the values of sustainability indices, the districts were categorized into four such as i) least sustainable (0.00 to 0.25) ii) moderately sustainable (0.26 to 0.50) iii) sustainable (0.51 to 0.75) and iv) highly sustainable (0.76 to 1.00).

Relationship among different sustainability dimensions: The Spearman's rank correlation coefficient was calculated to study the relationship between overall sustainability and its indices *viz.* economic, social and ecological.

Table 1: Indicators for sustainability assessment

Dimensions	Indicators	Unit	Year
Economic	• Rice productivity	• kg/ha	2013-14
	• Per capita output of food grains	• MT/annum	2013-14
	• Per capita income	• Rs./annum	2013-14
	• Public Distribution System (PDS)	• MT	2013-14
	• Fertilizer consumption	• kg/ha	2013-14
	• Cropping intensity	• %	2013-14
	• Livestock density	• No./sq.km.	2013-14
	• Labour availability	• million	2013-14
Social	• Female literacy	• %	2012-13
	• Infant mortality	• %	2012-13
	• Rural road connectivity	• km	2012-13
	• Village electrified	• %	2013-14
	• Telecommunication facilities	• No./sq. km.	2013-14
	• Employment in organized sector	• %	2013-14
	• No. of cooperative societies	• Number	2013-14
	• Expenditure in rural development	• Rs.	2012-13
Ecological	• Population density	• No./sq.km.	2012-13
	• Forest area covered	• %	2013-14
	• Cropping intensity	• %	2013-14
	• Livestock density	• No./sq/km.	2013-14
	• Area under rice cultivation	• ha	2013.14

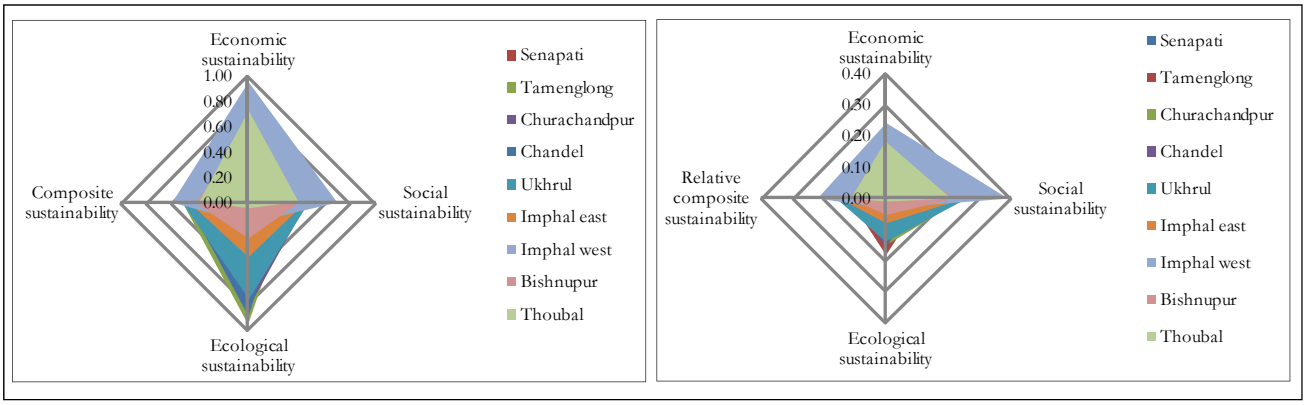

Figure 1: Distribution of sustainability dimensions across different districts of Manipur

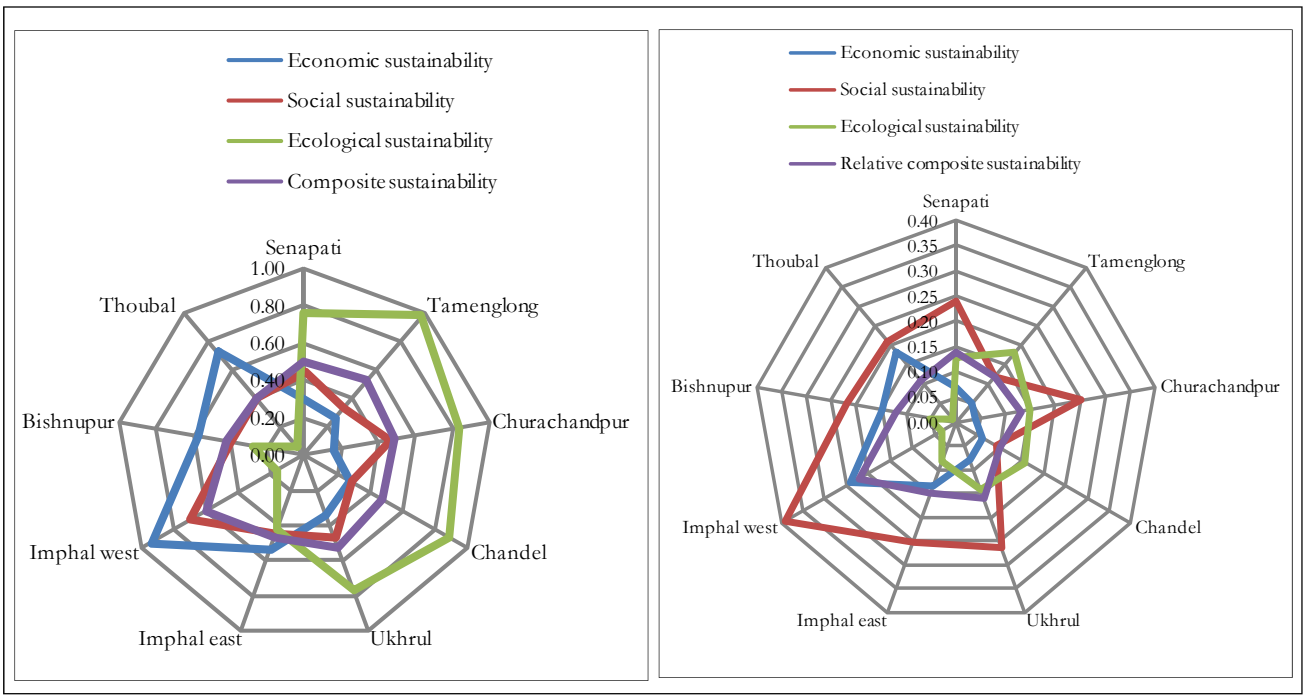

Figure 2: Distribution of indices for different districts across sustainability dimensions

Factors affecting the overall sustainability: Zero order correlation coefficients between overall sustainability and different identified indicators were calculated.

Further, path analysis, a multivariate statistical technique was applied to find out the variable has which contributed maximum to the three dimensions of sustainability. Path analysis consists of two paths; a) direct path b) indirect path. It specifies the relationship between the observed variables and examines the causal relationship among the variables. It indicates how the variables relate to one another and develop logical theories about the processes influencing a particular outcome (Duncan, 1966). The steps to estimate the direct and indirect effects are as follows

1) Standardize both effect (Y) and causal variables (Xs) as (x*) = (x-m)/SD, where, x* is the standardize value, x is the original value, m is mean and SD is the standard deviation.

2) Regress effect variable (Y) on the standardized variables (x*) which gives the partial regression coefficients (direct path coefficients).

3) The path coefficient (direct effect) from cause X_1 to the effect Y is given as

   $Y = \sigma X_1 / \sigma Y_1$, where s is the standard deviation.

4) The indirect contribution of X_1 to Y includes X_1 through X_2, X_3, *etc.* The same applies to X_2, X_3, *etc.* The equation below shows the splitting process for causal variables with one effect variable Y.

$$r(X_1,Y) = a + r(X_1,X_2)b + r(X_1, X_3)c \ldots\ldots\ldots\ldots\text{xiii}$$

$$r(X_2,Y) = r(X_2,X_1)a + b + r(X_2, X_3)c \ldots\ldots\ldots\ldots\text{xiv}$$

$$r(X_3,Y) = r(X_3,X_1)a + r(X_3, X_2)\, b + c \ldots\ldots \textit{etc.} \ldots\text{xv}$$

Where, a,b,c,… are the partial regression coefficients and $r(X_1,X_2)$, $r(X_1, X_3)$,….. are the correlation coefficients.

The above equation shows the partition of each of the correlation from (X_1 to Y), (X_2 to Y), *etc,* into their component paths.

i. Due to direct effect of X_1 on Y
ii. Due to indirect effect of X_1 on Y via X_2
iii. Due to indirect effect of X_1 on Y via X_3, *etc.*

If the correlation coefficient between a causal factor and effect is almost equal to the direct effect, then correlation explains the true relationship. If the correlation coefficient is positive but the direct effect is negative, the indirect effect seems to be the cause of correlation. In such cases, the indirect causal factors are to be considered. The correlation coefficient may be negative but the direct effect is positive and high. In these circumstances, a way to selectively drop the undesirable indirect effects will have to be introduced (Singh and Chaudhary, 1995).

RESULTS

Sustainability of different districts: The economic, social and ecological sustainability indices ranged from 0.16 to 0.95, 0.29 to 0.70 and 0.05 to 0.97, respectively, which reflects wide variation within each sustainability dimensions across the districts (Table 2). Among the nine districts, Imphal West district ranked first in economic and social sustainability but in case of ecological sustainability, Tamenglong district topped the list. Economic indicators such as rice productivity (2785 kg/ha), number of labourer (0.21 million), per capita income (Rs. 41421/annum) and food supply through PDS (66.43 MT) and social indicators such as female literacy (80%), telecommunication density (16564/ sq.km.) and employment in organized sector (34%) were better for Imphal West district as compared to other districts of Manipur. Tamenglong district topped as the forest coverage (89.07%) was larger in the district. Churachandpur (0.16) and Chandel (0.298), which are the hill districts, were at the bottom in case of economic and social sustainability, respectively. But, ecologically, Thoubal, a valley district was the worst performing district in Manipur as the area under rice cultivation (28.85 thousand hectare) was highest and forest coverage (10.89%) was lower as compared to other districts of Manipur.

In overall, Imphal West (0.60) was comparatively sustainable than all the other districts of Manipur, followed by Ukhrul (0.53) and Tamenglong (0.52) districts, whereas, Thoubal (0.39) and Chandel (0.10)

Table 2: Ranking of different districts of Manipur across sustainability dimensions

S.No.	Districts	Economic sustainability		Social sustainability		Ecological sustainability		Overall Sustainability	
		Index value	Ranks	Index value	Ranks	Index value	Ranks	Index value	Ranks
Hill districts									
1	Senapati	0.29	VI	0.44	V	0.76	V	0.50	IV
2	Tamenglong	0.26	VIII	0.33	VIII	**0.97**	**I**	0.52	III
3	Churachandpur	0.16	IX	0.46	III	0.84	III	0.49	V
4	Chandel	0.28	VII	0.29	IX	0.89	II	0.48	VI
5	Ukhrul	0.34	V	0.47	II	0.77	IV	0.53	II
Valley districts									
1	Imphal East	0.53	III	0.45	IV	0.43	VI	0.47	VII
2	Imphal West	**0.95**	**I**	**0.70**	**I**	0.16	VIII	**0.60**	**I**
3	Bishnupur	0.52	IV	0.40	VI	0.28	VII	0.42	VIII
4	Thoubal	0.72	II	0.39	VII	0.05	IX	0.39	IX

Table 3: Relative sustainability status of different districts of Manipur, India

S.No.	Districts	Economic sustainability		Social sustainability		Ecological sustainability		Overall Sustainability	
		Index value	Ranks	Index value	Ranks	Index value	Ranks	Index value	Ranks
1	Senapati	0.07	VI	0.24	V	0.13	V	0.14	IV
2	Tamenglong	0.05	VIII	0.12	VIII	**0.18**	**I**	0.12	VI
3	Churachandpur	0.04	IX	0.25	III	0.15	III	0.13	V
4	Chandel	0.06	VII	0.09	IX	0.16	II	0.10	IX
5	Ukhrul	0.08	V	0.26	II	0.14	IV	0.16	II
Valley districts									
1	Imphal East	0.13	IV	0.25	IV	0.08	VI	0.15	III
2	Imphal West	**0.24**	**I**	**0.39**	**I**	0.03	VIII	**0.22**	**I**
3	Bishnupur	0.15	III	0.22	VI	0.05	VII	0.12	VII
4	Thoubal	0.18	II	0.21	VII	0.01	IX	0.11	VIII

districts were the least sustainable district in Manipur when equal and appropriate weights were assigned, respectively. Imphal West turned out to be the best district in comparison to other districts because its performance on economic and social indicators was better than other districts of Manipur though it did not fare well in case of ecological indicators.

In terms of economic sustainability, majority of the districts of Manipur were in either moderately sustainable (44%) or sustainable (33%) category. Socially, 90% of the total districts turned out to be moderately sustainable. Ecologically, 60% of the total districts were highly sustainable, but 20% were in least sustainable category (Table 4, colmn 9, 10, and 11). In terms of overall sustainability, 75% of the total districts were moderately sustainable and the remaining was in sustainable category (Table 4, colmn 12). Hence, it can be stated that the overall performance of different districts of Manipur was not satisfying. Though the state performed well in terms of ecological sustainability which is primarily due to better performance of hill districts, only 10% of the districts scored more than 0.50 in case of social sustainability, which was hypothesized to be better in North Eastern states (Table 4).

Hill vs Valley districts: Economically, majority of the hill districts (80%) were moderately sustainable whereas, majority of the valley districts (75%) were in sustainable category (Table 4) because the per capita income and livestock density were higher in valley districts. In terms of social sustainability, all the hill districts and 75% of the valley districts were moderately sustainable. Remaining 25% of the valley districts were in sustainable category as the social indicators *viz.* female literacy, rural road connectivity and number of village electrified were better in valley districts. All the hill districts were highly sustainable ecologically due to larger forest coverage but, in case of valley district, 50% of the districts were moderately sustainable and remaining were least sustainable.

In terms of overall agricultural sustainability, majority of the hill districts (60%) as well as valley districts (75%) were in moderately sustainable category. Remaining 40% of the hill districts and 25% of the valley districts were in sustainable category (Table 4, colmn. 4 and 8).

Hence, in terms of economic sustainability and social sustainability, valley districts performed better than hill districts but it was reverse in case of ecological sustainability. Interestingly, the hill districts outperformed the valley districts in terms of overall agricultural sustainability which implies that ecological indicators cannot be overlooked while improving the economic sustainability of the districts.

Relationship among different sustainability dimensions: The rank correlation between economic and social sustainability is positive and significant, which signifies that by if the economic sustainability increases, the social sustainability will also improve. But, economic and ecological sustainability is negative and strongly significant, which suggests that by strengthening economic sustainability, the composite sustainability can

Table 4: Distribution of districts of Manipur across different sustainability categories

Category	Hill districts				Valley districts				Overall			
	ES	**SS**	**ELS**	**OS**	**ES**	**SS**	**ELS**	**OS**	**ES**	**SS**	**ELS**	**OS**
Column no	1	2	3	4	5	6	7	8	9	10	11	12
LS (0.00 to 0.25)	CP	-	-	-	-	-	IW,TH	-	CP	-	IW, TH	-
MS (0.26 to 0.50)	S,TM, CD, UK	S, TM, CP, CD,UK	-	S, CP, CD	-	IE, B, TH	IE,B	IE,B, TH	S,TM, CD, UK	S, TM,CP, CD,UK, IE, B,TH	IE,B	S, CP,CD, IE, B,TH
SU (0.51 to 0.75)	-	-	-	TM,UK	IE,B, TH	IW	-	IW	IE,B, TH	IW	-	TM,UK, IW
HS (0.76 to 1.00)	-	-	S, TM, CP,CD, UK	-	IW	-	-	-	IW	-	S, TM, CP,CD, UK	-

Note: ES = Economic sustainability, SS = Social sustainability, ELS = Ecological sustainability, OS = Overall sustainability S = Senapati, TM = Tamenglong, CP = Churachandpur, CD = Chandel, UK = Ukhrul, IW = Imphal West, IE = Imphal East, B = Bishnupur, TH = Thoubal

be improved but at the same time there would be a trade-off with ecological sustainability primarily. This is found similar in case of social and ecological sustainability. Similarly, Chand and Sirohi (2012) also suggested that the livestock sustainability can be improved by strengthening economic sustainability and there was a trade-off in terms of ecological security. This is similar in case of social and ecological sustainability of the districts as the increased construction activity destroys the ecology.

Factors affecting overall sustainability of the districts: The composite sustainability index (CSI) was significantly correlated with twelve out of nineteen variables, when equal weights were given and seven out of nineteen variables, when absolute weights were assigned. There was a strong and positive significant correlation between rice productivity, labour availability, per capita income, supply of food grains through PDS, livestock density, female literacy, telecommunication density, employment in organized sector and number of co-operative societies with the overall sustainability. Besides this, the livestock density had positive and significant correlation with the overall sustainability. Though it negatively affects the ecological sustainability, it helps in improving the overall sustainability through regular flow of income to the farmers.

Strong and negative significant correlation (-0.45) between overall sustainability and fertilizer consumption, when absolute weights were assigned and it shows that even if it is significant, the fertilizer consumption in the study area (hill districts) in not in optimum level (Table 6). The per capita output of food grains is low in valley districts due to high population density but the other sustainability indicators have done well in the valley districts. This is the root for negative correlation coefficient of the factor. The village electrification had negative and significant correlation with overall sustainability, which signifies the lack of reliable electricity supply in the hill districts of Manipur.

Direct and indirect effect of different indicators: Among all the causal variables per capita income had the maximum direct positive effect (0.347) on economic sustainability, followed by fertilizer consumption, livestock density and labour availability which imply that these variables are important for improving economic sustainability of the districts (Table 7).

Table 5: Rank correlation between sustainability dimensions

S.No.	Sustainability components	Spearman's rank correlation coefficient	
		Relative	Absolute
1.	Composite sustainability and Economic sustainability	0.37**	-0.15
2.	Composite sustainability and Social sustainability	0.97***	0.53**
3.	Composite sustainability and Ecological sustainability	-0.28	0.33**
4.	Economic and Social sustainability	0.40**	0.30**
5.	Economic and Ecological sustainability	-0.88***	-0.92***
6.	Social and Ecological sustainability	-0.38**	-0.33**

*** and ** significant at 1% and 5% level of significance, respectively

Table 6: Correlation between overall sustainability and the indicators

S.No.	Variables	Correlation coefficient	
		Relative CSI	Absolute CSI
1.	Rice productivity	0.54***	0.38**
2.	Fertilizer consumption	0.12**	-0.45**
3.	Cropping intensity	-0.001	-0.39**
4.	Labour availability	0.51***	0.001
5.	Per capita output of food grains	-0.50***	0.07
6.	Per capita income	0.76***	0.54***
7.	Supply of food grains through PDS	0.57***	0.06
8.	Livestock density	0.34**	-0.02
9.	Female literacy	0.78**	0.59***
10.	Infant mortality	0.25	-0.003
11.	Village electrification	-0.01	-0.39**
12.	Telecommunication density	0.82***	0.61***
13.	Employment in organized sector	0.74***	0.31
14.	Number of co-operative societies	0.66***	0.08
15.	Rural development	0.01	0.19
16.	Rural road connectivity	-0.23	0.30
17.	Population density	-0.48**	-0.03
18.	Forest area coverage	-0.30	0.26
19.	Area under rice cultivation	0.27	-0.28

Note: CSI = Composite Sustainability Index
*** and ** significant at 1% and 5% level of significance, respectively

Table 7: Estimate of direct and indirect effect on economic sustainability

Variable	RP	FC	CI	LA	PF	PCI	PDS	LD	ES
RP	**0.159**	0.052	0.033	0.109	-0.063	0.148	0.089	0.094	0.623
FC	0.041	**0.202**	0.128	0.142	-0.134	0.155	0.116	0.188	0.840
CI	0.029	0.141	**0.184**	0.046	-0.049	0.104	0.031	0.117	0.606
LA	0.090	0.149	0.044	**0.193**	-0.174	0.180	0.163	0.174	0.821
PF	-0.055	-0.147	-0.048	-0.182	**0.185**	-0.151	-0.163	-0.163	**-0.727**
PCI	0.068	0.091	0.055	0.100	-0.081	**0.347**	0.080	0.114	0.775
PDS	0.078	0.129	0.031	0.172	-0.165	0.152	**0.183**	0.163	0.744
LD	0.075	0.190	0.108	0.168	-0.151	0.198	0.149	**0.200**	0.940

Note: ES = Economic sustainability, RP = Rice productivity, FC = Fertilizer consumption, CI = Cropping Intensity, LA = Labour availability, PF = Per capita output of food grains, PCI = Per capita income, PDS = Public Distribution System, LD = Livestock density

Table 8: Estimate of direct and indirect effect on social sustainability

Variable	FL	IM	VE	TC	EO	CS	RD	RR	SS
FL	**0.442**	-0.104	-0.103	0.166	0.162	0.225	0.130	-0.108	0.810
IM	-0.140	**0.329**	-0.142	-0.065	-0.140	-0.213	0.047	0.118	-0.206
VE	-0.119	-0.121	**0.386**	0.078	0.173	0.150	-0.351	-0.225	-0.028
TC	0.219	-0.064	0.089	**0.335**	0.311	0.200	-0.103	-0.147	0.842
EO	0.207	-0.134	0.194	0.302	**0.345**	0.291	-0.167	-0.234	0.803
CS	0.277	-0.195	0.161	0.186	0.278	**0.360**	-0.071	-0.251	0.745
RD	0.143	0.039	-0.337	-0.086	-0.144	-0.063	**0.401**	0.124	0.077
RR	-0.135	0.111	-0.225	-0.140	-0.229	-0.256	0.142	**0.352**	-0.382

Note: SS = Social sustainability, FL= Female literacy, IM = Infant mortality, VE = Village electrification, TC = Telecommunication, EO = Employment in organized sector, CS = Cooperative society, RD = Expenditure on rural development programme, RR = Rural road connectivity

Table 9: Estimates of direct and indirect effects on ecological sustainability

Variable	PD	FA	CI	LD	AR	ELS
PD	**0.211**	0.201	0.106	0.215	0.159	0.679
FC	0.211	**0.233**	0.161	0.221	0.147	0.724
CI	0.100	0.144	**0.209**	0.123	0.055	0.568
LD	0.220	0.215	0.133	**0.226**	0.166	0.722
AR	0.136	0.120	0.049	0.138	**0.189**	0.580

Note: ELS = Ecological sustainability, PD = Population density, FA = Forest area cover, CI = Cropping intensity, LD = Livestock density, AR = Area under rice

The literacy level of women had the maximum direct positive effect (0.442) on social sustainability, followed by expenditure in rural development (0.401) and number of villages electrified (0.386). This indicates that emphasis should be given to the education of women, more expenditure should be made in different rural development schemes and village electrification should be expedited to improve the social sustainability across the districts (Table 8).

Among all the causal variables, the forest area covered had the maximum direct positive effect (0.233) on ecological sustainability, followed by livestock density (0.226) and population density (0.211). This revealed that more emphasis should be given to increase forest cover so as to maintain the ecological sustainability of the districts. Population density (0.211), cropping intensity (0.209), livestock density (0.226) and area under rice cultivation (0.189) have positive direct effect (Table 9).

CONCLUSION

Economically, majority of the districts of Manipur were in either moderately sustainable or sustainable category. Socially, most of the districts turned out to be moderately sustainable and ecologically, 60% of the total districts were highly sustainable, but 20% were in least sustainable category. In terms of overall sustainability, $3/4^{th}$ of the total districts were moderately sustainable and the remaining was in sustainable category. About 60% of the hill districts and 75% of the valley districts were moderately sustainable. In terms of ecological sustainability, hill districts performed better than valley district but, it was reversed in case of economic and social sustainability. The social and ecological sustainability were negatively correlated with economic sustainability, which means that by strengthening economic sustainability, the composite sustainability can be improved but at the same time there would be a trade-off in ecological and social sustainability. The composite sustainability index was significantly correlated with rice productivity, labour availability, per capita income, supply of food grains through PDS, telecommunication density, employment in organized sector, and number of cooperative societies. Among all the indicators of economic, social and ecological sustainability, per capita income, the literacy level of women and the forest area covered had the maximum

direct positive effect on economic, social and ecological sustainability, respectively. Per capita income, literacy level of female and the forest area coverage are the most important factors for economic, social and ecological sustainability of different districts in Manipur. Thus, to maintain the sustainability, efforts should be put to improve economic indicators in hill districts by enhancing per capita income and promoting livestock rearing. Social sustainability may be improved by increasing female literacy, extent of rural electrification and investment on rural development schemes by the State Government. And, the ecological sustainability of valley district should be improved by implementing afforestation and agro-forestry projects. Therefore, the study suggests that there is a scope of improving the economic, social and ecological sustainability by implementing the suitable means as suggested above in the study area.

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Income Generation Among the Women Members of SHGs Through Dairy Enterprise in District Bulandshahar, Uttar Pradesh

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ABSTRACT

Dairy as a commercial enterprise is an established venture from income generation perspective. Present study was conducted to investigate the SHG women's involvement in dairy as a business, awareness about different aspects of dairying, income generated, constraint faced and also the future prospects. Data was collected and synthesized fora large sample of 2864 rural women representing 247 SHGs across 63 villages under four blocks of the district. All the SHGs (average number of members 10-15/group)were engaged in dairy business and were earning a profit of Rs 1360/day. Dairy farming is highly occupied (65-70%) by rural women in district Bulandshahar. Almost all the dairy related chores are looked after by women in rural areas. During study it was found that most of the women (68.79%) from Jahangirabad block are involved in dairy related practices. 58.34% of SHGs of Block 4 (Jahangirbad) is facing some or the other constraints like social, financial and marketing followed by Block 1 (Anoopshahar), block 2 (Danpur) and block 3 (Dibai) with 56.64%, 55.88% and 51.56%, respectively. Well crafted awareness campaigns were found to be advantageous. Women were generally not much involved in banking procedures therefore they should be encouraged by males to look into banking procedures of SHGs. Processing of milk could also be taken along with mere sale of milk in SHGs to improve the earning. It was very much visible from the study that dairying could be appropriately accepted as a business for self reliability and to raise the socio-economic status of the rural women.

Keywords: Awareness, Dairy farming, Business, KVK, SHGs, Rural women

INTRODUCTION

Involvement of Indian women in country's progress at all levels is an undisputable reality although the intensity of engagement varies on space and time. The vital role of women in agriculture, allied occupations and household activities has however been immensely underestimated and undervalued. Women play significant and crucial role in agricultural development and allied fields like dairy farming, etc. Western Uttar Pradesh is quite rich in agriculture and women play an indispensable role in imparting agricultural operations. Bulandshahar is the major contributor in state's economy in terms of milk production. Women involvement in perusing dairy farming is commendable in the district. Dairying is an important means of livelihood to millions of rural farmers. Increasing demand for milk and milk products in recent years intensifies dairy farming as profitable enterprise for women (Mohapatra *et al.,* 2012). The government of India report indicates that 85 percent of rural women are engaged in livestock production (Viswanathan, 1989).

Women generally contribute more labour inputs in areas of fodder cutting, watering, cleaning of animals and their sheds etc (Arshad *et al.,* 2013). *Pardada Pardadi* Educational Trust (PPET), Anoopshahr is an educational trust which provides free education to girls and generates employment for rural women. It

establishes SHGs of women and involves them in one or the other entrepreneurship. Dairy farming for income generation for rural women is their main area of working. The SHGs are a powerful tool of socioeconomic development of the poor women in rural areas as it accelerates the change in income, occupation, social participation, expenditure, decision making and change in confidence level (Bansode *et al.,* 2013). Krishi Vigyan Kendra, Bulandshahar is providing technical trainings to these SHGs from time to time in entrepreneurship development and awareness generation. Women are facing many taboos in the society. The objective of the study conducted was to find out the effect of SHGs on income and constraint faced by the women in pursuing dairy as business.

MATERIALS AND METHODS

The present investigation was designed to study the role, participation, income generation and constraints faced by SHGs of rural women in pursuing dairy as a small scale business. Four blocks (Anoopshahr, Danpur, Dibai and Jahangirabad) were purposely selected as they were in cluster and 247 SHGs comprising of 2864 rural women were already established and involved in dairy business. They were established by Pardada Pardadi Educational Trust and trained from time to time by Krishi Vigyan Kendra, Bulandshahar. The women participation was around 70-75% in dairy related practices. A pretested semi structured interview schedule was used to collect the data by personal interview method. Contributions of women in dairy activities were studied with respect to their involvement in dairy activities like feeding, management, breeding, health care and processing of milk. Necessary information was also collected from secondary sources like departmental documents, dairy societies and the milk collection centres located in the selected SHGs. Following the completion of the data collection, the collected data were coded, tabulated, classified and further categorized for systematic statistical analysis. The descriptive statistical tools like frequency, average and percentage were used for analysis of data and the results were interpreted accordingly.

RESULTS AND DISCUSSION

The frequency of SHGs, villages and rural women in the four blocks as in Table 1 indicates that maximum number of respondents (2430) were from Anoopshahar block forming 211 SHGs from 51 villages. In Jahangirabad block only 03 SHGs were taken but they represented the whole block.

Socio-economic profile: It is revealed from the Table 2 that majority of the SHGs were under the capable hands of women in the age group of 20-40 years. It was known that women from Block 2 had maximum of Hindu population (90.58 percent) followed by Block 1 (87.04%). It was also revealed that only Hindu and Muslim population were involved in dairy business in SHGs. The findings showed that 70.08 per cent of respondents were literates, while 29.92 per cent of the women were illiterates. Majority of farm women had a family type who lived in joint family (51.80%) while 48.20 per cent lived in nuclear family. About the occupation, the study revealed that the major occupation was agriculture (46.82%) followed by labourers (36.37%). The remaining farm women were engaged as home makers and shopkeepers (16.81%). The frequency distribution as shown in Table 3 revealed that Block 1 had the higher quantity of Milch animals (6167) and least was met in Block 4. Majority of women (81.71%) were performing the milking practice in milch animals. It is evident from Table 4 that women were least involved (35.06%) in the vaccination as they usually took care of animals and vaccination was the job of males. But they were aware of vaccination and different

Table 1: Frequency distribution of SHGs in different Blocks of district Bulandshahr

Blocks	Villages	SHGs	Rural Women
Block 1-Anoopshahar	51(80.95)	211(85.43)	2430(84.85)
Block 2 –Danpur	05(7.94)	17(6.88)	223(7.79)
Block 3- Dibai	05(7.94)	16(6.48)	176(6.14)
Block 4- Jahangirabad	02 (3.94)	03(1.21)	35(1.22)
Total	**63**	**247**	**2864**

Figures in parentheses indicate percentage

Table 2: Socio-demographic profile of rural women of SHGs involved in dairy business of district Bulandshahar

Particulars	Anoopshahar	Danpur	Dibai	Jahangirabad	Average
Age (in years)					
20-40	1310(53.91)	115(51.57)	95(53.98)	22(62.86)	55.58
41-60	1120(46.09)	108(48.43)	81(46.02)	13(37.14)	44.42
Religion					
Hindu	2115(87.04)	202(90.58)	128(72.73)	27(77.14)	81.87
Muslim	315(12.96)	21(9.42)	48(27.27))	08(22.86)	18.13
Occupation					
Labourers	1290(53.09)	111(49.78)	75(42.61)	-	36.37
Agriculturists	1030(42.37)	88(39.46)	90(51.14)	19(54.29)	46.82
Others	110(4.53)	24(10.76)	11(6.25)	16(45.71)	16.81
Not Employed	-	-	-	-	-
Education					
Illiterate	609(25.06)	75(33.63)	52(29.55)	11(31.44)	29.92
Primary	918(37.78)	110(49.33)	71(40.34)	15(42.86)	42.57
High School	410(16.87)	25(11.21)	39(22.16)	05(14.27)	16.13
Intermediate	312(12.84)	08(3.59)	09(5.11)	03(8.57)	7.53
Graduation	181(7.45)	05(2.24)	05(2.84)	01(2.86)	3.85
Family type					
Nuclear	1410(58.02)	110(49.33)	85(48.30)	13(37.14)	48.20
Joint	1020(41.98)	113(50.67)	91(51.70)	22(62.86)	51.80

Figures in parentheses indicate percentages

Table 3: Frequency distribution of milch animal holding in different Blocks of district Bulandshahar

Milch animals	Anoopshahar	Danpur	Dibai	Jahangirabad
Cow	1245	111	96	22
Buffalos	1836	331	167	48
Cow+Buffalos	1456	184	119	20
Cow+Buffalos+goats	1630	142	167	88

Figures in parentheses indicate percentages

diseases due to time to time awareness campaigns organised by PPET. Maximum (87.74%) proportions of respondents from Block 1 were involved in chaff cutting and feeding animals. All the activities regarding feeding and watering were done only by women, which is in consonance with the findings of Gupta *et al.* (1986) and Rangnekar *et al.* (1992).

Awareness and income generation: The work of animal shed construction, grooming of animals were also performed by women which is in accordance with the findings of Puri (1971) who revealed that preparation of feed and bathing of animals were mostly carried out by women. It is evident from Table 5 that most of the women were fully aware(31.80%) of management practices like construction of shed, care of new born calves, cleaning of udder and milking, cleaning and bathing of animals and cleaning of cattle shed. It was revealed from the table that most of the women were unaware of marketing and financial issues including purchasing and selling of animals and availing credit facilities. Moreover the study indicates less participation of women in Care of animal during parturition and post parturition (39.91%) and treatment of animals during illness (20.63%) (Sarma *et al.,* 2002). Awareness regarding these topics needs to be taken into consideration. Dairying is practised by most of the rural folk as a business enterprise by involving themselves by selling the fresh milk to nearby cooperatives or markets by joining various groups. These groups serve as a continued support to be associated in the dairying enterprise which would otherwise involve great effort and labour on the part of the individuals. It was seen that the rate of milk varied from Rs 28 to 30 (Table 6).

Table 4: Frequency distribution of women involved in dairy practices in SHGs of different blocks of district Bulandshahr

Dairy related chores	Anoopshahar	Danpur	Dibai	Jahangirabad	Average
Chaff cutting, feeding and watering animals	2132(87.74)	174(78.03)	132(75.00)	21(60.00)	75.19
Milking	2026(83.37)	191(85.65)	142(80.68)	27(77.14)	81.71
Cleaning of shades	1652(67.98)	193(86.55)	111(63.07)	30(85.71)	75.83
Care of animals and vaccination etc.	906(37.37)	73(32.74)	48(27.27)	15(42.86)	35.06
Selling milk	1021(42.02)	136(60.99)	84(47.73)	19(54.29)	51.26
Total	**63.68**	**68.79**	**58.75**	**64.00**	

Figures in parentheses indicate percentages

Table 5: Awareness about different dairy practices of women in SHGs

Awareness Parameters	Average of all Blocks		
	Fully Aware	**Aware**	**Unaware**
Breeding			
High milk producing breed	366(12.78)	2078(72.56)	420(14.66)
Taking animals for pregnancy diagnosis	470(16.71)	1902(66.48)	490(17.11)
Care of animal during pregnancy	356(12.43)	958(33.45)	1550(54.12)
Care of animal during parturition and post parturition	247(8.62)	1192(41.62)	1425(49.76)
Average	**12.64**	**53.53**	**33.91**
Feeding			
Mixing and giving feed to animals	352(12.29)	1064(37.15)	1448(50.56)
Frequency of fodder given	506(17.67)	1088(37.99)	1270(44.34)
Frequency of water given	1578(55.10)	923(32.23)	363(12.67)
Average	**28.35**	**35.79**	**35.86**
Health care			
Taking animals to hospitals for treatment	575(20.08)	1440(50.28)	849(29.64)
Taking animals for vaccination	490(17.11)	1767(61.70)	607(21.19)
Deworming	336(11.73)	1900(66.34)	628(21.93)
Care of sick animals	573(20.01)	2012(70.25)	279(9.74)
Average	**17.23**	**62.14**	**20.63**
Management			
Construction of shed	992(34.64)	1736(60.61)	136(4.75)
Care of new born calves	747(26.08)	1627(56.81)	490(17.11)
Udder cleaning and milking	935(32.65)	1705(59.53)	224(7.82)
Cleaning and Bathing of animals	990(34.57)	1415(49.41)	459(16.03)
Cleaning of cattle shed	890(31.08)	1705(59.53)	269(9.39)
Average	**31.80**	**57.18**	**11.02**
Marketing			
Purchasing and selling of animals	1052(36.73)	1618(56.49)	194(6.77)
Sale of milk	1085(37.88)	1487(51.92)	292(10.20)
Record keeping	222(7.75)	1174(40.99)	1468(51.25)
Availing credit Facilities	347(12.12)	1302(45.46)	1215(42.42)
Average	**23.62**	**48.72**	**27.66**

Figures in parentheses indicate percentages

Table 6: Income generated by SHGs through dairying as business

Particulars	Anoopshahr	Av./gp	Danpur	Av./gp	Dibai	Av./gp	Jahangirabad	Av./gp
Milk sale/day (kg)	9720.00	46.06	892.00	52.47	704.00	44.00	140.00	47.67
Income incurred/day (Rs in th.)	291600	1381	24976	1470	21120	1320	3920	1306
Rate/litre (Rs)	30	30	28	28	30	30	28	28

Table 7: Constraints faced by SHGs in dairying as business

Constraints	Anoopshahr	Danpur	Dibai	Jahangirabad	Average
Social(male dominance, prejudice etc.)	52(24.64)	06(35.29)	04(25.00)	01(33.33)	29.57
Banking(uneasiness in handling bank issues)	126(59.72)	11(64.71)	12(75.00)	02(66.67)	66.53
Rate fixation of milk by milk vendors	172(81.52)	11(64.71)	09(56.25)	02(66.67)	67.29
Reimbursement from milk man	128(60.66)	10(58.82)	08(50.00)	02(66.67)	59.04
	56.64	55.88	51.56	58.34	

Figures in parentheses indicate percentages

The income generated maximum in Block 2by getting an average of Rs 1470/- per day with an average milk sale of 52.47 kg/day followed by Block 1 with an average of Rs 1381/- with an average milk sale of 46.06 kg/day.

Constraints experienced: The study also tried to visualise the constraints associated with the SHGs as a dairying enterprise and it was observed that male dominance, prejudice, uneasiness in banking, problem of rate fixation by vendors and reimbursement of money from milkman were the major issues. The significant were problem of rate fixation which emerged as the major problem (67.29%) followed by uneasiness in banking (66.53%) and reimbursement from milkman (59.04%) (Table 7). The male dominance is also associated with the problem but it can be compensated due to the fact that majority of the women level of education is either with primary education or below graduation and mostly are not very much versed with the practices of economy. The male members always tries to support them by associating themselves in marketing, banking, rate fixation and reimbursement from milkman etc but majority of them are well versed and can take up any such issues. Marketing and its linkage with SHGs is another important area for special thrust was also confirmed by Panda (2015).

CONCLUSION

Farm women efficiently perform most of the agricultural jobs and are considered to be the main actors in dairy farming inculcated as business. Awareness generation can play a crucial role in enhancing the efficiency of women in groups. Well crafted awareness campaigns were found to be advantageous. It was concluded from the study that dairy farming for income generation if done in groups found to be more beneficial as loss is minimum and profit earned could be evenly distributed. It is therefore recommended that dairy farming for income generation should be done in self help groups. Women should be encouraged more in handling bank issues of groups and to avail loan facilities. These groups are confined to only sale of milk and processing of milk could also be taken collectively to earn more profit.

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Analysis of Reasons behind Partial Adoption of Recommended Practices at Scientific Fish Farming in South Tripura: Farmers' Perception

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ABSTRACT

Partial adoption of recommended fish farming technologies was observed in selected adopted villages of Krishi Vigyan Kendra (KVK), South Tripura during April, 2011 to March, 2015. Eight group meetings were organized in eight adopted villages (covering 80 farmers) to identify the reasons behind partial adoption of scientific fish farming. After summarising the reasons, they were ranked to understand the level of relative importance of it in farmer's perception. Total 122 farmers from were interviewed using structured questionnaire. Rank Based Quotient (RBQ) was used to rank the reasons based upon the level of impediment to constraint the adoption process as per farmer's perception. Analysis showed that non-availability of financial support (rank 1), low-cost feed (rank 2) and quality fish seed (rank 3) are main for partial adoption of recommended practices. The lesser important reasons were non-consideration of fish farming as primary occupation (rank 4), difficulty in soil and water quality testing (rank 5), non-availability of pond specific technology (rank 6) and poor accessibility to extension services (rank 7). Based upon the analysis, probable strategies have been discussed to overcome the constraints behind successful adoption of scientific fish farming in South Tripura district under the intervention of KVK, South Tripura.

Keywords: Adoption, Rank based quotient, Scientific fish farming

INTRODUCTION

Adoption of recommended practices in scientific fish farming is a complex and socio-dynamic phenomenon which depends on many technical, economical and environmental factors. Adoption of a specific practice depends on series of actions and meaningful decisions (Wilkening, 1953). According to Rogers (1995), 'Adoption is a mental process through which an individual passes from hearing about an innovation to final adoption'. Implementation of any improved scientific technology in practical field depends on the behavior of adopter and several other socio-economic factors related to it. Adoption is the central point of research endeavours in the field of extension education. But in real sense, adoption is a very complex phenomenon and is affected by a number of overt and covert factors in the real field situation (Yadaw and Sharma, 2012). This is a tremendous task, which need dedicated and skilled workers to produce desirable impact of adoption of improved practices. Different organizations like Krishi Vigyan Kendras (KVKs), Departments of Fisheries, Non-Government Organizations (NGOs) etc. are involve in dissemination of scientific fish farming technology in farmers' fields.

Technology dissemination through skill development trainings and other extension activities is an important component in adoption. It is the basic mandate of Krishi Vigyan Kendra (KVK), the largest frontline extension system of our country. As a part of mandate, KVK, South Tripura conducted several trainings and related services on scientific fish farming for fish farmers, and rural youths of South Tripura

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district. In the last five years, more than 1000 people were trained through On Farm Trials (OFTs), Frontline Demonstrations (FLDs) and extension services. A Pilot survey was conducted by KVK, South Tripura during 2015 to investigate the adoption level of scientific fish farming among them which revealed that majority of the farmers (91%) adopted the recommended package of practices partially, whereas only about 8% beneficiaries adopted the recommended practices fully. There may be different reasons or constraints behind such partial adoption. Sharma *et al.* (2011) discussed different constraints like input constraints, technical constraints, socio-cultural constraints and post-harvest constraints in adoption of Recommended Kitchen Gardening Techniques. Again, while considering fish farmers, a study by Sharma *et al.*, 2012 reported that the access to adequate information is very essential to increase the level of adoption and productivity. Several studies (Singh *et al.*, 2008; Sharma *et al.*, 2012; Pandey *et al.*, 2014) analysed the level and extent of adoption for different package of practices on technologies. Further, Singh *et al.* (2013) revealed that the farmers felt difficulties in adaption of recommended technologies and preferred the refined technologies for better fit to their farming systems. With this background, an organized effort was undertaken in this study to identify the reasons behind partial adoption of recommended practices of fish culture and then to rank out the reasons according to its level of impediment considering farmer's perception.

MATERIALS AND METHODS

Sampling and Data: Eight villages were randomly selected from the villages adopted by KVK, South Tripura for scientific fish farming during 2011-12 to 2014-15. Data was collected in two phases. In first phase, 10 farmers were randomly selected from each village and group meetings conducted. Total eight group meets were conducted in eight villages covering a total of 80 farmers. Farmers reported many reasons behind partial adoption of scientific fish farming and these reasons were summarized under seven major thematic areas (Table 1).

Table 1: Summarized reasons behind partial adoption of scientific fish farming

Sl.No.	Summarized reasons	Factors reported by farmers
1.	Non-availability of quality fish seeds	a. Available fish seeds in the district are not of good quality and its performance is not good. b. Size of the seeds are not suitable for grow-out production; 4-5 cm seeds are available, whereas preferable is 10-12 cm.
2.	Non-availability of financial support	a. Fish farming involves substantial cost. b. Farmers find it difficult to manage financial support. c. Initial investment difficult for marginal and small farmers
3.	Non-consideration of fish farming as primary occupation	a. Most of the trainees are not motivated to take up fish farming as primary occupation. b. Farmers involved in multiple activities for income and rely on fish farming as secondary option.
4.	Non-availability of low-cost fish feed	a. Pellet or dust fish feed available in local markets are costly and not always affordable
5.	Less accessibility to extension services	a. They don't receive much technical support while farming fish
6.	Difficulty in soil and water quality testing	a. Farmers face difficulty to get the facility for testing the soil and water quality of ponds
7.	Non-availability of pond specific technology	a. Farmers have wide range of ponds of varying water and soil quality, seasonality. b. Available package of practice for scientific fish farming are suitable in many cases. c. Farmers find it difficult to manipulate the package of practice as per their needs.

The second stage of data collection was conducted after identifying the seven important reasons behind partial adoption of fish farming. In this stage, reasons according to its level of impediment to constrain the adoption process as per farmer's perception were ranked. In other words, the first ranked reason perceived by the farmer is highly responsible to constrain the adoption process most. To carry out the second phase study, a questionnaire was prepared to rank reasons according to its degeneracy. The ranking scale was 1 to 7 for seven identified reasons where rank 1 indicated the most critical reason and 7 as least. Total 122 farmers (n=122) was covered under second phase. The profile of same has summarized in Table 2.

Analytical Method

Rank Based Quotient (RBQ): The responses in the form of ranking the reasons were summarized and analyzed using Rank Based Quotient (RBQ). Preferential ranking technique has been used to rank the reasons as perceived by respondents which acted as constraints in adoption process of recommended practices at scientific fish farming in South Tripura. The quantification of data was done by first ranking the reasons and then calculating the RBQ as given by Sabarathnam (1988) which is as follows:

$$RBQ = \frac{\sum f_i (c + 1 - i)}{n \times c} \times 100 \ldots\ldots\ldots\ldots\ldots (1)$$

Where in, f_i = Number of respondent reporting a particular reason under i^{th} rank
n = Number of respondent/ sample size
c = number of reasons identified

RESULTS AND DISCUSSION

Pilot survey conducted in preliminary stage of the study showed a substantial percentage (91%) of partial adoption among the trained farmers in the villages adopted by KVK, South Tripura. Das *et al.* (2014) reported composite adoption index 66.05 in adopted villages of Department of Fisheries, Government of Tripura where special schemes on aquaculture taken up and 43.15 in non-adopted villages. Full adoption of recommended practices of fish farming is always meager in many villages where stakeholder's intervention is taken up.

The present study aimed at ascertaining the in-depth reasons behind farmer's perception. Ranking of reasons behind partial adoption of recommended practices at scientific fish farming has been given in Table 3 and RBQ scores including ranks of identified reasons summarized at Table 4.

A detailed discussion on each of the reasons has been made hereunder.

Rank 1: Non-availability of financial support: Farmers of KVK, South Tripura ranked the non-availability of financial support first cause behind partial adoption of recommended practices at scientific fish farming. Although farmers received technological guidance through training and other extension services from KVK, but adoption of full package of practices as per recommendation was not observed due to non-availability of financial support. Fish farming activities involves substantial financial investment in the form of

Table 2: Profile of the sample respondents (n = 122)

Parameter	Particulars		
Family size	1 – 3	4 – 7	>7
No. of respondents	14	82	26
(Percentage)	11.46	67.21	21.31
Annual Income	<0.75 lakhs	0.75 – 1.5 lakhs	>1.5 lakhs
No. of respondents	42	63	17
(Percentage)	34.43	51.64	13.93
Primary source of Income	Agriculture & livestock	Fish farming	Others
No. of respondents	72	36	14
(Percentage)	59.02	29.51	11.48
No of training on fish farming received from KVK in last five year	< 05	05-15	> 15
No. of respondents	21	97	4
(Percentage)	17.21	79.51	3.28

Table 3: No. of respondents reported a particular reason behind partial adoption of scientific fish farming under different rankings

Reasons ↓ Ranks →	I	II	III	IV	V	VI	VII	Total
Less accessibility to extension services	9	17	9	13	15	16	43	122
Non-availability of low cost feed	17	37	18	11	11	14	14	122
Non-availability of quality good sized fish seed	15	11	38	16	15	11	16	122
Non-availability of financial support	37	18	19	12	10	7	19	122
Non-consideration of fish farming as primary source of income	14	11	17	39	18	13	10	122
Non-availability of pond specific technology	19	10	9	16	13	43	12	122
Difficulty in pond soil and water quality testing	11	18	12	15	40	18	8	122
Total	**122**	**122**	**122**	**122**	**122**	**122**	**122**	

Table 4: RBQ scores including ranks of identified reasons behind partial adoption of scientific fish farming among the selected beneficiaries under KVK, South Tripura (2015)

Reasons	RBQ score	Rank
Less accessibility to extension services	68.21	7
Non-availability of low cost feed	98.21	2
Non-availability of quality good sized fish seed	90.71	3
Non-availability of financial support	102.32	1
Non-consideration of fish farming as primary source of income	88.39	4
Non-availability of pond specific technology	78.39	6
Difficulty in pond soil and water quality testing	83.75	5

fish seed, feed, manures, fertilizers, lime etc. For successful farming, financial support is an important concern for rural farmers. linking up the farmers with financial institutions like NABARD, NFDB etc banks can resolve this issue.

Rank 2: Non-availability of low-cost fish feed: Cost of fish feed is the major expenditure in scientific fish farming. It accounts 50 - 60% of the total cost of fish production. Fish feed available in the markets of feed. It significantly influences the cost of production. Small and marginal farmers are unable to effort it. Therefore, there is an urgent need for exploration of low-cost alternative feed sources like agri-horti residues, rubber seed etc.

Rank 3: Non-availability of quality good-sized fish seed: Farmers reported the non-availability of good-size fish seeds (fingerlings) as one of the important reasons behind partial adoption of scientific fish farming. If they don't stock quality seeds (8-10 cm), the production affected.

Rank 4: Non-consideration of fish farming as primary source of income: Many farmers don't consider fish farming as a primary source of income. Therefore, they are less motivated to take up scientific fish farming as business. Traditionally, farmers of South Tripura are mixed type and they depend more on agriculture and allied activities as a source of income. Fish farming is considered as secondary livelihood option. Motivation and encouragement towards scientific fish farming will be helpful to take up fishery as a primary source of income by the farmers.

Rank 5: Difficulty in soil and water quality testing: Farmers expressed difficulty in testing of soil and water quality of ponds. Scientific fish farming requires regular testing of water and soil quality of the pond. Initially, KVK, South Tripura could not facilitate the testing due to lack of facility in the establishment which however now mitigated. Farmers can approach KVK or ICAR, College of Fisheries, and State Department of Fisheries for analysis of their pond quality.

Rank 6: Non-availability of pond specific package of practices: Although farmers received training and guidance on fish farming, but they mentioned pond specific package of practices as per the type of pond

they have, are lacking. The size of the ponds varied 0.05 ha to 1 ha. Soil quality varied from sandy to extreme clay. Water retention period varied widely; some ponds were seasonal and some perennial. Therefore, package of practices need modification. . This issue constrained the overall adoption process of recommended practices at scientific fish farming.

Rank 7: Less accessibility to extension services: Farmers have responded to less accessibility of extension services as a cause of partial adoption of scientific fish farming. The accessibility of extension services received the least rank. Extension services can be improved by more field visits, frequent interaction with extension functionaries and improving the communication skills.

CONCLUSION

The study was attempted to know the farmers' perceptions behind partial adoption of recommended practices in scientific fish farming among the farmers trained by KVK, South Tripura during last five years. Non-availability financial support, low-cost feed and good quality fish seeds were the major reasons for partial adoption. Less important causes were -non-consideration of fish farming as primary source of income, difficulty in soil and water quality testing, non-availability of specific technology and less accessibility to extension services. Efforts on minimizing these issues will be helpful in better adoption of scientific fish farming technologies. Necessary approaches are - unwrapping the gap between farmers and financial institutions, exploration of low-cost alternative feeds and quality seeds etc. Farmers need to be motivated to undertake scientific fish farming as primary source of income and extension services need to be strengthened. Water and soil testing facilities need to be upgraded and pond specific technologies need to be promoted better adoption of fish culture.

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Attitude towards Audio Cassette Technology among the Students of Post Graduate Agricultural Colleges

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ABSTRACT

The term "agricultural education" has been referred as a collective term for all education in agriculture, encompassing plant and animal sciences, engineering, economics and others. If, ACT is fully exploited for educational system in our country, it may fulfill all the challenges and demand of educational needs of ever growing population. It is fact that ACT may not be at par with the printed literature, but it may reduce the consumption of paper and pressure on our forest resources at considerable extent and hand in hand, it may give a new dimension in the educational system of India. To measure the attitude towards the use of audio cassette in agricultural higher education among the postgraduate students, a study was conducted during the year 2008-10. Altogether, 135 numbers of students studying in randomly selected two agricultural colleges in the state of Uttar Pradesh became the sample size for present study. Percentage, mean, standard deviation were reckoned with the collected data for drawing the results. It was found that 77.04 per cent of students were having favourable attitude towards use of ACT in teaching-learning situation. Out of twenty selected statements, "ACT will help to improve the oration capability in the subject" was rated as first with the mean score of 3.99.

Keywords: Agricultural education, Attitude, Audio cassette technology, Statement

INTRODUCTION

Regular Agricultural education was started in the beginning of the 20th century, yet the importance of agricultural education in India to meet the requirement of the farming community and food security of the country was realized only after the independence of the country in 1947 when, there were 14 per cent literacy and seventeen universities. The Govt. of India appointed an education commission in 1948, under the chairmanship of Dr. S. Radha Krishnan which recommended the establishment of Rural Universities in the country. Later on, two Indo-American study teams headed by R.K. Damale 1955 and M.S. Randhawa 1959 also recommended the establishment of agricultural universities on the land Grand pattern of U.S.A. Consequently in 1960, the Govt. of India appointed an Agricultural University Commission headed by Dr. Raiph W. Cumings from the United States, which prepared the blue print and guidelines for the establishment of agricultural universities in different states. The first agricultural university was established at Pantnagar in 1960, which was a landmark in the history of agricultural education in India. It was a significant innovation and turning point for higher agricultural education system in the country. Presently, the country has forty four State Agricultural Universities, five Deemed Universities and one Central Agricultural University at Imphal.

In addition, three Central Universities: Banaras Hindu University, Vishva Bharati and Aligarh Muslim University, also have different programmes in agricultural education. There are eighteen other general universities also offering UG and PG degree programmes in Agriculture. These institutions provide for U.G. education in eleven fields of specialization in 194 constituent colleges with an intake capacity of above 15520 graduate and 5500 post-graduate students annually. Degrees are awarded in Agriculture, Veterinary

Sciences, Agricultural Engineering, Forestry, Home Science, Horticulture, Food Sciences, Dairy Technology, Fisheries, Sericulture and Agricultural marketing. There are sixty five disciplines in which specialisation at the P.G. programmes are available.

Instructional aids are backbone of teaching-learning process. With the rapid transformation of science and technology, mass media have become integral part of educational system and transfer of technology. Alarming population growth, increasing educational needs and making teaching learning more effective, have forced the educationists to include the mass media and teaching aids for sharing and lessening the burden of teachers to cope up the situation.

A number of mass media like, radio, television, video, computers, printed literatures etc. are helping learners in self learning process even in absence of a teacher. However, printed media like books are the major instrument in teaching-learning process as a supplementary aid. Growing educational concept needs and population explosion has increased the demand of paper for books, lectures notes monographs etc. Due to increasing demand of paper in teaching-learning process the pressure on our forest has increased. Forests are vanishing and cost of paper is escalating day by day hence, it has become difficult to provide cheap printed material to masses under present education system. Today, India has only 22.5 per cent forest cover whereas only 11 per cent is closed forest. However, as per the environmental standards our 33 per cent geographical area should have forest cover. Alarming situation of environment specially the depletion of forest cover has compelled us to find other supplementary alternatives to cope up the ever-growing demand of paper for our educational system and technology.

Breakthrough in technology has provided number of electric and electronic means as alternate and helping hand in teaching-learning process to save our forest and environment. Word processors, CD-ROMs, electronic books, Video technology, radio, television etc. are becoming common in view of situation. Wonderful breakthrough in electronic publishing electronic books can be held in hand with tiny clicks of information to slot in but such technologies are suitable to developed world. It is not sustainable for the countries like India and other third world countries as well. However, radio, television, video and computers are being used in education since last two decades, but extensive use could not be made so far in Indian situations.

Audio cassette technology (ACT) can overcome all those limitations and barriers which radio has. Moreover induction of ACT in educational system may bring exciting results and from the padagogical points of view; in terms of knowledge, cognitive aspects and retention rates. Even further, there are many more other advantages in this medium like there will be fully control of learner on medium, easy availability of equipment, comparatively cheap, may interact with learner as both mass media and interpersonal. Therefore, if ACT is fully exploited for educational system in our country, it may fulfill all the challenges and demand of educational needs of ever growing population. It is fact that ACT may not be at par with the printed literature, but ACT may reduce the consumption of paper and pressure on our forest resources at considerable extent and hand in hand, it may give a new dimension in the educational system of India.

In view of above facts, a study was planned to find out the possibility and workability of ACT utilization in our educational system. However, it is difficult to examine all the aspects of teaching-learning process for its suitability in a single research. Therefore, a study with the objective to measure the attitude towards the use of audio cassette in agricultural higher education among the postgraduate students was conducted during the year 2008-10.

MATERIALS AND METHODS

The state of Uttar Pradesh has three Central Universities, five Deemed Universities, three State Agricultural Universities (SAUs) and thirty eight other state universities. Excluding the three SAUs out of thirty eight state universities, seven universities offer degree programmes in Agriculture.

It was difficult to conduct such type of study in all the colleges of seven state universities where agricultural higher education programmes are being offered. Therefore, in view of objective of the study, only two state universities – (1) Deen Dayal Upadhyay Gorakhpur University, Gorakhpur and (2) VBS Purvanchal University, Jaunpur were selected

purposively. The purposive selection of two universities was made because of maintaining accessibility, smooth collection of data and acquaintance as well as contacts with the officials and teachers of the universities. The agricultural higher education programmes are being run by three and eight affiliated colleges of these two universities, respectively. To make the study in-depth, comprehensive and adequate size of sample, two affiliated colleges one each from two selected universities having postgraduate degree programmes in Agriculture were randomly selected. These selected postgraduate agriculture colleges were Baba Raghvadas Postgraduate College, Deoria of Gorakhpur University and Sri Durga Ji Postgraduate College, Chandesar Azamgarh of VBS Purvanchal University, Jaunpur.

The affiliated postgraduate colleges of selected universities offer postgraduate degree programmes in eight disciplines viz. Agronomy, Horticulture, Soil Science, Botany & Genetics, Entomology, Agricultural Economics, Agricultural Extension and Animal Husbandry & Dairying. Out of eight offered disciplines of postgraduate degree programmes, M.Sc. (Ag.) previous and final year students of five disciplines i.e., Agricultural Extension, Agronomy, Horticulture, Agricultural Economics and Agricultural Zoology & Entomology were selected randomly. Thereafter, lists of students of each selected discipline were prepared separately. Finally, 75 percent students from each list were selected at random making the total size of student sample 135.

Age, Income, Education, Socio-economic Status, Media exposure, Academic contact, Library utilization and Teaching experience were independent and Attitude was dependent variable under the study. ACT Attitude Scale developed by Kumar 1994on the basis of (Likert's, 1932) technique was used for collecting the data. (Bisht *et al.*, 2010).

RESULTS AND DISCUSSION

Attitude towards ACT among students: This part of findings presents the attitude of students of agricultural post-graduate studies towards the use of audio cassette technology (ACT) in teaching and learning. The attitude scale towards ACT was specially developed for the study and administered on the selected students of post-graduate programme of two universities. The total score of the respondents on attitude scale was obtained by adding the score of individual items of the scale. In case of attitude scores of the selected students in the present study ranged from 36 to 89. The obtained average score by the students was found 66.24, whereas the obtainable highest and lowest scores of the respondents were 20 and 100, respectively.

The average attitude score of each respondent towards ACT was calculated by summing the obtained scores of all the 20 items and dividing the total of obtained scores by the total number of items. The range of mean scores of students varied from 1.66 to 4.57. The overall mean score of students was 3.312. Based as the individual mean score, standard deviation was calculated and on the basis of overall mean score and standard deviation, the attitude of students was classified into three categories, namely 'Less favourable', 'favourable' and 'most favourable'.

The students who had obtained the mean score below and equal to 2.826 were classified as having 'Less favourable' attitude towards ACT. The students who had obtained the mean score from 2.827 to 3.712 were classified as having 'Favourable' attitude towards ACT. The students who had obtained the mean score more than and equal to 3.713 were categorized as having 'Most favourable' attitude towards ACT.

The following Table 1 highlights the attitude of students towards the use of ACT in agricultural post graduate education.

The Table 1 reveals that majority of 77.04 per cent respondents reported the favourable attitude towards the use of ACT followed by most favourable and less favourable degree of attitude among 14.07 per cent 08.89 per cent respondents, respectively. It may be

Table 1: Distribution of students according to their degree of attitude towards ACT

Degree of Attitude	Students (n = 135)	
	Average attitude Score	Frequency
Less Favourable	Below and equal to 2.826	12 (08.89)
Favourable	Between 2.827 and 3.712	104 (77.04)
Most favourable	Above and equal to 3.713	19 (14.07)

Figures in the parentheses indicate percentage
Overall Mean Score: 3.312, S. D.: 0.701
S. D. = Standard Deviation

concluded that 91.11 per cent students had strongly favoured the use of ACT in their agricultural postgraduate programmes. It is therefore inferred that introduction of ACT may be useful for effective teaching and learning the agricultural courses of postgraduate degree programmes. These findings are partially supported with the findings reported by Kulkarni, 1991 and Mohan *et al.* (1991). Similarly, Asiwal *et al.* (2008) and Chauhan (2011) have found partial conformity with present study.

The Table 2 shows that the overall mean attitude score of students was 3.31, which reveals that students had favourable attitude towards the utilization of ACT in their agricultural higher education. Further, it states that the 19th statement – "ACT will help to improve

Table 2: Attitudinal statements measuring the attitude of students towards ACT and their ranking

S. No.	Statements	Response categories (n=135)					Mean value	Rank
		Strongly agree	Agree	Unde-cided	Disa-gree	Strongly disagree		
1.	Audio Cassette Technology (ACT) is excellent for agricultural teaching.	22(16.27)	40(29.63)	31(22.96)	32(23.70)	10(07.41)	3.24	12
2.	ACT does more harm than good.	01(00.74)	10(07.41)	58(42.96)	61(45.19)	05(03.70)	3.44	8
3.	ACT can replace the burden of the teacher.	04(02.96)	74(54.81)	31(22.96)	22(16.30)	04(02.96)	3.39	10
4.	Audio Cassette is no better than class room lecture as it lacks sufficient subject matter.	14(10.37)	61(45.19)	38(28.15)	21(15.56)	01(00.74)	2.51	18
5.	Use of ACT in higher agricultural education can further improve in teaching	07(05.19)	90(66.67)	22(16.30)	15(11.11)	01(00.74)	3.64	5
6.	ACT should be popularized extensively for the improvement of higher agricultural education.	15(11.11)	83(61.48)	30(22.22)	05(03.70)	02(01.48)	3.77	3
7.	Through this technology poor students will not be benefited.	20(14.81)	69(51.11)	12(08.89)	39(28.89)	05(03.70)	2.78	17
8.	This technology is not appropriate for teaching and learning of agricultural courses.	04(02.96)	13(09.63)	27(20.00)	83(61.48)	08(05.93)	3.58	7
9.	Agricultural education through ACT will be very costly and uneconomical.	10(07.41)	43(31.85)	08(05.93)	69(51.11)	05(03.70)	3.12	15
10.	Subsidy and financial assistance should be given for purchase and production of educational audio cassettes and its equipments.	47(34.81)	68(50.37)	05(03.70)	03(02.22)	02(01.48)	3.93	2
11.	ACT will deteriorate agricultural educational standard.	18(13.33)	14(10.37)	16(11.85)	68(50.37)	19(14.07)	3.41	9
12.	The use of ACT will eliminate monotony and will provide variety in teaching.	08(05.93)	97(71.85)	08(05.93)	16(11.85)	06(04.44)	3.63	6
13.	ACT will make teachers and students lazy.	76(56.30)	21(15.56)	08(05.93)	16(11.85)	14(10.37)	2.04	19
14.	ACT will be helpful to clear the doubts which are not clear in the classroom.	12(08.89)	47(34.81)	10(07.41)	59(43.70)	07(05.19)	2.99	16
15.	ACT can only be useful in distance education.	06(04.44)	41(30.37)	18(13.33)	68(50.37)	02(01.48)	3.15	14
16.	ACT will reduce the dependency on books.	05(03.70)	70(51.85)	40(29.63)	12(08.89)	08(05.93)	3.39	10
17.	ACT will help in understanding problems more clearly.	16(11.85)	64(47.49)	13(9.63)	36(26.67)	06(04.44)	3.36	11
18.	Introduction of ACT will drop the student attendance.	06(04.44)	42(31.11)	10(07.41)	70(51.85)	07(05.19)	3.22	13
19.	ACT will help to improve the oration capability in the subject.	24(17.78)	96(71.11)	07(05.19)	06(04.44)	02(01.48)	3.99	1
20.	ACT will be helpful in re-inforcement of lectures and book reading.	24(17.78)	67(49.63)	25(18.52)	15(11.11)	04(02.96)	3.68	4
	Overall mean score	-	-	-	-	-	**3.31**	-

Figures in the parentheses show percentage of the total respondents

Table 3: Order of response against first ranked statement

Agreement Status	Frequency	Percentage
Strongly agree	24	17.78
Agree	96	71.11
Undecided	07	05.19
Disagree	06	04.44
Strongly disagree	02	01.48

the oration capability in the subject" ranked first (mean score = 3.99). The order of response to this statement is shown in the following Table 3.

It is clear from the above mentioned responses that 88.89 per cent of total respondents had favourable attitude towards ACT wherein 17.78 per cent respondents had strong favour of ACT. There were 05.19 per cent of respondents who were undecided about the use of ACT. It is encouraging to note that only 5.92 per cent respondents were against the use of ATC wherein only 01.48 per cent respondents had negative attitude towards the use of ACT in agricultural higher education system. However, ACT in higher education is inevitable in view of sharply increasing strength of students. After going through all the statements regarding the attitude towards ACT, it was observed that the statement number 13 - "ACT will make the teachers and students lazy" had the lowest mean score (2.04). These results were found very similar to the findings reported by Sawant and Khuspe 1986 and Malik, Patel 1990 and Sah and Kumar, 2010.

CONCLUSION

ACT can overcome all those limitations and barriers which radio has. Moreover, induction of ACT in educational system may bring exciting results from the padagogical points of view in terms of knowledge, cognitive aspects and retention rates. If, ACT is fully exploited for educational system in our country, it may fulfill all the challenges and demand of educational needs of ever growing population. In fact, it may not be at par with the printed literature, but may reduce the consumption of paper and pressure on our forest resources at considerable extent, which may give new dimensions in the educational system of India. The results of present study are very enthusiastic. Such study may be conducted in future in other parts of the country to support the existing educational policy of Government of India.

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Ergonomic Study of Cotton- Picking Activity- Comparison of Ergonomic Cost between Conventional and Improved Methods

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ABSTRACT

Punjab is famous for producing large quantities of high quality cotton, although participation of women in Punjab in agricultural activities is less as compared to other states, still women participate in activities such as harvesting of crops, picking of cotton, plucking of vegetables. The study was undertaken to study existing cotton-picking practices and constraints faced by rural women so as to suggest appropriate technologies to reduce drudgery. The study was conducted in two phases- field survey (200 respondents) and field experiments (60 subjects). Results revealed the involvement of 8.51 percent respondents daily in cotton –picking activity. Most of them (76%) spent 8-9 hours/day in performing cotton-picking activity. They shrunk most of the time from leisure, relaxation and sleep activities. Constraints encountered by them included figure injuries, chest pain, body aches, etc. Comparison of ergonomic cost (Physiological and muscular stresses) between conventional method and improved techniques (plucker, improved bag, full sleeves shirt and cushioned shoes) exhibited significant reduction (heart rate 7.29%, energy expenditure 17.30%, TCCW 43.75%, PCW 43%, postural deviation 61.42%). Incidence of pain was eliminated in fingers and chest whereas it reduced in feet (61.06%) and calf muscles (48.945). The use of improved bag was found to be most satisfying by the subjects, followed by cushioned shoes and plucker.

Keywords: Cotton bolls, Drudgery, Ergonomic cost

INTRODUCTION

Almost all women in rural India today can be considered as 'farmers' in some sense; working as agricultural labour, unpaid workers in the family farm enterprise or combination of the two. Rural women form the backbone of the rural economy, as they constitute at least one third of the country's economically active population, particularly in the unorganized agrarian sector (Shobha, 2001). Women perform about 70 percent of farm work, which aptly justifies that most farmers in India are women (Dash, 2000). Any short stay in a rural area is sufficient to observe women's active involvement in diverse field activities. They participate in various crop production activities including sowing, winnowing, seeding, harvesting of crops, picking of cotton, plucking of vegetables, storage of grains, etc. They perform these activities in addition to their routine household chores and animal husbandry activities. Rural women in this area spend approximately 8 to 9 hours per day in cotton- picking activity. They work intensively during a particular season (October to November), which ranges from 50 to 60 days. They perform the activity with drudgery prone methods thus putting large demands upon their time and energy. If drudgery could be reduced with improved methods, the women can contribute in a better way to improve their family environment.

But no mechanization has been introduced for farm women dominated farm operations to reduce their drudgery at work. Drudgery refers to the dissatisfactory and painful experiences that constraint work performance and also affect the health and productive capacity of women. Therefore, drudgery reduction

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measures should be initiated to avoid such undesirable situations. Keeping in view the above scenario, an attempt has been made under All India coordinated Research Project (AICRP) on Home Science to develop or test drudgery reducing tools for farm women (in cotton picking activity) which can also improve their worth efficiency with the following specific objectives:

1. To study and compare the ergonomic cost of cotton-picking activity with conventional method and with the use of improved techniques.
2. To determine the impact of improved techniques of cotton-picking activity on women's family environment.

MATERIALS AND METHODS

The study was conducted in one of the intensive cotton growing area of Punjab i.e., *Bathinda* with 200 representative samples to identify cotton picking activity as a drudgery prone activity. Sixty volunteer subjects involved in cotton picking activity were selected to test ergonomic cost of work with existing and improved method. Field survey was conducted to study the extent of involvement of rural women in cotton-picking activity, the existing cotton picking practices and the constraints faced by them.

The data thus collected were tabulated and analyzed by using suitable statistical tools to compare the conventional and improved methods of cotton- picking activity and to see the impact of improved method on drudgery reduction and family environment of the subject.

RESULTS AND DISCUSSION

The study revealed that the respondents belonged to the age group of 21 to 45 years (Table 1). Most of them were illiterate (58.50%). While some of them were educated up to middle (10%) and matric (9%), a few were graduated (4%) also. Majority of them belonged to nuclear family system (76.50%) and to the families having up to five members (60%). A large percentage of the respondents were form poor landless families (43.50%) and worked on payment basis.

Some of them were involved as supervisor-cum-workers and only a few worked in their own fields. They spent up to half an hour for going and coming back from fields. Whereas, 8 to 9 hours and sometimes even above that, were spent in cotton-picking activity in the fields. The respondents spared this time mostly by the postponement of leisure time activities and reducing relaxation and sleeping hours. Some portion of time (1 hour) was spared from the time allotted to childcare and education as well as care of animals.

Table 1: Distribution of respondents according to their background information (n=200)

Particulars	Number	Percentage
Age (Years)		
Up to 25	61	30.50
25-35	73	36.50
35-45	66	33.00
Education		
Illiterate	117	58.50
Primary	37	18.50
Middle	20	10.00
Matric	18	09.00
Graduate	08	04.00
Family type		
Nuclear	153	76.50
Joint	47	23.50
Family size		
Up to 5 members	120	60.00
6-8 members	72	36.00
9 members and above	08	04.00
Number of children in the family		
Up to 5 years	57	28.50
5-8 years	60	30.00
9 and above	83	41.50
Operational land holding (acres)		
Landless	87	43.50
Up to 5	24	12.00
5-10	21	10.50
More than 10	68	34.00
Family income (000' Rs. per annum)		
20-35	74	37.00
35-50	37	18.50
50 and above	89	44.50

The data collected on the existing practices of cotton-picking activity revealed that all the respondents were plucking the cotton bolls with fingertips and collected the same in the cloth, tied at the back to form a bag. They tied this cloth in two styles viz. *Punjabi* style and *Rajasthani* style (Table 2). Majority of them used half sleeves shirts (75.5%) whereas some of them wore full sleeves shirt (24.5%) due to habitual reasons. Most of

Table 2: Existing practices being followed for cotton-picking activity by the respondents (n=200)

Existing practices	Number	Percentage
For picking cotton bolls		
Use of finger tips directly	200	100
For collecting picked cotton bolls		
Cotton cloth tied in *Punjabi* style	184	92
Cotton cloth tied in *Rajasthani* style	16	08
Type of dress		
Full sleeves shirt	49	24.5
Half sleeves shirt	151	75.5
Type of shoes		
Covered shoes	74	37
Chappals	126	63

them wore *chappals* (63%) in their feet and some of them wore *Punjabi jutti* (37%), again due to habitual reasons.

As regards the constraints faced by the respondents (following existing practices), all of them reported about finger injuries in the form of scratches, cuts and even wounds. Majority of them reported about strain on shoulders, pain in the chest, exertion due to seasonal workload, lack of appropriate tools for work etc.

Impact of improved techniques on drudgery reduction and family environment of the subjects: As regards the incidence of musculo-skeletal pain in the subjects the comparison of both the method has been illustrated in Table 4. The gleaning of data in the table shows that the chest pain, finger injuries and scratches on the lower arms were totally eliminated with the use of improved method. The chest pain was abolished by elimination of knots in the bag where as the finger injuries didn't occur, as the fingers didn't come in direct contact with the dried brackets and twings. The use of full sleeves' shirt helped the subjects to protect their arms while performing the cotton picking activity. Further, the table also reveals the decrease of pain in the upper extremities (neck, shoulders and back) due to the supportive padded shoulder belts and in the lower extremities (legs, knees, feet, ankles and calf muscles) due to the use of soft cushioned shoes. Redfern and Chaffin (1995) also reported that the use of soft cushioned surface under the feet could conserve up to 50 percent of the muscle energy of the worker.

Table 3: constraints faced by the respondents involved in cotton-picking activity

Constraints	Mean scores
Scratches and cuts on fingers	2.00
Strain and rashes on shoulders	1.95
Body aches	1.88
Pain in chest due to knot of picking cloth	1.71
Exertion due to seasonal workload	1.62
Lack of appropriate tools/devices	1.61
Decreased efficiency in performing household activities	1.32
Irritated behavior at the end of the day	0.77

Table 4: Incidence of musculo-skeletal pain in the subjects while performing cotton-picking activity with conventional and improved methods (mean scores)

Parts of the body	Intensity of pain (mean scores)	
	Conventional	Improved
Shoulders (top)	4.81	1.72
Fingers/hands	4.78	-
Ankles/feet	4.70	1.83
Calf muscles	4.70	2.40
Chest	4.58	-
Lower back	4.48	1.83
Shoulders (back)	3.88	1.70
Neck	3.50	1.96
Lower arms	3.08*	-
Upper leg	2.57	2.33
Knees	1.68	1.68

*In addition to muscular pain there were scratches and cuts on the lower arms, hands and fingers caused by the dried brackets and twigs which were eliminated with use of improved methods.

Impact of improved techniques on drudgery reduction and family environment of the subjects: The impact of improved techniques of cotton-picking activity was determined with respect to different ergonomic parameters by calculating the percent reduction for each of the parameters (with the use of improved technique). The results presented in the Table 5 give information about the percent reduction with respect to cardiovascular stresses, muscular stresses and RPE. It is clear from the table that the average working heart rate was reduced by 7.29 percent and peak heart rate was reduced by 8.04 percent by introducing the improved techniques. The drudgery reduction with respect to average and peak energy expenditure was 17.30 percent and 16.55 percent followed by 43.76 percent reduction in physiological cost of work, when the subjects shifted from conventional method to the

Table 5: Percent reduction in cardio-vascular stresses of the subjects while performing cotton-picking activity with improved methods

Ergonomic parameters	Conventional	Improved	% reduction
Average heart rate	94.49	87.60	7.29
Peak heart rate	107.29	98.66	8.04
Average energy expenditure	6.30	5.21	17.30
Peak energy expenditure	8.34	6.96	16.55
TCCW	1780	1001.20	43.75
PCW	14.83	8.34	43.76
Rated perceived exertion	3.85	2.95	23.38

improved one. The rated perceived exertion was reduced by 23.38 percent with the use of improved method. The study conducted by Sandhu and Bakshi (2001) on elderly people in Punjab supports these findings. They found that improved technologies were effective enough to reduce both heart rate and energy expenditure to a considerable extent for performing the selected household activities.

The data incorporated in Table 6 indicates the impact of improved method in the form of percent reduction in postural analysis and muscular strength. It was found that there was 61.54 percent reduction in adoption of bending posture while performing cotton-picking activity with improved method. This was due to the fact that the lumbar region belt supported that back muscles as well as the subjects were made aware of the use of thigh muscles to adopt squatting posture for plucking the bolls at lower level and avoid excessive bending of spine. As a result there was less physical fatigue. The angle of deviation was also reduced by 61.42 percent whereas the grip fatigue was reduced by 90.52 percent and 97.59 percent for right hands respectively.

Table 6: Percent reduction in postural analysis and grip strength of subjects during cotton-picking activity with improved methods

Ergonomic parameters	Conventional	Improved	% reduction
Frequency of postural changes			
Bending	26	10	61.54
Squatting	-	6	-
Postural deviation			
Angle of normal standing	193.96	194.42	-
Angle of bend	198.00	196.00	-
Angle of deviation	4.07	1.57	61.42
Grip strength			
Percentage change in right hand	9.81	0.93	90.52
Percent change in left hand	9.13	0.22	97.59

Table 7: Percent reduction in incidences of pain in different body parts of the subjects while cotton-picking activity with improved methods

Parts of the body	Intensity of pain (mean scores)		
	Conventional	Improved	% reduction
Shoulders (top)	4.81	1.72	64.24
Fingers/hands	4.78	-	100.00
Ankles/feet	4.70	1.83	61.06
Calf muscles	4.70	2.40	48.94
Chest	4.58	-	100.00
Lower back	4.48	1.83	59.15
Shoulders (back)	3.88	1.70	56.19
Neck	3.50	1.96	44.00
Lower arm	3.08	-	100.00
Upper leg	2.57	2.33	9.34
Knees	1.68	-	-

*In addition to muscular pain there were scratches and cuts on the lower arms, hands and fingers caused by the dried brackets and twigs which were eliminated with the use of improved methods.

The data incorporated in Table 7 shows the percent reduction for incidence of pain in different body parts. The table clearly indicates that in chest, arms, hands and fingers, the pains and injuries were totally vanished away with the use of improved techniques. The next maximum reduction was felt in shoulders (64.24%), which was induced with the ergonomic shoulder belts of the improved bag. A considerable percent reduction in fatigue and pain was observed in feet, ankeles and calf muscles by using the soft cushioned shoes while picking the cotton. The soft cushioned shoes were helpful in reducing the fatigue because their use prevented the formation of varicose veins and thus helped in reducing degenerative changes in the blood. The findings are in full agreement with the results of Redfern (1995) who also recommended the use of anti fatigue mats under the feet to reduce the fatigue from standing on hard floors for long hours. He further reported that this resulted in conservation of muscle energy by fifty percent. However, more than 50 percent reduction was observed in almost all body parts mentioned here except neck and knees.

Table 8: Impact of improved techniques on drudgery reduction and family environment of the subjects for cotton-picking activity (mean score for acceptability)

Statements indicating impact	Acceptability (Mean Scores)
Less time is required for cleaning the feet in the evening	2.0
There is less exertion and irritability in behavior with the use of improved methods	2.0
No problems in doing other household activities because of absence of scratches and cuts	1.95
The use plucker eliminated the scratches, cuts and injuries on fingers	1.95
The quality of picked cotton is excellent	1.93
The use of improved bag eliminated the pain in the shoulders	1.9
The use of cushioned shoes protected the feet and increased the speed of walking	1.86
The plucker is cost effective	1.83
The use of improved bag provided enough support to low back and thus reduced the backache	1.81
It is comparatively easier to do evening work	1.78
There is a considerable decrease in pain in the lower legs and feet	1.78
The improved bag is user friendly	1.66
It is easy to use the plucker	1.56
The improved bag is cost effective	1.26
The use of plucker slowed down the speed of picking	1.01

Further, it was observed that as a result of decreased fatigue the subjects felt more comfortable and enthusiastic at work and they felt even increased efficiency in performing other activities also. The impact of improved techniques on drudgery reduction and family environment was also studied by the acceptability scores, given to the different indicative statements by the subjects. The scores for different statements were given on a 3-point scale. The mean scores were then calculated, which are presented in Table 8. The critical examination of the table shows that, while working with the improved methods, the subjects felt less exerted and didn't feel irritated at the end of the day. They thus performed the household work comfortably. All of them were also highly satisfied with the use of cushioned shoes, as they didn't feel tired. The shoes protected their feet from dust and thorns also. They also reported that, with the use of these shoes, they need not spend more time in cleaning and washing of feet. The use of improved bag reduced the physical fatigue to a large extent. The use plucker for protection from finger injuries was given the mean score of 1.95. The subjects also reported that though this was good for protection, but the amount of cotton bolls picked was less as compared to conventional method.

Further, it was observed during record keeping of the picked cotton bolls (kg) by the subjects, that there was a decrease of only 0.5 kg to 1 kg per hour. After adding up the total amount for the full day and calculating the remunerations, it made an average difference of Rs. 15 only. However, this difference could easily be compensated because the quality of cotton bolls picked with plucker was far better (totally free from dried leaves, brackets, twigs, etc.) to fetch a higher price in the market.

On the whole, different indicators used to measure the acceptability of the improved techniques exhibited a highly positive impact on the reduction of drudgery as well as physical fatigue and also increased the comfort during work. This in turn increased the physical and mental efficiency of the workers.

CONCLUSION

Results of all selected parameters showed that by improved method on drudgery reduction and on family environment, all the respondents were highly satisfied as they reported that the improved techniques were less fatiguing. They said that they felt very much comfortable. Also they didn't feel irritated while doing the household work in the evening, after performing the cotton-picking with the improved techniques. The subjects were very happy to wear the soft cushioned shoes while performing the activity as they felt more comfortable and enthusiastic while doing the work as well as saved the time consumed in cleaning of feet in the evening. They were also highly satisfied with the use

of improved bag to make their work performance easier and more comfortable. The use of plucker eliminated the finger/hand injuries.

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Effect of Different Planting Techniques and Weed-control Measures on Growth Yield and Weed Control of Rice in North Eastern Plain Zone of India

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ABSTRACT

A field experiment was conducted at IARI Regional Station, Pusa, Bihar during 2013-14 and 2014-15 to evaluate the performance of different herbicides under various planting techniques in NEPZ of India. The experiment was conducted in Split Plot Design allocated three crop establishment methods (Puddled Transplanted Rice, Direct Sowing Rice, Bed Planting, and System of Rice Intensification) in main plots and eight weed control measures including one weedy check in sub-plots and replicated thrice. System of Rice Intensification (SRI) recorded the lowest weed density and weed dry weight as compared to other methods of planting. Significantly highest yield attributes and yields were recorded under System of Rice Intensification (SRI) method followed by Puddled Transplanted Rice (PTR) and lowest values were recorded in Direct Seeded Rice (DSR). Among the chemical weed control measures, application of Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml) was highly effective in controlling the weeds as its recorded lowest weed density and weed dry weight of 5.67 m^{-2} and 8.13 g m^{-2} followed by application of Bispyribac sodium + 2,4-D. Significantly higher weed control efficiency and weed control index were observed with the application of Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml) (61.32% and 62.79%, respectively) followed by Bispyribac sodium + 2,4-D treated plots. Significantly, highest numbers of effective tillers m^{-2} and grains per spike were recorded when weeds were controlled by two hand weedings at 20 and 40 DAT and were at par with Bispyribac sodium + Pyrazosulfuron. The highest grain yield was observed with the tank mix application of Bispyribac sodium + Pyrazosulfuron which was at par with tank mix application of Bispyribac sodium + 2,4-D and sole application of Bispyribac sodium and significant over rest of the treatments.

Keywords: Growth, NEPZ, Planting techniques, Rice weed flora, Weed control, Yield

INTRODUCTION

Rice is a staple food crop for more than half of the world's population and more than 90% of rice grown and consumed in Asia (Chauhan, 2012). Rice plays a vital role in food and livelihood security for almost every household, particularly to the farmers of North Eastern Plain Zone (NEPZ) of India. At present, population growth rate in India is 1.55% which requires about 120-135 million tones rice by 2020. In keeping the above requirement of rice, it is quite important to raise the productivity levels of rice. North Eastern Plain Zone (NEPZ) of India is the major rice producer but having lower productivity. Weeds are the major problem in rice as they not only compete the crop but also affect the quality of crop produce. Reduction in yield of transplanted rice by about 28-45% has been reported by Yadav *et al.* (2009). Therefore, timely weed control

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at an early stage, is very important for realizing desired level of productivity. An efficient and economic weed management practice is necessary to control different types of weeds. With the increasing trend of labour scarcity, manual weeding is costly as compared to the chemical weed control measures. *Echini chloacolona* (L.) and *E. crugalli* (L.) are the major weed of rice in this region and at their early growth stages, looks similar to rice seedlings and having mimics with rice crop making manual weeding difficult. Due to increased use of tractors and other machines, vegetative propagated weeds are becoming dominant in these areas. Moreover, shortage of labours, increased wages and lack of suitable weed controlling implements have compelled farmers to think for alternative weed management strategies (Duary *et al*., 2013). The use of herbicides offers selective and economic weeds control at early stage of crop growth giving crop an advantage of good start and competitive superiority. A number of old pre-emergence herbicides like but achlor, pendimethalin and anilophos etc. have been recommended for the control of early flushes of grassy weeds in rice field. These herbicides are specific and are effective against narrow range of weed species. The intensive use of such herbicides year after year has resulted in herbicide resistance problems and consequently, management of weeds is becoming increasingly more difficult and complex (Karim *et al.,* 2004). Several pre-emergence herbicides like pendimethalin, oxadiazone, oxdiargyl and pyrazosulfuron) and post-emergence herbicides like bispyribac-sodium, azimsulfuron, penoxsulfuron, fenoxaprop, ethoxysufuron and 2,4-D have been reported to provide effective weed control.

The present study was, therefore, conducted to find out suitable herbicide combinations with comparing to two hand weeding to provide a comprehensive weed control options and to evaluate the effect of single and sequential application of pre and post-emergence herbicides for puddled and transplanted rice under NEPZ of India.

MATERIALS AND METHODS

The field study was carried out during 2013-14 and 2014-15 at Indian Agricultural Research Institute, Regional Station, Pusa, Bihar (25°58'49" N latitude, 85°40'48" E longitude and an altitude of 52.12 meters above mean sea level). The experimental field had an even topography and good drainage condition. The soil of the experimental site was sandy loam in texture with a pH of 8.3 and having low in organic carbon (0.42-0.43%), medium in available P_2O_5 (18.2-18.5 kg/ha) and available K_2O (192-195 kg/ha) with EC range of 0.2 to 0.3. The climate of the site is sub-humid tropical with hot summer and cold winter.

The experiment was laid out in Split Plot Design allocated three crop establishment methods [Puddled Transplanted Rice (PTR), Direct Seeded Rice (DSR), Bed Planting (BP) and System of Rice Tntensification (SRI)] in main plots and eight weed control measures (Pretilachlor as pre-emergence, Pendimethalin as pre-emergence, Bispyribac sodium as post-emergence, 20-25 DAP, Pyrazosulfuron as post-emergence at 20-25 DAP, Bispyribac sodium + 2,4-D as post-emergence as 20-25 DAP, Bispyribac sodium + Pyrazosulfuron as post-emergence at 20-25 DAP, 2 hand weeding at 20 and 40 DAS/DAT and weedy check in sub plots and replicated thrice. The experiments were conducted in two consecutive years to know the performance of different planting techniques and weed-control measures on growth, yield, weed control and economics of rice in North Eastern Plain Zone of India. Rice variety "Rajendra Subhasini" was transplanted in the second week of July and harvested in mid November. In direct seeded rice, fields were prepared by cultivating twice with a disc harrow, followed by leveling with a wooden board. Seeds were sown with a single-row drill at a seeding rate of 30 kg/ha at 20 cm row spacing. In case of transplanted rice, field was prepared with two disking followed by the use of cultivator twice and leveling with a wooden levelers. In SRI method of transplanting, 6-8 kg seed rate was sown in nursery and about 14 days old seedling was transplanted at a spacing of 25×25 cm. Recommended doses of fertilizer (RDF) were applied through chemical fertilizers i.e. urea, diammonium phosphate and muriate of potash. Half dose of N and full dose of P and K through urea, diammonium phosphate and muriate of potash, respectively were applied at the time of sowing and at last puddling. Remaining nitrogen was applied in two splits at 20 and 40 days after transplanting (DAT). Pre-emergence (PE) herbicides were applied at 2 DAT and post-emergence (POE) herbicides were applied at 20 DAT. Herbicides were applied with knapsack sprayer having a flat-fan nozzle and water used at 500 L/ha for

PE spray and at 350 L/ha for POE spray. Weed density and biomass was measured at 60 DAS/DAT. The weed density was recorded from 1 sq. meter area placed randomly thrice in each plot. Weeds were cut at ground level, sun- dried and oven dried at 65-70 ^{0}C and then weighed. Weed indices were calculated by using following equations (Das, 2008).

$$\text{Weed control efficiency (WCE)} = \frac{\text{WDc-WDt}}{\text{WDc}} \times 100$$

$$\text{Weed control index (WCI)} = \frac{\text{WDMc-WDMt}}{\text{WDMc}} \times 100$$

Where, WDc is the weed density/m^2 in weedy check; WDt is the weed density/m^2 in treated plots

WDMc is the weed biomass (g/m^2) in weedy check; WDMt is the weed biomass (g/m^2) in treated plots.

When crop matured, plants from border rows were harvested and removed from the field, thereafter, net plots were harvested separately and produce was left in the field for some days to get dried. Bundle weight was recorded separately for each plot. Threshing was done by manual labour. Grains were cleaned and weighed for each net plot and yield was expressed in t ha^{-1}. The weight of straw was calculated by subtracting grain weight from bundle weight. Other management practices were adopted as per recommendation of the crop grown under NEPZ of India. Weed density data were transformed with square-root transformation [$\sqrt{}$(X+0.5)] before analysis.

The data collected were subjected to statistical analysis following standard statistical procedures of Gomez and Gomez (1984) for randomized block design and factorial randomized block design.

RESULTS AND DISCUSSION

Weed density, Weed dry weight, Weed control efficiency and Weed control index: During the crop season, the experimental field was mainly infested with different types of weeds, broad leaved weeds, narrow leaved weeds and sedges also. Wild rice [*Echinidhloa colona* (L.) Link.], false daisy (*Eclipta alba* Hassak, bermuda grass (*Cynodon dactylon* (L.) Pers), barnyard grass ((*Echinochloa crussgalli* (L.) Beauv), purple nutsedge (*Cyperus rotundus* L.) and yellow sedge (*Cyperus iria* L.) etc. Among all planting techniques, System of Rice Intensification (SRI) recorded the lowest weed density and weed dry weight as compared to the other methods of planting. The highest weed density and weed dry weight (7.17/m^2 and 12.18 g/m^2) were recorded in direct seeded rice (DSR) method. Weeds are a serious problem in DSR because dry tillage and aerobic soil conditions are conducive to the germination and growth of many weeds (Chauhan *et al*., 2011 and Prasad, 2011). On the basis of two years mean data, it can be interpreted that among the weed management treatments, lowest weed density and weed dry weight of 4.95 m^{-2} and 6.48 g m^{-2} were recorded with two hand weeding at 20 and 40 DAS. Among the chemical weed control measures, lowest weed density and weed dry weight of 5.67/m^2 and 8.13 g/m^2 were observed with the application of Bispyribac sodium + Pyrazosulfuron followed by application of Bispyribac sodium + 2,4-D and was significantly lower than other treatments. Application of Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml) was highly effective in controlling the weeds. Significantly higher weed control efficiency (WCE) and weed control index (WCI) were recorded in the plot having two hand weeding. Among the herbicidal weed control measures, significantly higher weed control efficiency and weed control index were observed with the application of Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml)(61.32% and 62.79%, respectively) followed by Bispyribac sodium + 2,4-D treated plots. The similar result was also reported by Mahajan and Chauhan (2013) in dry seeded rice under scented rice-wheat rotation of western Indo-Gangetic Plains of India. Similar results were reported by Saha *et al.* (2010) and Saha *et al.* (2009) (Table 1).

Crop growth: The tallest plants were observed under the plot having two hand weeding at 20 and 40 DAS/ DAT. Among the herbicide treatments, the highest plant height (101.5 cm) was recorded with the application of Bispyribac sodium + Pyrazosulfuron followed by Bispyribac sodium + 2,4-D. The lowest plant height was recorded in Pretilachlor (1.5 kg/ha) as PE treated plot. The interaction effect of crop establishment methods and weed control measures on plant height were found non-significant.

Yield and yield attributes: Among the crop establishment methods, significantly highest yield attributes were recorded under System of Rice Intensification (SRI) method followed by Puddled Transplanted Rice (PTR) and lowest yield attributes were recorded in Direct Seeded Rice (DSR). Significantly highest effective tillers m^{-2}, grains per spike and test weight (237.57, 140.48 and 24.01, respectively) was recorded in SRI method which was significantly higher than rest of the methods. Grain yield, biological yield and straw yield were also followed the same trends as in case of yield attributes. Significantly higher grain yield (5.46 t/ha) was recorded in SRI method and lowest value of grain yield (3.57 t/ha) was recorded in DSR method. SRI method provide good aerobic condition for rice growth particularly in root zone which accelerated the root growth and good stand of crop, improvement in nutrient uptake and ultimately higher growth, yield attributes and yield of crop. Research has shown that grain yield losses are greater in DSR than in PTR because of limited weed control options (Chauhan and Johnson, 2010). Weeds are more problematic in DSR than in PTR because of the absence of a head-start advantage over germinated weed seedlings and the absence of standing water that prevents light from reaching weed seeds through a layer of standing water (Chauhan 2012; Chauhan and Johnson 2010). Weeds grow more quickly in DSR than in PTR (Akwar *et al.,* 2011; Chauhan and Johnson, 2010) (Table 2).

Significantly highest numbers of effective tiller/ $m^2$and grains per spike were recorded when weeds were controlled by two hand weeding at 20 and 40 DAT and were at par with Bispyribac sodium + Pyrazosulfuron. Amongst all herbicide applications, tank mix application of Bispyribac sodium + Pyrazosulfuron found the best combination for controlling weeds followed by Bispyribac sodium + 2,4-D application. Alleviation stress caused by weeds through herbicidal weed control

Table 1: Effect of various planting techniques and weed control measures on growth, yield attributes and yield of rice (pooled mean of 2 years data)

Treatment	Biological yield (t/ha)	Grain yield (t/ha)	Straw yield (t/ha)	HI (%)	Grains/ spike	TW (g)	Effective tillers/ m^2	Plant height (cm) at maturity
Main plot								
PTR	13.27	4.42	8.85	33.32	125.90	22.68	202.86	100.8
DSR	11.32	3.57	7.75	31.56	114.26	20.79	172.35	97.3
SRI	15.44	5.46	9.98	35.35	140.48	24.01	237.57	103.4
SEm±	0.09	0.05	0.05	0.26	0.53	0.37	2.30	0.9
CD	0.35	0.19	0.19	1.01	2.09	1.46	9.02	3.4
Sub plot								
M1-Pretilachlor (1.5 kg/ha) PE	12.79	4.22	8.57	32.85	123.47	21.97	195.63	99.4
M2- Pendimethalin(3.33 kg/ha) PE	12.94	4.29	8.65	32.96	124.87	22.19	197.11	99.8
M3- Bispyribac sodium (250 ml/ha)	13.56	4.56	9.00	33.46	127.09	22.58	204.67	100.6
M4- Pyrazosulfuran ethyl (250 ml/ha)	13.24	4.41	8.82	33.19	126.93	22.29	199.67	100.1
M5- Bispyribac sodium + 2,4-D (80 + 250 ml/ha)	13.72	4.67	9.05	33.86	128.30	22.71	208.26	101.1
M6- Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml)	13.94	4.79	9.15	34.14	130.29	23.07	216.48	101.5
M7- Hand weeding (2 HW at 20, 45 DAS)	14.13	4.86	9.27	34.26	133.01	23.40	223.93	102.1
M8- Weedy check	12.42	4.07	8.36	32.54	121.07	21.75	188.33	99.2
SEm±	0.14	0.10	0.17	0.80	1.30	0.42	2.69	0.8
CD	0.40	0.27	0.50	NS	3.70	NS	7.67	NS
Interaction								
SEm±	0.25	0.17	0.30	1.39	2.25	0.73	4.65	1.4
CD	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of various planting techniques and weed control measures on weed density, weed control efficiency, weed dry weight and weed control index rice

Treatment	Weed density/ m^2	WCE (%)	Weed dry weight (g/m^2)	WCI (%)
Main plot				
PTR	7.03(55.75)	56.07	11.77(154.49)	47.25
DSR	7.17(57.92)	48.69	12.18(163.41)	40.42
SRI	6.88(53.17)	48.03	11.16(144.00)	44.88
SEm±	0.11	3.81	0.14	4.60
CD	NS	NS	0.54	NS
Sub plot				
M1-Pretilachlor (1.5 kg/ha) PE	7.03(49.33)	51.04	14.07(199.04)	31.95
M2- Pendimethalin (3.33 kg/ha) PE	6.50(42.00)	55.18	12.65(160.52)	39.28
M3- Bispyribac sodium (250 ml/ha)	6.13(37.33)	57.87	10.76(116.71)	49.09
M4- Pyrazosulfuran ethyl (250 ml/ha)	6.24(38.67)	56.88	11.66(137.41)	44.33
M5- Bispyribac sodium + 2,4-D(80 + 250 ml/ha)	6.04(36.00)	58.41	9.52(90.81)	55.24
M6- Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml)	5.67(31.78)	61.32	8.13(67.96)	62.79
M7- Hand weeding (2 HW at 20, 45 DAS)	4.95(24.22)	66.74	6.48(45.68)	70.76
M8- Weedy check	13.63(185.56)	0.00	20.34(413.60)	0.00
SEm±	0.18	1.60	0.47	2.76
CD	0.50	4.56	1.34	7.87
Interaction				
SEm±	0.31	2.77	0.82	4.78
CD	NS	NS	NS	NS

Weed density and weed dry weight at 60 DAS

significantly improved effective tillers m^{-2} and grains per spike. All weed control measures resulted in significantly highest biological, grain and straw yields. Significantly highest yields were recorded in the plot having two hand weeding which offer the complete removal of weeds at 20 and 40 DAS. Among herbicides treatments, a significant value of grain, straw and biological yields were recorded with the tank mix application of Bispyribac sodium + Pyrazosulfuron followed by Bispyribac sodium + 2,4-D compared to weedy check. The highest grain yield was observed with the tank mix application of application of Bispyribac sodium + Pyrazosulfuron which was at par with tank mix application of Bispyribac sodium + 2,4-D and sole application of Bispyribac sodium and significant over rest of the treatments. The maximum biological yield was produced by weed control through Bispyribac sodium + Pyrazosulfuron mixture. However, it was at par with Bispyribac sodium + 2,4-D, but significantly superior to the other treatments. Among herbicide treatments the highest harvest index (HI) and 1000 grain weight (g) was recorded under tank mix application of Bispyribac sodium + Pyrazosulfuron followed by Bispyribac sodium + 2,4-D and was non- significant. The entire yield attributes and yield of rice improved in the herbicide treated plots compared with the weedy check, which was due to less weed competition with the rice crop. The increase in grain yield might be owing to reduced weed density, weed dry weight and better weed control efficiency. Minimum effective tillers m^{-2}, grains per spike and 1000 grain weight in weedy check plots may be the due to the higher competition among the crop and weeds for nutrient, space, light and carbon dioxide (Tindall *et al.*, 2005). In previous studies, improvement in yield and yield variables in rice were reported in the herbicide-treated plots compared with the non-treated plots (Mahajan *et al.*, 2009). These results confirm findings of Kumar *et al.* (2010), Singh *et al.* (2008) and Gopinath *et al.* (2012).

It was concluded that under the presence of mixed weed flora, weed control in rice in NEPZ of India should be done by tank mix post-emergence application of Bispyribac sodium + Pyrazosulfuron (100 ml + 100 ml) at 20-25 DAS/DAT and the crop should be transplanted with SRI method for higher profitability and effective weed control.

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Short Communication

Economic Analysis of Onion (*Allium cepa* L.) Production and Entrepreneurship Development in Saharanpur District of Uttar Pradesh

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ABSTRACT

The study was carried out in Saharanpur district of Uttar Pradesh during 2010-11 to 2013-14. An experiment was conducted to assess and popularize the suitable variety for onion production (NHRDF Red-2) during the *Rabi* season in different locations in entire district and compared with the farmers' practices. It was revealed from the data that NHRDF Red-2 variety resulted in maximum vegetative growth (plant height, number of leaves, neck thickness) and bulb growth (bulb weight, bulb length, bulb diameter and bulb size). Similarly, maximum yield per hectare was also found with NHRDF Red-2 variety while minimum yield was observed with farmer practices (N-53). The average net returns with NHRDF Red-2 were observed to be Rs. 169592 per ha in comparison to control plot i.e. 1,11,380 per ha and on an average Rs. 58212 per ha as additional income was realized which may be attributed to the technological intervention provided to the farmers. Therefore, it is concluded that cultivation of onion with NHRDF Red-2 variety will produce higher yield along with quality bulbs at lower cost of production. With the great adoptability of NHRDF Red-2 variety for the cultivations by the farmers some of rural youths started nursery raising for entrepreneurship development through production and marketing of vegetable seedlings.

Keywords: Economic analysis, Entrepreneurship development, Onion, Production and marketing

Onion (*Allium cepa*) is one of the most important commercial vegetables. It is grown in western, northern as well as in southern India. Maharashtra, Gujarat, Uttar Pradesh, Orissa, Karnataka, Tamil Nadu, Madhya Pradesh, Andhra Pradesh and Bihar are Major onion growing states in India. India stands second position in onion production after China in the World. In India, Gujarat stands second position in onion cultivation after Maharashtra state. Onion is one of the important and flavors diffusing vegetable crop since a very long period of time but for the last one decade it becomes an important export goods and foreign exchange earning crop. Conventional varieties have undoubtedly helped in improving both bulb yield and quality. But lately, non-recommended variety and routine management practices in Saharanpur district of Uttar Pradesh appear to be incapable of maintaining yields over the long-term. A gradual shift from using non-recommended varieties to introducing NHRDF Red-2 variety is gaining acceptance. As the area of onion cultivation is continuously increasing to meet the demand of domestic as well as in international market, it is obvious that increasing cultivation requires suitable variety for higher productivity and remuneration. Intensive cultivation and excess use of chemical fertilizers with non-recommended varieties resulted in unstable yield of crops. Therefore, suitable variety has become necessary for increasing productivity of onion by

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sustaining the soil productivity. In view of the following facts, multi-location trials were conducted to the optimize and popularize the suitable variety for onion production in Saharanpur district of Uttar Pradesh.

Field trials were conducted during the *Rabi* seasons of 2010-11, 2011-12, 2012-13 and 2013-14 at the farmers' fields in different locations to evaluate the growth, yield and economic parameters of onion var. "NHRDF Red-2". The experiment was laid out based on multi-location trials at 19 villages in entire district and having two treatments. The treatment involved improved onion variety "NHRDF Red-2" and Farmers' practice (N=53). The plot sizes of multi-locational trials were kept 50m x 30m per trial. The seeds were collected from National Seeds Corporation Ltd. Regional center, Kanpur. Seeds were sown in the nursery beds at 15 July every year. For early season crop, the seeds were treated with copper oxychloride (2.5 g/lit) mercurial fungicide to save the young seedlings from fungal diseases. The seeds were sown and covered with fine and well-rotten farm yard manure (FYM). Beds were immediately misted with the help of sprinkler and all the beds were covered with wheat straw. After 8 days, germination of seeds started and completed within 14 days. Irrigation was given at intervals of eight days with the help of sprinkler. When the seedlings attained the height of 3 cm, thinning was done to get healthy and strong seedlings. Seedlings of 8-week old were transplanted after seedling dip treatment with bio-fertilizers at the spacing of 15x10 cm. Recommended dose of fertilizer NPK (150:60:60) in the form of Urea, Single Super Phosphate and Muriate of Potash were applied to grow the crop. The soil samples has collected and tested from each experimental plot before transplantation of seedlings. Full dose of P_2O_5 (60 kg/ha) as single super phosphate (SSP) and K_2O (60 kg /ha) as Muriate of potash (MOP) with half dose of N (75 kg/ha) through urea were applied at the time of soil preparation, while the remaining N was applied as urea 30 days after transplanting. Before transplantation, the experimental field was irrigated and the second irrigation was applied 5 days after transplantation. After this, irrigation was given at 10-15 days interval as per the need of crop up to the harvest of crop. Data were recorded with random samples on plant height (cm), number of leaves, neck thickness (cm), bulb weight (g), bulb length (cm), bulb diameter (cm), bulb size (cm^2), yield per hectare (t/ha) and economics. B:C ratio was computed by dividing the gross income by cost of cultivation.

It is apparent from the data presented in Table 1 that selected variety of onion (NHRDF Red-2) has significant and beneficial effect on vegetative growth and yield of onion. Data indicated that maximum plant height (53.73 cm), number of leaves (10.13), neck thickness (2.41 cm), bulb weight (107.66 g), bulb length (6.27 cm), bulb diameter (6.95 cm), bulb size (42.75 cm^2), and yield per hectare (315.60 q/ha) were found with variety NHRDF Red – 2 in 2013-14 followed by year 2012-13, 2011-12 and 2010-11. Minimum values for these parameters were observed in farmer practice over all the experimental years. Similarly, data presented in Table 2 exhibit a beneficial response to variety NHRDF Red-2 that 20.0 per cent increase in yield during 2010-11, 16.30 per cent during 2011-12, 13.80 per cent during 2013-14 and 12.80 per cent during 2012-13, respectively.

Data on economics presented Table 2 revealed that demonstrated technology of improved variety of onion "NHRDF Red-2" and their associated agronomical practices produced 52.05 per cent higher net return (Rs. 216500/-) over the existing farmer practices (Rs. 143325/-). For motivating the farmers for acceptance of improved onion variety "NHRDF Red-2" the Front Line Demonstrations were carried out at the farmer's field and data also indicated that 15.73% higher yield was recorded in demonstrated field than the existing technologies adopted by the farmers. In case of benefit cost ratio maximum benefit cost ratio was observed with NHRDF Red-2 variety of onion compared to farmer practice.

The results revealed that improved onion variety is able to produce, by itself, plant growth and bulb yield that were higher compared to farmer practice. The highest growth and yield response were achieved with NHRDF Red-2. This positive performance of the variety might be due production potential of the improved variety and adoption of scientific agronomical practices leads to improved nutrient availability to growing crop (Singh *et al.*, 1999). As the crop grown under irrigated condition, the beneficial effect of improved variety with scientific agronomic practices like

Table 1: Effect of NHRDF Red-2 and farmer practices (N-53) on different growth parameters of onion

Years	No. of Experiments	Plant height (cm)		No. of Leaves		Neck thickness (cm)		Bulb weight (g)		Bulb length (cm)		Bulb diameter (cm)		Bulb Size (cm^2)	
		Experiments	FP	Experiments	FP	Experiments	FP	Experiments	FP	Experiments	FP	Experiments	FP	Experiments	FP
2010-11	22	48.47	43.12	8.53	7.43	2.17	1.82	89.92	78.32	4.59	4.34	5.51	4.98	31.15	28.78
2011-12	30	50.11	45.16	9.43	7.92	2.21	1.93	92.58	84.07	5.21	4.76	6.13	5.49	35.15	32.10
2012-13	25	51.68	44.56	9.71	7.98	2.27	1.88	96.55	87.32	5.49	4.81	6.25	5.58	38.12	33.97
2013-14	27	52.73	46.80	10.13	9.34	2.41	2.13	107.66	92.78	6.27	5.20	6.95	6.09	42.75	37.23
Mean	**26**	**50.75**	**44.91**	**9.45**	**8.17**	**2.27**	**1.94**	**96.68**	**85.62**	**5.39**	**4.78**	**6.21**	**5.54**	**36.79**	**33.02**

Table 2: Yield performance and economic indicators of Front line Demonstration of Onion

Year	No. of Experiments	Yield (q/ha)		Increase (%)	Cost of cultivation (Rs.)		Gross return (Rs.)		Net return (Rs.)		CB ratio	
		Experiments	FP		Experiments	FP	Experiments	FP	Experiments	FP	Experiments	FP
2010-11	22	2940	245.00	20.00	58550	58000	176400	122500	117850	64500	2.01	1.11
2011-12	30	303.00	260.50	16.30	61000	60550	212100	169325	151100	108775	2.47	1.79
2012-13	25	310.80	275.60	12.80	66697	64000	248640	181943	192920	128920	2.72	2.01
2013-14	27	315.60	278.50	13.80	67000	65550	283500	208875	216500	143325	3.23	2.18
Mean	**26**	**305.85**	**264.90**	**15.73**	**63311**	**62025**	**230160**	**170660**	**169592**	**111380**	**2.61**	**1.77**

nutrient management, weed management etc. results in greater and longer availability of nutrients as per demand of the crop. Highest plant height with the application of newly developed variety of onion was also reported by (Vora *et al.*, 1999). The average bulb weight is known to be influenced by bulb length and bulb diameter which in turn affect yield. These findings are in confirmation with the findings of (Krontal *et al.*, 2000) who found significant effect of improved varieties of onion on bulb length and diameter. An attempt was made to compare the profitability of onion variety NHRDF Red - 2 with other varieties in different study areas. Data on economics presented Table 2 revealed that gross income in different years varied from Rs. 1,76,400/- to Rs. 2,08,875/-ha. This might be due to higher bulb yield per hectare. These findings are also in close agreement with the (Ali *et al.*, 2005; Aminu and Abba, 2006; Barakade *et al.*, 2011; Chandrashekhar, 2007; Chaudhary *et al.*, 2008; Kumbhar, 2000 and Shah, 2000).

Entrepreneurship development: After taking four year continues successful field trials, we have organized vocational trainings at KVK for rural youths to develop employment. Some of the farmers/rural unemployed youth adopted certain vocations as entrepreneurship that resulted in good monetary returns. Examples of some entrepreneurship development are as under:

Entrepreneurship Development through Production and Marketing of Vegetable Seedlings: The commercial vegetable cultivation is becoming popular among rural youth because of higher demand in local market and good economic returns. The availability of quality seedlings of recommended varieties is crucial for vegetable cultivation. Most of the seedlings available in the local market is of poor quality which results in poor yield.

The KVK trained the rural youth for quality seedlings raising. The emphasis was given on selection of variety, and off-season nursery raising for higher returns. Three rural youth namely Sri Satpal Singh, Sri Rakesh & Sri Sandeep from the KVK adopted village Raniyala Dayalpur started vegetable nursery raising vocation after taking training from KVK. Within one year all the three rural youth established vegetables nursery. During last two years the production and marketing of nursery reached up to a noticeable level. The vegetable nursery farmers for sale of seedling from neighboring districts and also from Uttarakhand and Haryana visit the nursery on regular basis for purchasing quality seedlings. Within one year sale of vegetable nursery unit around 5,12,000 seedlings of different vegetables were sold and secured net income Rs. 3,87,950/- in a year (Oct., 2013 to May, 2014).

The nursery business has enabled the youths for purchasing new motor cycle collectively which has facilitated mobility. These youth have become role model for others. Many youth visited their unit for motivation the media has also highlighted their entrepreneurship. This success story has been telecasted by Doordarshan and ETV.

Cultivation of onion with improved variety NHRDF Red-2 all the years resulted in the maximum yield of good quality of marketable bulbs proved to be the most suitable variety of the onion crop for the region of Saharanpur district of Uttar Pradesh. Farmers can gain a handsome profit by growing NHRDF Red-2 adopting the transplantation and agronomic practices. The potentials of the improved onion verity for higher yield and income were communicated to the farmers through demonstrations. Concerted efforts must be made for promotion of such varieties of the benefit of the farmers. With the efforts made by KVK, many farmers has adopted new technology and this is acceptable by the farming community in the Saharanpur district of Uttar Pradesh and verity has lateral spread in 315 ha area. Some of the rural youths have started onion nursery raising and selling to onion growers of the states as entrepreneurship development to generate employment and money.

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