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ABOUT THE SOCIETY

MOBILIZATION Society was established in 2003 as a non-profit professional society aimed at sensitizing and mobilizing development partners and community for sustainable development. The Society, during these ensuing years has successfully mobilized researchers, academicians, planners, grass root mobilizers and student and created conducive intellectual atmosphere for introspective deliberations and conducted National seminars/ workshop to address the emerging problems experienced by the agrarian mass. Presently the Society has more than 1100 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

Though, agriculture today stands on the height of self-sufficiency in food grain production, key challenges plaguing the sector involve shrinking resource base, increased cost of production, climatic aberrations, ever increasing food demand, a convoluted supply chain with multiple levels and intermediaries, reduced farm profitability etc. Time has come to enunciate captivated shifts in agricultural strategies with innovations in all the fields related to it rather to follow traditional transfer of technology regime. Delivery of demand driven technological options, co-management of the resource base, leveraging ICT and big data in production and post production, F2F (farmer-to-farmer) extension, integration of traditional and scientific knowledge, market linkage model etc. are imperatives which can bring a climate of economic advantages in the agriculture and related fields. Among these options, the most important game changer which transforms the farming as a business is the development of start-up ecosystem with the integration of different knowledge domains and skills in agri-innovation.

The Society for Community Mobilization for Sustainable Development (MOBILIZATION), with more than 1100 renowned planners, eminent researchers, academicians, grass-root mass mobilizers and students as its active life members is now at the 16th year of its venerated journey. Unconditional and dedicated support of the members from the foundation day till date equipped the society to meet different challenging agricultural situations and to stand for diversified activities among the research community including organization of national and international seminars, community mobilization and facilitation of knowledge sharing among the professional groups on a regular basis.

We are very happy to place before you the January-April, 2019 issue of the journal. Our strides to bring novelty with multi-disciplinary nature in the journal articles are fruitful as this issue is rich with quality research findings from different areas of agriculture and allied sector. Agripreneurship Development, On-Farm Testing, Nutritional Studies, Gender Studies and Women Empowerment, ITK, Analysis of Socio-cultural Constructs, Field Crops and Adoption Research, Health Studies, ICTs, Knowledge Management, Impact Analysis, Agri-Credit and Economic Analysis, etc are some of the main research areas included in this issue. We feel proud and contented to share that our admired journal has attained NAAS rating of 5.30 since January, 2017 and we are in a constant stride to uphold the quality and upgrade it further. Now it is published quarterly.

I am indebted to the committed editorial team members Drs. Souvik Ghosh, S. K. Dubey, R. Roy Burman, Nishi Sharma, S.R.K. Singh, Reshma Gills, Sudipta Paul and Sujit Sarkar for their continued help and support at each and every point of the journal drafting. I thank them for both the quantity and quality of their contribution to bring out this issue on time. I express my sincere thanks to Ms. Subhashree Sahu and Dr. Hema Baliwada for their efficient management and timely support in shaping this issue of the journal as on-line editors. Finally, I would like to thank the contributors and readers of Mobilization Journal for their interest in the journal..

J.P. Sharma
Chief Editor

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Lac Based Agri-Entrepreneurship Development Model of District Sitapur in Uttar Pradesh

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ABSTRACT

Lac based agri- entrepreneurship development is an attempt to bring both human and material resources together to capacitate farmers and farm women of the district- Sitapur (U.P.). The present work was undertaken in two phases. First phase involved stimulation and technology backstopping by conducting appropriate training to the selected rural youth and farmwomen on nursery production of traditional and new lac host plant-*Flemengia semilata* and development of various value added products of Lac. In second phase, trained participants were hand holded to start their own enterprise by forming their self help groups. Constant follow up, backward-forward linkages and support was provided to new entrepreneurs. Currently, additional income is being started flowing into the rural families through sell of nursery plant, lac based value added products and raw lac. Intercropping of Lac host plant as border crop and inter crop with various vegetables ensured additional economic returns to the farmers of the district-Sitapur.

Keywords: Border crops, Entrepreneurship, Intercropping, Lac culture, Nursery production, Value added products

INTRODUCTION

The vast majority of the rural poor continue to be dependent on land and water resources for their meagre livelihoods. Paradoxically, however, various phenomena including flood, deforestation, drought, soil erosion, low risk bearing capacity of farmers, small holding size, traditional methods of cultivation, poor net-work of transport, lack of marketing avenues etc. have resulted in decreased incomes for farming families. Due to growing pressure of population, the job opportunities are decreasing. The urgent need for job opportunities has become imminent. The inhabitants in such circumstances are forced either to migrate in search of work or survive on local resources. This situation demands optimum utilisation of the available resources or alternative sources of income, taking into account the resources available to the local populace and entrepreneurship development in rural areas can transformed their vicinity (Singh and Kumar, 2004).

According to Vijayshankar and Krishnamurthy (2012), rural products of India are unique and innovative and have good utility and values. Large number of agri-based rural products (like handicraft items, food products, embroidery, clothes and other products) sustained a significant segment of the population in the rural areas. In India like agrarian society, the concept of holistic development embodies women as an integral part. Practically, however, women are discriminated and often denied their fundamental rights to survive comfortably. Women from poor household are almost always engaged in economic production, and this income is a vital source of livelihood for them (Goel and Kholiya, 2011). Women play crucial role in agriculture as labour, farmers, co-farmers, female family labour, farm manager and farm entrepreneurs (Prakash *et al.,* 2014; Tripathi *et al.,* 2018). They are largely make home-based, self-employed producers making a variety of goods ranging from handicrafts, garments to food and dairy products. Empowering rural women is important because of two reasons: first they constitute half of the population; second, it is they who share the burden of poverty. In order to reduce poverty, we need to promote development and achieve gender equality. Kirtimani *et al.* (2016) in their study reported that when the training need of farm women was assessed it was found that almost all respondents were curious to know about the new technologies and time management techniques. It is necessary to increase women's access to economic resources, education, information and communication technologies.

Our line of intervention of lac culture and value addition for income generation through entrepreneurship development among rural areas is also supported by the Mandal and Sarkhel (2014) as they found lac cultivation is simple with no involvement of high technology and very low investment. It is imminently suited to the farmers living in the vicinity of the forests including women as it demands only their part time attention. In the district its cultivation provides an important additional income next only to the agriculture. Farmers are also dependent on lac cultivation for their livelihood and Lac is regarded as an important source of cash flow to the marginal, small and large farmers.

The KVK-II, Sitapur initiated Lac based entrepreneurship among farmers/ farmwomen. Lac Host Plant (*Flemengia semilata)* Nursery production and Lac value added products development is readily adopted by the farmers and rural youth and farmwomen respectively. Rural Women and girls groups take up lac value added products development to earn few more bucks for their family. Farmers of the area started producing Lac and selling their raw lac outside the district with the help of KVK. We provide training to our women and girls in processing of raw lac and its value addition, we provide forward channel to Lac nursery producers and Lac cultivators as well as will provide income generating avenues for the young girls and farm women.

MATERIALS AND METHODS

In pretext of doubling the farm income, the KVK-II, Katia, Sitapur with the technical support of Indian Institute of Natural Resins and Gums, Ranchi started Lac Culture in two phases. First phase was comprised of organisation of awareness campaigns in villages to promote lac culture in the area, selection of interested participants and the basic and advanced skill development trainings of selected rural youth and farmwomen on lac host plants' nursery management, lac based value added product development in batches according to their interest, ability and working experience.

Second phase was comprised of setting up of new enterprises, setting up of backward and forward linkages hand holding and follow up. To provide backward and forward linkages to the newly developed enterprises, campaign were organised to create awareness on economical importance of traditional lac host plants i.e. Palash, Ber and Kusum (*Buteamonosperma, Zizyphusmauritiana, Schleicheraoleosa* respectively) and nobel Lac Host Plant named *Flemingia semialata*. In this phase farmers were motivated to plant *Flemingia* as intercrop with their vegetable and fruit crops to earn extra money from the same land acreage. To address the problem of low price fetched by unprocessed Lac, farmwomen and girls made trained in Lac processing and value addition. Trained and motivated participants were grouped to produce different lac based household utility articles. Different home decoration and utility articles are being made from the locally available agriculture/ animal and forestry wastes or resources viz cow dung, hay, straws, stems, twigs, wood, stones, bark etc. list of items is exhaustive and includes paper weight, wall decoration pieces, table accessories, flower vases, idols, dustbins, photo frames etc. These raw items are decorated by using coloured Lac, sparkled lac, stones and other decorative materials.

RESULTS AND DISCUSSION

Experiences of on-farm trials: The district Sitapur is very rich in lac host plants (*Buteamonosperma, Zizyphusmauritiana, Schleicheraoleosa*etc.) in scattered places but due to lack of knowledge and awakening, farmers ignore host trees and they cut and use for fuel purposes. Dual characteristics of nature i.e. rainfed agriculture as well as Flood Prone situations is prevalent in the district. Now-a-days, crisis in cash flow among farmer through their traditional source of income from sugar industry turns deep down and the situation is very challenging.

Thus to support farmers the KVK-II, Katia had taken an initiative of introducing the Lac Culture in the district in 2013-14. On-farm trial was conducted at KVK Farm as well as at farmers' field of the surrounding villages, on 30 *Ziziphusmauritiana* plants *(Kusumi Lac)* in collaboration with Indian Institute of Natural Resins and Gums (IINRG, Ranchi, Jharkhand) and successfully received average yield 1.45 kg/plant (Without Pruning). (Detailed observations and outcomes of the on-farm-trail can be seen in the Table-1). Though some plants were destroyed by the locals but we were successfully assessed Lac Cultivationin local conditions and become able to showcase importance of this promising technology among farmers of the area through trainings and field days.

In next year (2014-15), the KVK introduced short heighted and very fast growing host plant of the Lac culture for the wide spread of this technology among farmers who do not own traditional host plants but eagerly

Table 1: Summary of *Kusumi* Lac production in 2013-14 (Lac cultivation only on Ber- *Ziziphus* plants)

Place	No. of Ber plant inoculated	Date of Inoculation	Quantity (kg/plant)	Total brood Lac inoculated (kg)	No. of tree produced Lac	Date of harvesting	Quantity (kg/plant)	Total produced Lac (kg)
KVK-Farm	22	11-July 2013	0.8	17.0	14	17 Feb. 2014	1.7 – 2.5	32
Village-Oripur	3	11 July-2013	0.4	1.2	3	18 Feb. 2014	0.7, 0.6, 0.4	1.7
Village-Sarwahanpur	3	11 July-2013	0.3	1.2	3	19 Feb. 2014	0.1, 0.6, 0.3	1.0
Village- Ghuripur	2	11 July-2013	0.3	0.6	2	20 Feb. 2014	0.5, 0.4	0.9
Total	**30***			**20.0**	**22**			**35.6**

*8 Insect Inoculated Ber Plants were damaged by Local Villagers

want to try Lac culture, namely *Flemingia Semialata* . Front-line demonstrations were conducted at farmers' fields on *Ziziphus mauritiana* and *Flemingia semialata* plants. The average yield received was found to be 3 kg/plant from *Ziziphus* plants and 212 g/plant from *Flemingia semialata* plants. Detailed results are shown in the Table 2.

This technology got vast attention of print as well as electronic media and was viewed by more than 3000 farmers of Sitapur, Hardoi, Barabanki, and Kanpur Dehat farmers also. The technology was also demonstrated in Kisan Melas, Exhibitions organisied by different Universities/ Institutes/ organisations.

Promoting the entrepreneurship: For sustainable management of the technology and involvement of the half of the population i.e. rural women in income generation activities, a group of 25 farm women was provided trainings on production of Lac based value added handicraft products. The harvested Lac was also being utilized by trained rural women farmer in making different types of Lac based value added handcrafted products viz. pencil stands, pens, *kadas*, mirror case, hair pins, watches, paper holders, clips, wall panels and many other household utility items where our imagination could reached and now they are now able to earn 50-70 Rs./day for doing 3-5 hour additional craft making work from their homes apart from their existing work profile that mainly includes household chores, work in the farms, child rearing, dairy, poultry, goat rearing etc. This group is able to create sensation in the surrounding areas and this group is now expands its members as well as working capacity by giving training to the interested farmwomen and rural girls of the area. Figure-1 shows the farmwomen and rural girls getting training on lac based handicraft production. Conference mementos are being developed by them.

Intensifying the cropping system: From 2015-16 onwards, the KVK initiated plantation and intercropping of *Flemingia semialata* with their other crops so that additional income to the farmers can be ensured. Idea of intercropping came into existence if in case of adverse weather conditions as experienced by the farmers of area, crop of lac will be unaffected and will save the farmers from the complete crop failure and losses. Presently the technology of farming been adopted in 8 Blocks of Sitapur district covering 22 Ha Area and farmers received income of Rs. 48/ Plant from Ziziphus and Rs 50/Plant from *Flemingia semialata*as shown in Table 3.

Intangible benefits incurred: There is one other perception of *Flemengia semilata* based Lac culture that this plant belongs to the leguminous family thus plantation of this plant will improve the soil fertility of the land by fixation of atmospheric nitrogen in the soil. It can easily be intercropped with the existing crops, can easily be grown

Table 2: Summary of Kusumi Lac production in 2014-15 (Lac cultivation on *Ber* + *Flemingia*, Lac type- Kusumi)

Host plant	Location	Date of inoculation	No. of plant selected for inoculation	Quantity (kg/plant)	Total brood lac inoculated (kg)	Total produced lac (kg)
Ber	Village-Oripur	18 -July 2014	7	1 kg	7.0	21
Flemingia semialata	Village-Ghuripur	19 -July 2014	160	50g	8.0	34

*Produced lac was purchased by KVK-II, Sitapur @ Rs. 160/kg

Table 3: Details of plantation of *Flemingiasemilatain* in district-Sitapur (2015-16)

Village	Block	No. of *Flemingia* plant planted	Intercropping
Allipur	Maholi	2100	Muskmelon
Akbapur	Pahla	1600	*Anacyclus pyrethrum* (Akarkara)
Saraiya Mahipat Singh	Pahla	800	Radish, spinach
Sukhavan Kalan	Biswan	1700	Okra, Bitter gourd
Kashiyapur	Mahmoodabad	2000	Asparagus
Raghunathpur (Aini)	Godlamau	1000	Cucumber
Ghuripur	Biswan	1500	Urdbeen
Alhanapur, Goraich	Rampurmathura	1000	-
Maheshpur	Reusa	2000	-
Total		**13700**	

*Produced lac was purchased by KVK-II, Sitapur @ Rs160/ kg

on barren lands and low fertile lands. The heavy flowering on the plants attracts lots of honey bee activities which in turn leads to high pollination in the main crop as well as high production of honey by the bee-keepers. The blue bull is major problem faced by the farmers, the dense border plantation of the *Flemengia* is found effective in checking the blue bull attacks in the field as they don't like its taste, as well as protect the main crop from cold/hot waves when planted as border crop. Consequently we will be able to contribute in Doubling the Farmers' Income by 2022 and Improving Soil Health Concept. Lac cultivation found to have potential of adoption as small enterprise with low inputs by the rural people as it provides additional income to small and marginal farmers. Lac Production is considered to be a complimentary and supplementary form of income to the existing livelihood activities of households.

CONCLUSION

Thus lac cultivation and value addition directly and indirectly contributes in the empowerment of the rural community and enable them to initiate and control their own development. Now they are aware about their needs, and motivated to improve the quality of life of their family members. Thus lac culture could be a perfect agriculture based enterprise which addresses societal challenges by enhancing knowledge and skills of the rural girls and women thus will contribute in generation of additional income by them for the enhancement of quality of life of their family.

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Occupational Health Hazard among Farm Women in Kannauj district of Uttar Pradesh

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ABSTRACT

Most tedious and back breaking farming, livestock and post harvest tasks are performed by farm women. Many of these operations are traditionally done sitting long hours in varying body posture which cause inconvenience and body pain and become source of drudgery for farm women. However, the drudgery of farm women is not yet precisely been identified and quantified. The present study was an effort to assess the occupational health hazards among farm women due to the tools they use and work they do at farm. Investigation was carried in two villages Digsara and Bahelianpurva of Jalalabad block in district Kannauj U.P. Twenty farm women/village from each enterprise i.e. crop production, live stock and post harvest were selected comprising total sample of 120 respondents. The results indicate major farm activities performed by women were transplanting 89.16 per cent, weeding 88.33 per cent, cutting/uprooting and picking/diffing 84.16 per cent, bundling and heaping 87.50 per cent, winnowing 85.00 per cent and inter culturing and dusting pesticide 44.16 per cent. Cent percent farm women were involved in crushing, beetling, sieving, cleaning, grading, storage of grains, feeding animal and cleaning of shed. Majority were having very few traditional tools like sickle, hoe and hand ridger. Farm tools were not comfortable for 37.50 per cent farm women, 60.83 per cent need change in design of farm tool and 45.00 per cent found them heavy. Majority 65.00 per cent reported injury while harvesting followed by 33.33 per cent while weeding and 25.00 per cent while cleaning land. Joint problem was reported by 89.16 per cent farm women in wrist, 88.33 per cent in knee, back bone and shoulder, 75.00 per cent in neck and 73.33 per cent in elbow. Majority of farm women reported physical problems like body pain (95.83 per cent), tiredness (92.50 per cent) and physical stress (90.83 per cent) while transplanting. Farm women also reported impact of skin disease during farm activities i.e. heat stroke (84.16 per cent), heat exhaustion (68.33 per cent) and fungal infection and allergic reaction (23.33 per cent).

Keywords: Drudgery, Farm women, Crop production, Post harvest, Livestock

INTRODUCTION

Women play a significant and crucial role in agricultural development and allied fields including the main crop production, livestock production and post harvest operations. It is estimated that women are responsible for 70 per cent of actual farm work and constitute up to 60 per cent of the farming population (Chaudhary and Singh, 2003). Agriculture work sometimes becomes risky and it has been reported that workers in this sector have among the highest rate of fatalities (Bureau of Labour Statistics, 2014). Occupational health hazard constitute a major source of morbidity and mortality among all workers (Driscoll *et al.*, 2005). The occupational health hazard may be mainly due to two reasons i.e. the use of harmful chemicals in farming and biomechanical and posture demand of the workplace leading to musculoskeletal problem. Many women's job requires static effort, exerted when muscles are contracted for long period. This type of effort creates musculoskeletal and circulatory problem due to interference with circulation. Workers in agricultural operations for both crops and animal production typically use repetitive motions in awkward positions which can also cause musculoskeletal injuries (Kirkhorn *et al.,* 2010).

Farm women often lack education and information on the health hazard and habitually view pain as a normal part of work and seek care only when the conditions become severe and disabling. Usually they do not understand the association of a health problem with its source. Further women being overburdened with so much work load both on farm and at home they usually reject

their health (Menon and Sheshadri, 2004). The effect on health of women's multiple role is still poorly understood, hence present study was planned to assess the perception and concern of farm women on prevalence of farming associated health hazard among them.

MATERIALS AND METHODS

The study was conducted in Digsara and Bahelianpurva villages of Jalalabad block in district Kannauj in Uttar Pradesh state during 2016-2017. From each village, twenty farm women from all three farm operations i.e. Crop production, livestock management and post harvest handling were selected for the study. Pre- structured interview schedule was utilized to collect data on perception of farm women regarding health hazards associated with farming operations. Data was collected on parameter like involvement of women in farm operations, farming tools available to them for the purpose, their experience of using tool and associated health hazards. Data was quantified to get the self reported drudgery of farm women to introduce location specific interventions..

RESULT AND DISCUSSION

Women's involvement in farm activities: Women play a distinctive role in the process of earning livelihood for the family but over the year women cultivators are typically and wrongly characterized as economically inactive and women cultivator play only a supportive role in agriculture. Present study through data in Figure 1 represents that rural women involved in all most all activities starting from cleaning field to milking animal.

It is clear from the figure above that major involvement of farm women was observed in transplanting, weeding, harvesting , post harvest processing and animal care. Cent percent farm women reported their involvement in crushing/ beetling, sieving, cleaning, grading, storage, feeding animal and cleaning shed. Other farm operations showing major involvement were transplanting (89.1 per cent), weeding (88.3 per cent), heaping/bundling (87.5 per cent), winnowing, (85.0 per cent) harvesting 84.1 per cent), picking/diffing (84.1 per cent) and bagging/matting (75.8 per cent). Dusting pesticide, inter culturing, removing stalks, cleaning field, dibbling, gap filling, irrigation and spreading/ mixing manure were performed by 44.1,44.1, 38.33, 33.33, 24.16, 20.83, 14.16 and 8.33 per cent farm women respectively. Aggarwal and Singh (2003) also reported that in some of the farm activities like processing and storage women predominate so strongly that men workers are numerically insignificant. They further reported that about 60 per cent of agricultural operations like sowing seed, transplanting sapling, winnowing, storage of grain etc are handled exclusively by women, while in other jobs they share the work with men.

Tools used by Farm women: During field survey it was observed that cent percent farm women were performing their farm operations using traditional farm tools like sickle, spade and hand hoe etc which may lead to many physical,

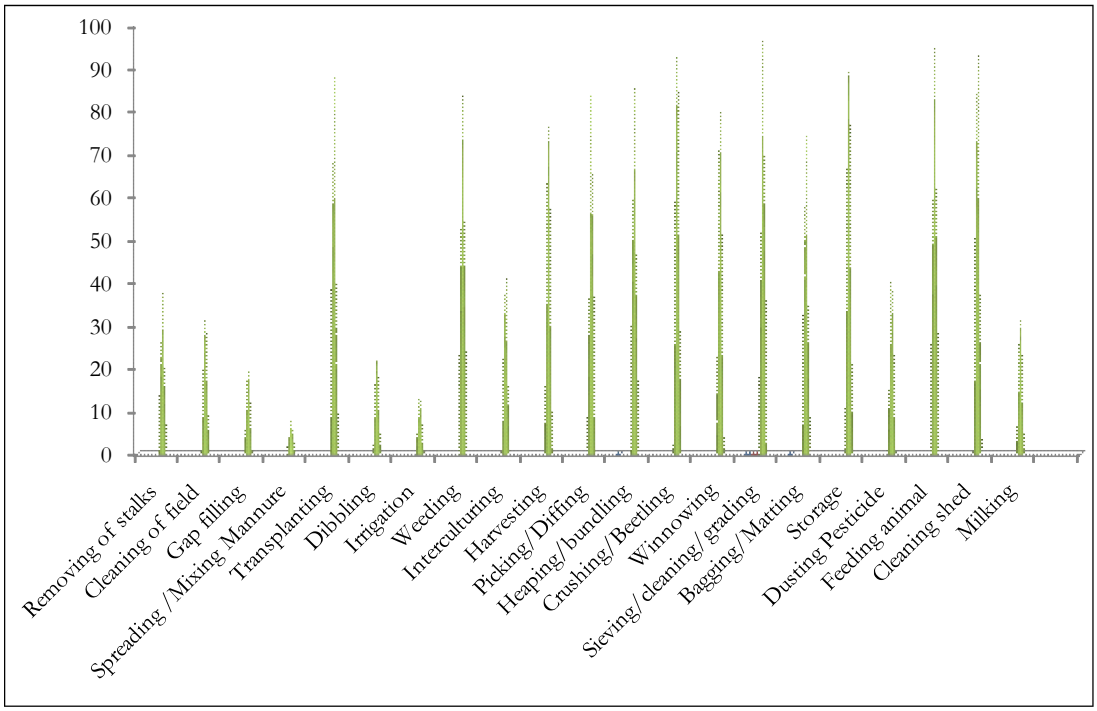

Figure 1: Women's involvement in farm activities

mechanical and ergonomical health hazards among them. Few farm women were not even aware about improved farm tools and many who know about it also have no access to them due to their non-availability at local market.

General experience of using tools: Banerjee (2001) reported that women constitute 32 per cent of the labour force in the preparatory work before cultivation, 76 per cent for sowing seeds, 90 per cent transplanting, 82 per cent transporting crops from the field, 100 per cent traditional food processing and 69 per cent in dairying at the national level. Despite their pivotal role in agriculture most of the women are using old age traditional tools and equipment till date.

Data regarding farm women's general experience of using farm tools in Table 1 reveals that majority of farm women experienced that traditional farm tools used by majority of them cause tiredness (72.50 per cent), Joint problem due to long working hour and posture (84.16 per cent), physical problem (73.33 per cent), scratch on hand/feet due to poor design and construction (53.33 per cent), skin disease due to farm activities (35.00 per cent), and also cause injury (40.00 per cent). They further reported that farm tools were heavy (45.00 per cent), sickle handle were made of wood (76.66 per cent) and also they do not reduce force needed to work with them (40.83 per cent). Due to being habitual to use these tools since years 45.00 per cent found it comfortable but still 60.83 per cent need change in design of tool to enhance productivity. Singh *et al.* (2001) had also stated that drudgery which is generally conceived as physical and mental strain, agony, monotony and hardship experienced by human being, is alarming more such activity because of using old tool and implements specially khurpi and hoe. Though improved tools have been developed, most of them have not reached to the farm women.

Farming associated health problems faced by farm women: Agricultural works are associated with several occupational disorders among farmers, and agriculture farming involves several types of hazardous activities including prolonged and awkward posture (Das *et al.,* 2011).

Much agriculture health related hazards are difficult to identify because of the delayed appearance of the symptoms or ill-effects. In present study farming associated

Table 1: General experience of farm women using farm tools N=120

Parameters	Farm women's general experience of tools		
	Yes	No	Can't say
Farm tools are comfortable	54(45.00)	45(37.50)	21(17.50)
Farm tools need change	73(60.83)	31(25.83)	16(13.33)
Farm tools are heavy	54(45.00)	45(37.50)	21(17.50)
Farm tools cause injury	48(40.00)	59(49.16)	13(10.83)
Sickle handle made of wood	92(76.66)	28(23.33)	-
Farm tool reduce force while working	44(36.66)	49(40.83)	27(22.50)
Farm tools cause tiredness	87(72.50)	22(18.33)	10(8.33)
Joint problem due to farm activities	101(84.16)	19(15.83)	-
Physical problem due to farm activities	88(73.33)	20(16.66)	12(10.00)
Scratch on hand/feet due to farm activities	64(53.33)	56(46.66)	-
Skin disease due to farm activities	42(35.00)	78(65.00)	-

health hazard were studied under four categories wiz: joint problems, Impact faced on body, Injuries and skin diseases during farm operations.

Joint problem during farm operation: Problems associated with joints, bones, ligaments, tendons, muscles, and nerves cause joint problems. Because the symptoms of arthritis and musculoskeletal conditions are similar, correctly diagnosing the condition can be difficult. In this section, selected body parts majorly involved in farm operations were assessed for musculoskeletal pain and data in Figure 2 reveals 89.16 per cent farm women reported pain in wrist followed by 88.33 per cent in knee, backbone and shoulder. About 75.00 per cent farm women also reported pain in neck and elbow joint. Pain in waist was reported only by 50.83 per cent respondents.

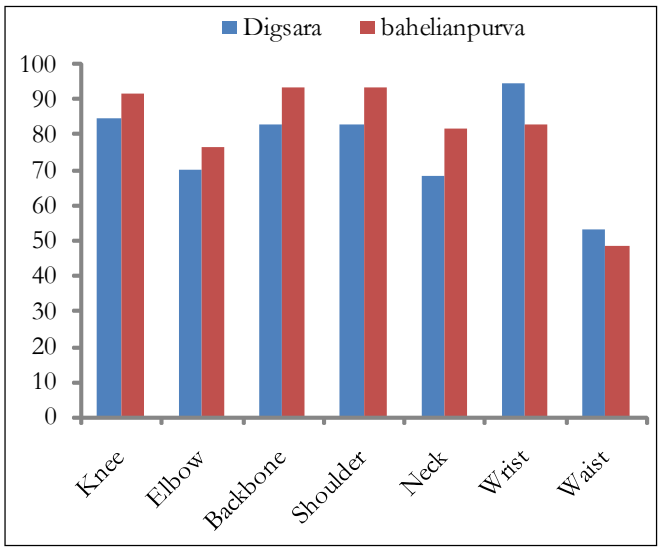

Figure 2: Joints problem during farm operations

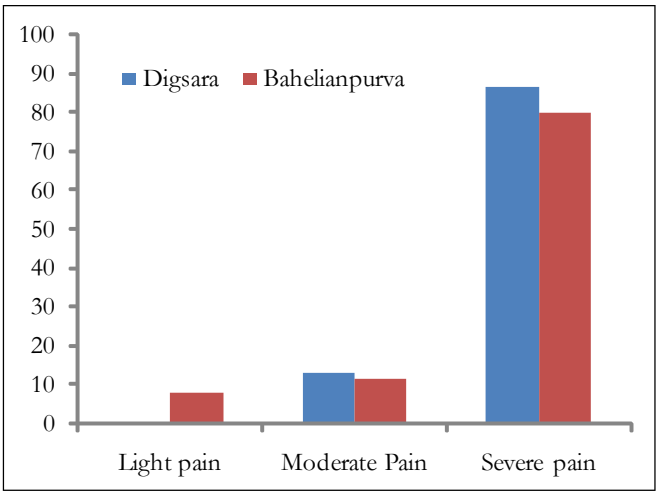

Figure 3: Exertion faced during farm operations

***Exertion faced on body during farm operation*:** Exertion is the physical or perceived use of energy. It is strenuous or costly effort resulting in generation of force, initiation of motion or in performance of work. Data in Figure 3 reveals that 83.33 per cent farm women reported severe pain while performing farm operation. Sawakar 2001 also reported that the rating of perceived exertion of the female labourer for agricultural activities was heavy to very heavy.

Injuries faced during farm operation: Intrinsic injuries can be further subdivided into two categories: acute and chronic. Acute intrinsic injuries occur spontaneously when one tries to exceed the limits of his/her body. A chronic intrinsic injury results from continuously stressing the body without giving it adequate time to heal. According to (NASS 2013) 6 of every 1,000 agricultural workers

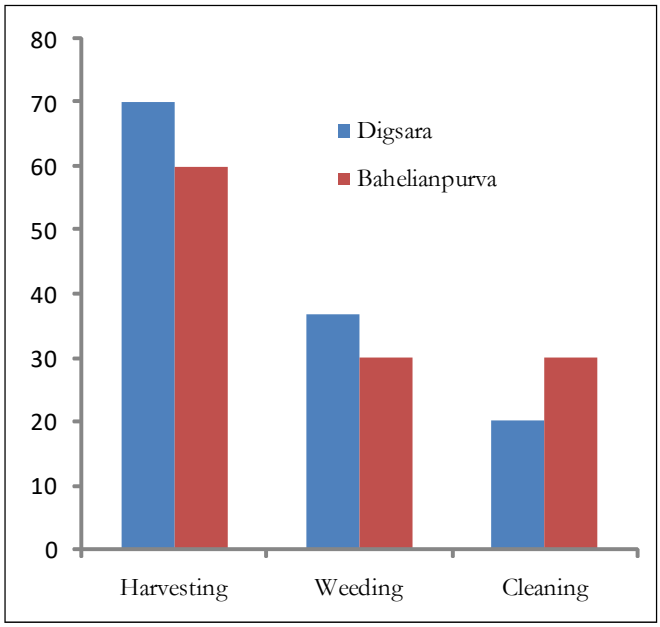

Figure 4: Injuries faced during farm operations

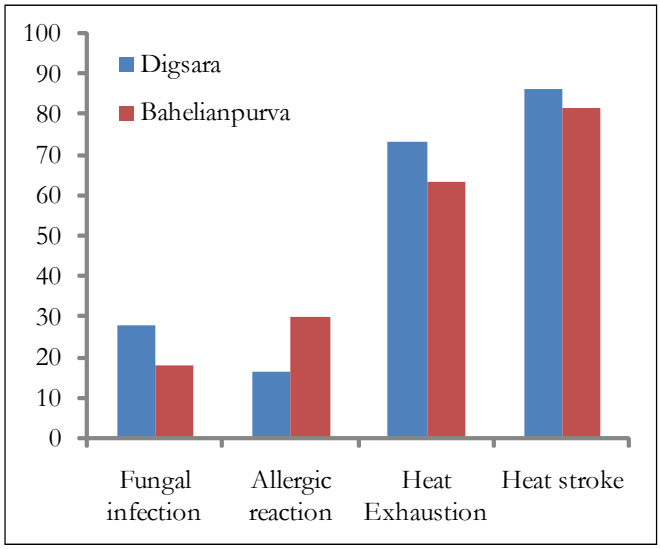

Figure 5: Skin diseases during farm operations

experiences either primary or secondary injuries. Data in Figure 4 shows that farm women reported harvesting operation as major injury prone followed by weeding and cleaning.

Skin diseases during farm operation: Contact dermatitis is a skin disorder that occurs among agriculture workers. There are two general categories: irritation and allergic. Irritation act directly on the skin at the place of contact. Allergy changes immune system so that subsequent contact produces a reaction. About one – fourth (23.33 per cent) farm women reported fungal infection and allergic reaction during farm operations. Heat stress occurs when body builds up more heat than it can handle. High temperature, high humidity, sunlight and heavy work load increases the likelihood of heat stress. Data in Figure 5 reveals that problem of heat stroke was reported by 84.16 per cent farm women and heat exhaustion by 68.35 per cent.

CONCLUSION

Occupational Health Hazards have been a widespread problem in agriculture in more than a decade. Occupational risk factors include static position, forward bending, heavy lifting and carrying, kneeling and vibration in agriculture. With women predominant at all levels-production, pre harvest, post harvest, processing ,packaging, marketing- of the agriculture value chain, to increase productivity in agriculture, it is imperative to adopt gender specific interventions. There is need to initiate women oriented researches in agriculture. As woman has different ergonomical characteristics than man, design of women friendly tools and equipment would be of greater help in reducing their occupational health hazards.

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Adoption of off Season *Rabi* Pumpkin in Commercial Basis in Assam

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ABSTRACT

The cultivation of crops outside the regular cropping calendar and when there supply is low and prices are high can fetch farmers better profits and consumers more choice. The field study was undertaken to study the off season cultivation for *rabi* pumpkin in silt deposited river banks in agro-ecological conditions of Chengnoi and Mairadanga areas of Nalbari district, Assam. The study was based on field observations and farm level data in planting times of July, August, September and October months in rainfed condition with variety Arjuna. Data were collected on yield attributes, crop duration and economic indicators. Results showed the substantial differences among means of traits at different planting date treatments. September planting produced higher yield as compared to the early and very late planting dates. The results revealed that higher number of fruits per plant and fruit weight were reported in September planting. Similarly maximum yield (168.83 q ha^{-1}) was produced by September planting. However, July planting fetched the best market price whereas highest B:C ratio (5.76) was reported for August planting.

Keywords: Offseason*, rabi* pumpkin, Planting time, Adoption, Silt deposited area

INTRODUCTION

Vegetables taste best when eaten in season. This is good for consumers, but farmers would prefer producing and selling vegetables in the off-season-if they could, for more income. India is the second largest producer of vegetables in the world, next only to China, and accounts for 2 per cent of the total area of the country, which is rather low in view of the national requirements. In spite of the importance of vegetables, both as food as well as the source of vitamins, proteins, carbohydrates, oils and minerals, the per capita consumption of vegetables in India is around 130 g/capita/per day as against the requirement of 300 g recommended by Indian Council of Medical Research (ICMR)-pl. give reference to this data.

Off-season vegetable cultivation is the growing of vegetables by preponing and postponing the normal time of planting. The agricultural cropping season in India is generally divided into two main seasons. The *kharif* season is characterized by high temperatures, high rainfall and high humidity which generally lasts from July to September and the *rabi* season lasts from October to March. Cucurbitaceae is the largest family in vegetable kingdom and includes highest number of edible types. Pumpkin is an important vegetable of Cucurbitaceae family and occupies a prominent place owing to its high productivity, nutritive value, good storability, long period of availability and better transport potentialities. Pumpkin fruit is extensively used as a vegetable both in immature and mature stages throughout India.

Pumpkin is a very popular vegetable among the people of Assam and is widely cultivated in *rabi* season by the farming community of the state. However, in light soil (river bank), growing of pumpkin during *rabi* season is difficult as water availability becomes very less due to low water holding capacity and irrigation cost increases by manifolds. So growing the crop in *rabi* season is found to be less profitable. Although Pumpkin is a very important vegetable, but no work so far has been reported regarding its off season cultivation in the silt deposited river banks of the state. An attempt, therefore, has been made in this paper to study the time of off season planting of pumpkin in silt deposited area on the river bank for good yield and economic returns.

MATERIALS AND METHOD

The study was conducted using observational data and field data in the farmers' field under rainfed condition at Chengnoi and Mairadanga villages of Nalbari during the cropping year 2015-2017. The village Chengnoi is situated at 26°29.627'N latitude & 91°28.315' E longitude and

Mariadanga is situated at 26°29.657' N latitude and 91°28.325' E longitude with an average elevation of 42 m above mean sea level. Four planting dates viz., July, August, September and October were considered based on personal observations and farm data. The distances between row to row and plant to plant were kept 10 ft. and 5 feet, respectively. All the other pre-sowing and post sowing cultural practices like levelling, manuring, weeding, hoeing *etc*. were carried out as per package of practices. All the plant protection measures were adopted to make the crop free from insects. The data were recorded for yield attributes, crop duration and economic findings.

RESULTS AND DISCUSSION

Days to 1st flowering: The days to 1st flowering was affected considerably by different planting times. The data in Figure 1 shows that the results for days taken to flowering were noteworthy. Maximum number of days taken to flowering was recorded as 55 in October sowing while the minimum days of 45 was observed in July and August sowing. These findings may be due to the change in temperature, because lower temperature (in the month of October) caused the delay in flowering. Similar findings were also observed by Farooq (1992) in musk melon and Khan *et al.* (2001) in tinda gourd.

Average number of fruits per plant: Data (Table 1) regarding number of fruits per plant revealed an increase with delay in planting time. Maximum number of fruits per plant (4.63) was produced by September planting with minimum 2.88 in July planting. These observed variation may be due to the difference in their environment, rainfall during flowering/fruit set or soil wherein these are sown.

Average fruit weight: The mean values for average fruit weight of pumpkin as affected by different sowing dates are given in Table 1. The maximum fruit weight (3.09 kg) was recorded in September sowing being substantially different from other treatments. Minimum fruit weight of (2.47 kg) was observed in October sowing, most probably due to the faster depletion of moisture towards the last part of the cropping season.

Crop duration: Data (Figure 1) revealed that crop duration was substantially affected by planting times. Early planted pumpkin had shorter crop duration compared to normal planting time (October). This may be due to the reason that warmer temperature shorten the developmental stages of the crop.

Yield (q per ha): The data recorded on yield (q ha^{-1}) as affected by different sowing dates is being presented in Table 1. Results showed that maximum yield of 168.83 q ha^{-1} was obtained in September sowing. July and October sowing produced expressively lower yields of 122.68 q and 127.43 q ha^{-1}.

The direct impact of frequent rain-splash during July sowing on flowers may lead to pollen damage and flowers abortion, leading to low fruit formation and yield

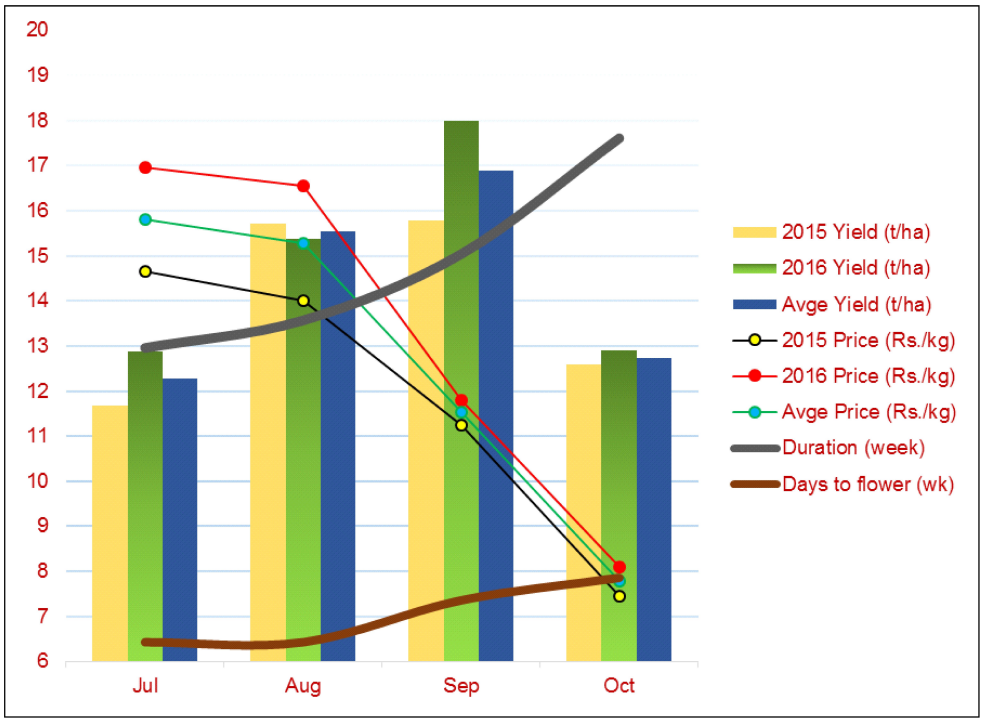

Figure 1: Year wise yield, price fetched, duration (weeks) and days to flower (weeks) of the crop

Table 1: Yield attributes – Fruits/plant, average fruit weight and yield of the crop in 2015 and 2016.

Parameters/	Fruits/plant (No.)			Fruit wt. (kg)			Yield (q/ha)		
Sowing time	Farm 1	Farm 2	Average	Farm 1	Farm 2	Average	Farm 1	Farm 2	Average
Mid July 2015	2.80	2.60	2.70	3.10	2.63	2.87	124.80	108.60	116.70
Mid July 2016	2.90	3.20	3.05	2.72	2.93	2.83	123.40	133.90	128.65
Average	2.85	2.90	**2.88**	2.91	2.78	**2.85**	124.10	121.25	**122.68**
Mid Aug. 2015	3.90	4.40	4.15	2.84	2.32	2.58	168.80	145.40	157.10
Mid Aug. 2016	4.20	3.80	4.00	2.96	3.08	3.02	160.60	146.80	153.70
Average	4.05	4.10	**4.08**	2.90	2.70	**2.80**	164.70	146.10	**155.40**
Mid Sep. 2015	4.10	4.80	4.45	2.91	3.26	3.09	145.20	170.30	157.75
Mid Sep. 2016	4.60	5.00	4.80	3.21	2.98	3.10	187.20	172.60	179.90
Average	4.35	4.90	**4.63**	3.06	3.12	**3.09**	166.20	171.45	**168.83**
Mid Oct. 2015	4.00	4.50	4.25	2.15	2.28	2.22	119.50	132.10	125.80
Mid Oct. 2016	3.90	4.30	4.10	3.07	2.36	2.72	121.70	136.40	129.05
Average	3.95	4.40	**4.18**	2.61	2.32	**2.47**	120.60	134.25	**127.43**

Table 2: Economic parameters of the crop in 2015 and 2016

Parameters/	GROSS RETURN (Rs.)			NET RETURN (Rs.)*			B:C RATIO		
Sowing time	Farm 1	Farm 2	Average	Farm 1	Farm 2	Average	Farm 1	Farm 2	Average
Mid July 2015	180,960.00	160,728.00	170,844.00	143,460.00	123,228.00	133,344.00	4.83	4.29	4.56
Mid July 2016	211,014.00	224,952.00	217,983.00	166,014.00	179,952.00	172,983.00	4.69	5.00	4.85
Average	195,987.00	192,840.00	**194,413.50**	154,737.00	151,590.00	**153,163.50**	4.76	4.65	**4.70**
Mid Aug. 2015	236,320.00	203,560.00	219,940.00	198,820.00	166,060.00	182,440.00	6.30	5.43	5.87
Mid Aug. 2016	258,566.00	249,560.00	254,063.00	213,566.00	204,560.00	209,063.00	5.75	5.55	5.65
Average	247,443.00	226,560.00	**237,001.50**	206,193.00	185,310.00	**195,751.50**	6.03	5.49	**5.76**
Mid Sep. 2015	159,720.00	195,845.00	177,782.50	122,220.00	158,345.00	140,282.50	4.26	5.22	4.74
Mid Sep. 2016	217,152.00	207,120.00	212,136.00	172,152.00	162,120.00	167,136.00	4.83	4.60	4.72
Average	188,436.00	201,482.50	**194,959.25**	147,186.00	160,232.50	**153,709.25**	4.55	4.91	**4.73**
Mid Oct. 2015	83,650.00	104,359.00	94,004.50	46,150.00	66,859.00	56,504.50	2.23	2.78	2.51
Mid Oct. 2016	99,794.00	109,120.00	104,457.00	54,794.00	64,120.00	59,457.00	2.22	2.42	2.32
Average	91,722.00	106,739.50	**99,230.75**	50,472.00	65,489.50	**57,980.75**	2.23	2.60	**2.41**

*The Costs of production of the crop were Rs. 37,500/- and Rs. 45,000/- for 2015 and 2016, respectively.

reduction, as observed in this study compared to September sowing (Aderibigbe *et al*., 2016). Lower yield in October planting may be due to water stress because of less rainfall during that period.

Economics: Results regarding economics (Table 2) showed that there was meaningful difference between effects of different planting times on this trait. In terms of price fetched, August planting performed better than other planting dates due to good market demand. Highest B:C was recorded in August planting (5.76) while the least in October planting (2.41). Offseason planting of pumpkin during July and August in a silt deposited area on a river bank helps reducing irrigation cost as the water retention capacity in such area is less. Early planting also helps in fetching good market price due to the market demand as at the time of early harvesting the pumpkin is scarce in the market.

CONCLUSION

With the intervention of KVK, Nalbari the planting time of *rabi* pumpkin was preponed to July-August and it was found that change in planting time helps in reducing irrigation cost to a considerable extent in the given soil condition. Else planting during normal time in silt deposited river bank during October-November requires frequent irrigation and adds to production cost. Off season planting of Rabi pumpkin proved to be a successful one as early planting helps in fetching good market price due to the market demand besides reducing the cost of irrigation. In crux, it is concluded that September planting of pumpkin is more appropriate in terms of higher yield than July crop in agro-ecological conditions of silt deposited river bank of Chengnoi and Mairadanga villages of Nalbari. However under these conditions, July planting fetched more price and August planting resulted highest net return.

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Rural Farmers and ICT Based Extension-Farmers Response and Preferences to ICT Based Extension

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ABSTRACT

Information communication technology creates an efficient and effective enabling environment for farmers to access latest technologies. ICAR–Central research institute on jute and allied fibres initiated ICT based extension services to farmers through Expert systems, Mobile advisory through text and voice SMS, Video films, Short demonstration programmes through Doordarshan etc. The attitude of farmers towards ICT based extension services was measured which showed more than one third (36.92%) of the farmers had favorable attitude towards ICT tools followed by 30.76 per cent had least favorable and 32.3 per cent had most favorable attitude. Age and experience in farming had a negative and significant relationship with attitude of farmers towards ICT based extension whereas education, innovation proneness, social participation, economic motivation and mass media exposure had a positive and significant relationship. Farmers preference on different methods of extension contact showed that the farmers had a high preference on communication through mobile phone as voice messages, followed by direct contact and television. The barriers for ICT based extension as reported by the farmers were low computer literacy (96.92%) followed by lack of training availability to learn about ICT (95.38%)

Keywords: Information, Communication, Extension, Attitude, Prefernce, Barriers

INTRODUCTION

Majority of Indian farmers belong to the small and marginal categories. The performance of agriculture is the output of these small and marginal farmers. Although production and productivity levels had increased over time, the margin of profit for the growers had decreased continuously resulting in losing confidence of farmers in farming activities. Social scientists had identified that the lack of timely and precise information to farmers is one of the reasons for low profit of farmers in farming activity. In this era of globalization and liberalization, the need of information to farmers at the right time is of at most important. Modern communication technology is inevitable for fast communication to a large number of farmers without any distortion of messages, in the absence of sufficient number of extension agents.

ICAR–Central Research Institute on Jute and Allied Fibres initiated ICT based extension services to farmers through Expert systems, Mobile advisory through text and voice SMSs, Video films, Short demonstration programmes through Doordarshan etc. Many ICT based extension services were also initiated in the last two decades for ensuring the delivery of fast and efficient information to the farmers by various development agencies. But knowledge on how far the ICT were accepted by the small and marginal farmers, their preferences, attitude, and constraints in using ICT tools in agriculture is lacking and it is very much essential for reaching large number of farmers in short span of time. With this in mind the present study was conceptualised with the following objectives.

- To measure the attitude of farmers towards ICT based Extension
- To analyse the influence of socio demographic factors on the attitude towards ICT based extension
- To find the preference of farmers to ICT tools
- To assess the barriers for effective ICT based extension services.

MATERIALS AND METHODS

The study was conducted at two different districts of West Bengal, Hooghly and North 24 Parganas where farmers are already exposed or aware about the ICT tools. Two

villages were selected and thirty farmers were selected randomly from each village for data collection which formed a total sample size of 60. Researcher had collected the primary data from farmers using the interview schedule developed. The scale developed by Kumar and Ratnakar (2010) was used to measure the attitude of farmers towards ICT based extension with some modifications. Likert's procedure was used for attitude measurement. The independent variables selected for the study were age, education, experience in farming, annual income, social participation, leadership ability, innovation proneness, economic motivation, Mass media exposure and extension contact. Looking in to the nature of research problem, Ex-post facto research design was selected, as the present investigation deals with a phenomenon which has already occurred. The data was collected through schedules, participant observation and focussed group discussions with farmers

RESULTS AND DISCUSSION

Level of attitude of farmers towards ICT based Extension: The attitude of farmers towards ICT based extension services was measured and it was observed that more than one third (36.92%) of the farmers had favorable attitude towards ICT tools followed by 30.76 per cent had least favorable attitude and 32.3 per cent had most favorable attitude (Table 1). it can be observed from the table that nearly 67.5 per cent of the farmers had favourable or most favourable attitude towards ICT based extension which indicate the scope of reaching more number of farmers through modern communication tools. Least favourable attitude of farmers may be due to fear of access to technology or lack of sufficient facilities in their proximity.

Table 1: Level of attitude of farmers towards ICT based Extension

Level of attitude	Number	Percentage
Most Favourable	20	30.76
Favourable	24	36.92
Least Favourable	21	32.3

Socio demographic characteristics of the respondents: The results indicates the presence of both young and old aged men in farming. More than one third of the farmers (40%) interviewed were old aged and nearly one third farmers contributed to the young age group. However there is a slight decrease in the number of young farmers coming forward for farming practices. In terms of education, nearly one third of the respondents had education of high school and above whereas 40 per cent of them had primary school education and nearly one third were illiterates. Altogether the results indicated that the respondents had relatively low educational back ground.

More than one third of the respondents had high experience in farming. Annual income was medium for nearly half of the respondents and high for more than one third of the respondents. Interms of social participation nearly half of the respondents had medium level of participation whereas just above one third of the respondents had high social participation. Most of the participants were active in farmers club or self-help groups in theses villages for which their social participation was more. Leadership ability of the participants were high to medium. With regard to innovation proneness, 38.5 per cent of farmers had high and low innovation proneness each. Economic motivation of the farmers were high for 36.9 per cent of farmers where as 38.5 per cent farmers had medium economic motivation. Low mass media exposure was reported by 40 per cent respondents whereas 38.5 per cent had medium mass media exposure (Table 2).

Relation of socio-demographic variables on the attitude of farmers towards ICT based Extension: Though the results had shown that majority of the respondents had a highly favourable or favourable attitude towards ICT based extension, it is important to know whether this attitude is related to their socio-demographic characters. Hence a correlation analysis was done to study the relation of independent variables on the attitude of farmers towards ICT based extension and the results are depicted in table 3. The study revealed that age and experience in farming had a negative and significant relationship with attitude of farmers towards ICT based extension whereas education, innovation proneness, social participation, economic motivation and mass media exposure had a positive and significant relationship with farmer's attitude towards ICT based extension (Table 3). Young and more educated farmers had shown a high attitude towards ICT based extension. The study is supported by the findings of Hall *et al.* (2003) who reported that younger and more educated farmers demonstrate a greater appreciation for modern sources of information. Social participation might have created a

Table 2: Socio demographic characteristics of the respondents

	Category	No.	%
Age	Young	21	32.3
	Middle	18	27.7
	Old	26	40.0
Education	illiterates	20	30.8
	Primary school	26	40.0
	High school & above	19	29.2
Experience in farming	Low	19	29.2
	Medium	19	29.2
	High	27	41.5
Annual income	Low	10	15.4
	Medium	30	46.2
	High	25	38.5
Social participation	Low	12	18.5
	Medium	30	46.2
	High	23	35.3
Leadership ability	Low	17	26.2
	Medium	26	40.0
	High	22	33.8
Innovation proneness	Low	25	38.5
	Medium	15	23.0
	High	25	38.5
Economic motivation	Low	16	24.6
	Medium	25	38.5
	High	24	36.9
Mass media exposure	Low	26	40.0
	Medium	25	38.5
	High	14	21.5
Extension contact	Low	16	24.6
	Medium	28	43.1
	High	21	32.3

platform for farmers to discuss about ICT in extension. This may be the reason for favourable attitude among the farmers with high social participation. Those who are interested in a technology and are keen to adopt the same will try to know about the technology through all available sources including Information communication tools and this might have contributed to the positive significant relation of innovation proneness of farmers and attitude towards ICT based extension. Annual income, leadership ability and extension contact were having a non-significant relationship with farmers attitude towards ICT based extension. The findings are similar to that of Chauhan (2010), Amin *et al.* (2013) and Vosough *et al.* (2015).

Table 3: Factors affecting the attitude of farmers towards ICT based extension

Variables	Correlation coefficient
Age	-0.917**
Education	0.451**
Experience in farming	-0.841**
Annual income	0.150^{NS}
Social participation	0.458**
Leadership ability	0.013^{NS}
Innovation proneness	0.839**
Economic motivation	0.372**
Mass media exposure	0.388**
Extension contact	-0.54^{NS}

**Significant at 0.01 level; NS = Non significant

Farmers preference for different information communication channels: Farmers access a number of communication media from traditional to modern to receive information about agriculture technologies. An analysis of farmers' preference on different channels or methods of technology transfer showed that the farmers had a high preference on communication through mobile phone as voice messages, followed by direct contact and television (Table 4). Maximum respondents (96.9%) had revealed that voice SMS in local language was the communication medium that helped them most to take informed decisions regarding crop production and hence they preferred it than other communication channels.

Mobile based advisory system was more or less like personal communication whereas the programmes through

Table 4: Farmers preference for different channels/methods for technology transfer

Mode of communication preferred	Number	Percentage
TV	49	75.3
Newspaper	34	52.3
Radio	27	41.5
Direct contact	55	84.6
Mobile SMS text	48	73.8
SMS voice	63	96.9
Internet	6	9.2
Written communication	36	55.3

radio and television are more for mass communication. This may be the reason for farmers to develop more trust on mobile based communication. Often farmers found the timings of agriculture programmes broadcasted through mass media were not suitable for them. It is to be noted that farmers (84.6%) preferred direct contact for technology transfer. This may be due to the credibility of the source and usefulness of the message. Text messages through mobile was also preferred by farmers(73.8%) because most of the messages they received were location specific, timely, useful and from credible sources.

The least preferred channel for information by farmers were internet (9.2%). Most of the farmers reside in rural areas where the internet facilities are very poor. The above findings are in line with Howell and Habron (2004) and Nazari and Hazbulla (2008).

Barriers for ICT based Extension: Even though ICT had penetrated in all walks of life, the use of it particularly by farmers to gain information on latest farming practices need a boost. The analysis of barriers for penetration of ICT among rural farmers can help to accelerate the process of ICT based extension by addressing the reasons holding back the farmers from using ICT.

Table 5: Barriers for ICT based Extension

	Number	Percentage
Individual Barriers		
Lack of training availability to learn ICT	62	95.38
Lack of confidence to use ICT	55	84.61
Language barrier	48	73.84
Lack of skills to use ICT	44	67.69
Technological and policy barriers		
Lack of infrastructure development	48	73.84
Less availability of ICT in agriculture	39	60.00
Poor connectivity in rural areas	58	89.23
Low computer literacy	63	96.92
No privilege given to farmers to use ICT based extension contact	60	92.3

Out of the barriers mentioned by farmers, low computer literacy (96.92%) was the highest indicated barrier followed by lack of training availability to learn about ICT (95.38%). Success of ICT is dependent on the knowledge of people on how to use devices and navigate the internet (Barber *et al.,* 2016) training the farmers on using ICT would definitely improve their knowledge and skills in using ICT and also develop confidence in them. Another major barrier indicated by farmers is lack of any privilege given to farmers to use ICT based extension services (92.3%) in terms of subsidies. Majority of the farmers had opined that the data charges for using internet were not affordable to them. The availability of low cost ICT gadgets along with rural broadband connectivity can make the farmers to access agricultural information by multiple ways at affordable cost.

CONCLUSION

Attitude of farmers towards ICT based extension was most favourable and favourable for around seventy percent of farmers. Degree of accessibility of different ICT tools indicate cell phones and television as most powerful medium for technology transfer. The level of acceptance for the communication through mobile was highest after the direct contact method. The study recommends the mobile based communication text as well as voice SMS to be selected to reach vast number of farmers to deliver the information timely. Training for farmers would help to develop their knowledge and skill on use of computer to access the information on latest farming technologies. ICT has a major role to play in reaching a large number of farmers with need based information in short period of time. In order to make the communication systems through ICT effective, it is very much essential that to equip farmers with knowledge and skill to harness the Information communication technology for the betterment of Indian agriculture.

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Scientific Rationality of Indigenous Technical Knowledge related to Pulse Production: Researchers' Perception

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ABSTRACT

Indigenous knowledge is the pool of knowledge resources accumulated by a community over years of experimentations for surviving the challenges faced. This knowledge resource offer many advantages in terms of availability and affordability to the indigenous farming community. Assessment of this precious knowledge resource for its scientific rationality could be a step towards their integration in the formal research system. The study was conducted among 68 pulse researchers for assessment of their perception on indigenous knowledge as well as documented indigenous technical knowledge related to pulse production from Uttar Pradesh state. Majority of the researchers perceived that integration of indigenous knowledge in formal agricultural research could lead to easy adoption of technologies by the farming community (79.41%) and their integration with improved agriculture practices could make agriculture more sustainable (82.35%). More than 71 per cent of the researchers found the four documented indigenous practices related to pulse production to have high scientific base while about 58 per cent of the researchers perceived the indigenous practices relating to forecasting of insect pest to have high scientific base. Majority of the researchers (>75%) recommended the indigenous practices relating to crop protection for scientific validation.

Keyword: Indigenous, Knowledge, Perception, Pulse production, Researchers, Scientific rationality

INTRODUCTION

Indigenous Technical Knowledge (ITK) in agriculture refers to the accumulated knowledge evolved by farmers over generations for deriving solutions to agricultural production situation related problems. It reflects body of knowledge that is evolved in local environment through experimentations and constant incorporation of influences of intra and inter societal interactions. This body of knowledge is trusted by the community, basically for meeting the newer challenges faced and for survival of the community and is unique to a given culture or (Warren, 1991).

Indigenous knowledge has powerful advantages over outside knowledge in terms of cost involved and ease in availability. Understanding of Indigenous knowledge pool gives the information on the way people have dealt with or experimented with their local environment in the past. It ensures an enhanced participation level of people, their empowerment and also enhances their feeling of self-sufficiency. Bhushan *et al.* (2008) also reiterated the same view. Understanding and working with indigenous systems improves the communication between farmers, extension agents and researchers thereby help in generation of location specific, need and problem oriented, socially desirable and economically affordable technologies (Sah *et al.*, 2009; Sah *et al.*, 2014). The main objective for the promotion of indigenous knowledge is its effective use for sustainable development (Quiroz, 1996). They can play a key role in evolving technologies that are sustainable and can also increase their acceptance of the same among the farming community.

Pulses in India are basic to the diet as well as cropping system across the country. These crops primarily occupy marginalized land in rainfed conditions. Only 10 per cent of the total pulse area in India is irrigated with preference for crops like wheat, paddy, and maize in these lands with irrigation facilities and are grown as subordinate crops in cropping systems (Nene, 2006). In addition, pulses are usually grown by farmers having little or no access to costly inputs, credits and markets (Ali, 2004). Pulses are grown for "income" and 'not just for home consumption" primarily by small farmers operating under complex, diverse and poor resource conditions. In this context,

Indigenous knowledge pool assumes special significance for crop management of pulse.

Understanding the perception of researchers on the Indigenous pool could be the first stage of incorporation of this precious knowledge base in the formal research system and generation of technologies that are appropriate and sustainable with ensuring faster rate of adoption among farming community. With this background, the study was undertaken to assess perception of researchers with regard to ITKs relating to production, protection and post harvest handling of pulse crops.

MATERIALS AND METHODS

The study was conducted among 68 pulse researchers of national agricultural research system including ICAR-Indian Institute of Pulses Research, Kanpur, Chandra Shekhar University of Agriculture and Technology, Kanpur and scientists working in Krishi Vigyan Kendras of Uttar Pradesh state during 2009-2010. The researchers selected for the present study belonged to crop protection (40 nos.) and crop production (32 nos.) disciplines. The sampled researchers were administered a structured questionnaire to ascertain their perception of ITKs. The perception items included both positive and negative statements that were included and finalized after due consultation with the experts. In addition, researchers were exposed to the indigenous knowledge related to pulse production as well crop protection, collected from the nine districts of Uttar Pradesh state and were asked to respond on their perception on the scientific base of the documented ITKs and their perception on scientific validity of the same on a three point continuum. The data was complied and subjected to descriptive statistics to draw meaningful inferences.

RESULTS AND DISCUSSION

Researchers' perception of indigenous technical knowledge: As indicated in Table 1 majority of the sampled researchers agreed that integration of indigenous knowledge in formal agricultural research could lead to easy adoption of technologies among the farming community (79.41%) and perceived that integration of traditional practices/knowledge with Improved agriculture practices can make the agriculture more sustainable (82.35%). About 84 per cent of the respondents perceived that scientific basis of the indigenous practices needs to be confirmed by on-station experimentations. More than 40 per cent of the researchers disagreed with the statement that traditional or indigenous knowledge is of little relevance to agricultural development while about 23 per cent researchers disagreed that modern agriculture science can only solve the problem of food security and Indigenous knowledge cannot solve the complex problems of pulses production.

The perception of researchers was found to be favorable towards ITKs, however majority of them

Table 1: Perception of scientist towards indigenous technical knowledge (N=68)

Statement	A	SA	DA	Mean score
Traditional or indigenous knowledge is of little relevance to agricultural development	30(44.12)	10(14.70)	28(41.17)	1.97
Integration of indigenous knowledge in formal agricultural research could lead to easily adopted technologies among the farming community	54(79.41)	08(11.76)	06(08.82)	2.71
Modern agriculture science can only solve the problem of food security	20(29.40)	32(47.06)	16(23.52)	1.94
Integration of Traditional practices/ knowledge with Improved agriculture practices can make the agriculture more sustainable	56(82.35)	12(17.65)	0(00.00)	2.82
Indigenous practices are best suited to resource poor farming conditions only	18(26.47)	28(41.12)	22(32.35)	2.06
The scientific basis of the indigenous practices needs to be confirmed by on-station experimentations	57(83.82)	08(11.76	03(04.41)	2.79
Indigenous knowledge cannot solve the complex problems of pulses production	22(32.35)	31(45.59)	16(23.52)	1.94
Indigenous practices are low cost technologies, thus they may use may enhance profitability of pulses cultivation	35(51.47)	25(36.76)	08(11.76)	2.40
Farmers use ITKs because they do not have access to improved technologies	20(29.41)	34(50.00)	14(20.59)	1.91
Use of ITK in large magnitude and wider geographical area is possible	27(39.71)	24(35.29)	17(25.00)	2.15

A = Agree; SA = Somewhat Agree; DA = Disagree

stressed on scientific rational of the traditional indigenous knowledge resources need to the confirmed by experimentations.

Researchers' perception of ITKs related to pulse cultivation: Indigenous practice of soil moisture test by pressing soil in form of ball drawn from 3 inch deep layer was perceived to be having high scientific rationality and recommended it for scientific validation by more than 71 per cent of the sampled respondents as indicated in Table 2.

Seed soaking before sowing in soils with low moisture level was indigenous practice reported to be performed in situation where soil moisture was not sufficient for sowing of pulses seed. The practice was perceived to have high scientific base by more than 81 per cent of the researchers and equally it was recommended for validation. Ploughing back the urd bean plants after plucking was used as nutrient conservation technique and the practice of irrigation after flowering initiation in mung bean crop was followed by pulse growers of state, these practices were judged to have high scientific base by 75 per cent of the sampled researchers. In addition, more than 81 per cent of the researchers recommended these indigenous practices for validation.

Researchers' perception of ITKs related to crop protection: Majority of the sampled researchers (58%) from the discipline of crop protection perceived the indigenous method of forecasting using direction of wind as an indicator for insect pest infestation in crop to have high scientific base and more than 80 per cent of the researchers recommended it for further validation (Table 3). In the same line about 58 per cent of the researchers perceived high scientific rationality of the indigenous practice of forecasting insect pest infestation with prevalence of cloudy sky for 5-6 days.

Researchers' perception of ITKs related to safe storage of pulses: Safe storage of pulse grains have important role in overall farm returns from crops. Various

Table 2: Researchers' perception of ITKs related to pulse production (n=32)

Indigenous Technical knowledge related to crop production	Scientific base			Recommended for validation	
	High	Little	Nil	Yes	No
Soil moisture test before sowing of *rabi* crop					
Before sowing of rabi crop, soil from 3" deep layer is drawn and pressed into fist to form a ball. If ball is formed but breaks on opening the fist is indicative of adequate soil moisture for sowing. If the ball doesn't break on opening the fist, the moisture is high and soil is not ready for sowing. This favors proper germination.	23(71.87)	7(21.87)	2(6.25)	23(71.87)	9(28.12)
Seed soaking before sowing in soils with low moisture level	26(81. 25)	6(18.75)	0(0.00)	24(75.00)	6(18.75)
Nutrient conservation technique by ploughing back the urd bean plants after plucking	24(75.00)	7(21.87)	1(3.12)	26(81.25)	8(25.00)
Irrigation time in mung bean crop after flowering initiation	24(75.00)	3(9.37)	5(15.62)	26(81.25)	8(25.00)

Table 3: Researchers' perception of ITKs related to crop protection aspect of pulse production (n=36)

Indigenous Technical knowledge related to protection from insect pest	Perceived Scientific base			Recommended for validation	
	High	Little	Nil	Yes	No
Forecasting of insect pest infestation: Direction of wind is considered as an indicator for insect pest infestation in the crops. It is believed that wind blowing from West to East during full vegetative crop stage is an indication of a less insect pest infestation whereas wind blowing from East to west "Purwa" is considered as warning for heavy insect pest infestation in the crop.	21(58.33)	8(22.22)	7(19.45)	29(80.56)	7(19.44)
Forecasting of insect pest infestation: Cloudy weather if prevail continuously for 5-6 days in winters forecast heavy insect pest attack on pulse crops	21(58.33)	11(30.56)	4(11.11)	21(58.33)	15(41.67)

indigenous practices were documented related to safe storage of pulses from the study area. The indigenous practices of plastering followed by drying of storage walls with mud& cow dung prior to storage of pulse grains, burning of neem leaves in store and coating of lime on the inner surface of the earthen bins recorded from the selected district for storage of pulse grains. Majority of the sampled researchers perceived these practices to have high scientific rationality (75%), while 11 to 14 per cent perceived these practices to be of little scientific relevance. The said indigenous storage practices were recommended for scientific validation by more than 86 per cent of the researchers (Table 4).

For safe storage of mungbean seeds, indigenous practice of mixing of fine ash followed by storage in clean earthen pots was recorded. The space left on the top was filled with paddy straw, while the mouth of the pot was then sealed with mud and dried thoroughly. The practice was perceived to have high scientific base by more than 72 per cent of the sampled researchers. In addition, for building up the seed stock, sampled farmers were observed to practice selection and threshing of healthy plants from first plucking of mung bean crop. After proper sun drying, mixing with ash (@1kg) & Neem leaves (@250 g)/5 kg seed), seeds were stored in earthen pots with lid closed and plastered with mud. Majority of the sampled researchers perceived aforesaid indigenous methods to have high scientific base (86%) and recommended it for scientific validation (75%).

For safe storage of chickpea and lentil, storage of chickpea and lentil was done in gunny bags along with neem leaves (1.5 kg/sack), and sacks were kept in wheat straw. The practice was reported to have high and medium scientific base by more than 81 per cent of the sampled researchers and more than 90 per cent of them recommended it for scientific validation. The country storage structure (bunda) was reported to be having high scientific validity by more than 58 per cent of researchers

Table 4: Researchers' perception of indigenous pulse storage practices (n=36)

Indigenous Technical knowledge related to safe storage of pulses	Perceived Scientific base			Recommended for validation	
	High	Little	Nil	Yes	No
Preparation for storage structures & safe storage					
The walls of the store are plastered with mud& cow dung and is allowed to thoroughly dry prior to storage of grains including pulses.	27(75.00)	07(19.45)	2(05.55)	31(86.11)	5(13.89)
Neem leaves are burnt in the store prior to grain storage for safe storage	27(75.00)	5(13.89)	4(11.11)	31(86.11)	5(13.89)
Coating of lime on the inner surface of the earthen bins followed by proper drying in shade prior to storage of grains.	27(75.00)	06(16.66)	3(08.33)	31(86.11)	5(13.89)
For storage of urd and mung bean seeds:					
Fine Ash is mixed @1:5 seeds and water is sprinkled so that the ash properly gets coated on the seed surface. The seed is then thoroughly dried in shade. The seed is then filled in a clean earthen pot and the remaining empty space in the pot is filled with paddy straw. Mouth of the pot is then sealed with mud and is dried thoroughly.	26(72.22)	10(27.78)	0(00.00)	33(91.67)	3(8.33)
Mung/Urd bean seed storage:					
Healthy plants are selected in the field & threshed and big sized pods are sieved from the produce of first plucking. Pods are dried properly in sun and cooled and ash (@1kg) & Neem leaves (@250 gm) / 5 kgs seeds are mixed. Earthen pots are cleaned, dried & treated seeds are stored in them with lid closed and plastered with mud. They are then dried in sun and kept inside wheat straw on any dry surface	31(86.11)	5(13.89)	0(00.00)	27(75.00)	9(25.00)
Storage of Chickpea and lentil:					
Storage of chickpea and lentil is done in gunny bags along with neem leaves (1.5 kgs), and sacks are then kept in wheat straw	24(66.67)	7(19.44)	5(13.89)	33(91.67)	3(8.33)
Indigenous storage structures: *Bunda* (Country Stores)					
1-1 ½ feet thick layer of wheat straw is used to cover the walls and the floor. The space thus made in the centre of the store, is utilized to keep Grains in sacks or heaps. Before closing the entrance of the store, a layer of wheat straw is put.	21(58.33)	7(19.44)	8(22.22)	31(86.11)	5(13.89)

and more than 86 per cent recommended it for scientific validation.

CONCLUSION

The above finding clearly indicates a positive attitude of researchers towards indigenous practices and they recommended for scientific validation of some of the indigenous practices. Based on the findings of the project it could be recommended that future research work on pulses should also include validation of some of the documented indigenous practices with high scientific validity. This would offer low cost, viable and sustainable alternative technological interventions for improving pulse productivity on a larger scale.

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Perception of the Trainees on the Model Training Course: A Post Training Assessment

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ABSTRACT

Considering the growing importance of enclosure culture in inland fisheries sector in India, Ministry of Agriculture and Farmers' Welfare, Govt. of India sponsored a Model Training Course (MTC) for the officers working in the fisheries sector with an intent to build their capacity which would eventually trickle down to the end users of technology. The present study was undertaken to measure both pre-training and post-training perception of the twenty-six officers across eleven states of the country about the training programme on enclosure culture conducted by the ICAR-Central Inland Fisheries Research Institute from 23rd to 29th August 2017. A pre-training need assessment with the help of priority matrix revealed highest training need for cage culture in reservoir, feeding and disease management followed by water quality and species selection in cage culture. Post training assessment of overall quality of the training programme showed that 50 per cent of the participants rated the training programme as excellent while, 34.62 per cent perceived it as very good and 15.38 per cent as good. All the participants perceived the training programme to be helpful to improve their job performances and 60 per cent of them expressed willingness to conduct farmers' training on the same topic in future. 53.84 per cent stated that their expectations were fulfilled "to a great extent" and for rest of the trainees it was "to some extent". Further, significant positive association was found between the normalized scores of training need and fulfilment of expectation of the trainees with the help of correlation coefficient at 5 per cent level of significance (r=0.632, P=0.000). Significant correlation coefficient was also found between the normalized scores of expressed training needs of the topics and Rank Based Quotients (RBQs) of the perceived values of topics covered under the programme at 5 per cent level of significance (r=0.763, p=0.006). This indicates accomplishment of the training needs of the trainees by the sessions taken under the programme. The findings of this study could be useful for conducting and improving similar type of model training courses in future.

Keywords: MTC, Perception, Post-training assessment

INTRODUCTION

Given the present government priority of 'doubling farmers income', exploring multiple sources of income for farming community has become imperative. Dependence on crop sector alone is not sufficient for livelihood in the present scenario. Therefore, rural livelihood diversity is important for subsistence, flexibility, resilience and stability. Diverse livelihood systems are proven to be less vulnerable and are also likely to be more sustainable over time (Pal *et al.*, 2017). Therefore, the potential of different agricultural and allied sectors is to be exploited to the fullest extent to derive maximum income out of them. Fisheries sector in India has huge potential that engages over 14.50 million people in the country. It contributes about 0.92 per cent to the country's Gross Domestic Production (GDP) and 5.23 per cent to the agricultural GDP (Anonymous, 2016). India is the second largest fish producing nation in the world contributing annually 11.41 million tonnes of fishes. Considering importance of this sector, The Government of India has launched the second Blue Revolution or the Neel Kranti Mission in the year 2016 with a vision to achieve food and nutritional security together with economic prosperity of the country through scientific utilization of water resources for fisheries development. However, habitat degradation, climate change, pollution, over-fishing and lack of proper governance mechanism lead to declining fish catch from inland open water.

At this juncture, enclosure culture technology assumes special importance to increase fish production and

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productivity particularly from reservoirs and wetlands thus, aiding to livelihood security of the fishermen. Indian reservoirs with water spread area of 3.15 m ha can produce much more fish than current production level. Intervention of enclosure culture technology at large scale can bridge the gap of the current 93,700 tonnes production and expected production potential of nearly 1 million (Karnatak, 2014). Therefore, diffusion of this technology can really boost up the fish production scenario of the country. Skill development and capacity building of the fishermen is necessary to disseminate and popularize the technology. Besides, directly training the fishermen in enclosure culture, capacity building of the extension personnel and officers of state fisheries departments is equally important. They are the people who work at the grassroots level and are the carriers of technology to the end users. According to Rogers (1962) technologies and innovations have their inherent ability to trickle down to one level of users to the next level which he has named as "Trickle-down effect" in his classical diffusion theory. Hence, in order to spread the technology to the end point, training of the professionals working in this field is of utmost necessity. Equipping these professionals through effective training also becomes imperative in order to maximize their job performance (Nassazi, 2013). A study by Tiwari *et al.* (2011) also highlighted the importance of imparting on the job trainings to the field veterinarians. Such short trainings of eight days were found to have brought significant gain in knowledge of the veterinarians leading to greater work efficiency in the field.

Keeping this in consideration the Ministry of Agriculture and Farmers' Welfare, Govt. of India sponsored a Model Training Course (MTC) at Indian Council of Agricultural Research-Central Inland Fisheries Research Institute (CIFRI) for the officers working in the fisheries sector. ICAR-CIFRI is one of the leading institutes in India for research, extension and training in inland fisheries and aims to create awareness, provide training and consultancy in inland open-waters (Roy *et al.*, 2018). The MTC was organized at Barrackpore, Kolkata which is the head quarter of the institute with the aim of sensitizing the officers about the importance of enclosure culture technology for sustainable enhancement of fish production in inland open waters, developing manpower for carrying out enclosure culture technology in different parts of India and increasing production of fish from inland water bodies in sustainable manner. The training course had taken place for eight days from 22.08.2017 to 29.08.2017 with a total of thirty-five sessions on several topics. A total of twenty-six scientists from the institute along with three guest speakers had been assigned for several sessions under the programme. Class lectures coupled with AV aids and field trips were used to train the officers and training manuals and e-manuals were also distributed among them. The present study aims to assess the training programme based on the perception of the trainees about various facets of the training programme. Monitoring and evaluation are in-built components of extension and training systems. They are essential activities in judging the value of human resource development. However, training evaluation in most of the cases is either ignored or done half-heartedly and as a result it becomes difficult to reflect the success of training investment (Meena *et al.*, 2010). Therefore, the attempt has been made to investigate the reaction and perception of the trainees about various facets of the training programme based on their expressed need and expectations.

MATERIALS AND METHODS

Twenty-six officers participated in the training programme. Following the arguments of Lynton and Pareek (1978) of three phases in effective training programme, a pre-training assessment has been conducted followed by a post-training assessment after completion of the training programme. A semi-structured interview schedule containing both closed ended and open-ended questions was constructed to collect responses from the respondents. Two separate interview schedules were used for measuring pre-training and post training perception of the trainees. Similar kind of approach was followed in assessing pre-training and post-training feedback in a training programme on cage culture of seabass conducted by ICAR-Central Marine Fisheries Research Institute (Joseph, 2010). The variables studied and their measurement techniques are presented in Table 1.

For need prioritization a close-ended interview schedule was formed with eleven topics and trainees were asked to respond in a Three-point continuum scale based on priority of the topic. The responses ranged from very important, somewhat important and not important.

$$\text{Score for a topic} = \frac{n1*3+n2*2+n3*1}{N}$$

Table 1: Variables and their measurement

Variables	Measurement
Pre-training	
Reason for participation	Open ended questions
Expectation	Open ended questions
Perceived training need matrix	Three-point continuum priority
Post-training	
Perceived value of the sessions	Rank Based Quotient (RBQ)
Fulfilment of expectation	Three-point continuum rating scale
Satisfaction with the physical facilities and resources	Three-point continuum rating scale
Satisfaction with Training atmosphere & methodology	Three-point continuum rating scale
Major learning	Open ended Priority matrix
Overall grading	Four-point continuum rating scale
Action Plan	Open ended questions

Where,

n1=Number of trainees who stated the topic as most important

n2=Number of trainees who stated the topic as somewhat important

n3=number of trainees who stated the topic as not at all important.

N=Highest possible score (Total number of trainees*3)

Further normalization of the scores was done with the following formula:

$$\text{Normalized score} = \frac{Maximum\ \ score - Actual\ \ score}{Maximum\ \ score - Minimum\ \ score}$$

In a study by Saha and Bahal (2014) training needs were prioritized in similar fashion by working out relevancy coefficients for each item by dividing the scores obtained by individuals by the maximum possible score and then the needs were ranked.

The individual training need scores were also calculated by summing up the scores of an individual in each topic. The same scoring pattern was followed as in case of priority matrix.

For finding out the perceived value of the topics covered under the training programme respondents were asked to rank the eleven topics as per their perceived value. Roy and Hassan (2013) used Rank Based Quotient (RBQ) method to identify the problem of enclosure technology in West Bengal , RBQ was used to analyse the constraints using the following formula.

$$RBQ = \frac{\sum_{i=1}^{n}(f_i)(n+1-i)}{Nn}$$

Where,

fi = frequency of the trainees for the i^{th} rank of the topic

N = number of trainees

n = maximum number of ranks given for various topics by a user

Σi= Sum the multiplication factor

For measuring major learnings, open ended interview schedule was used asking the trainees simply to list down their top four learnings from the programme in order of priority. A score of four was assigned to the item listed on the top. Accordingly scores of 3,2, and 1 were assigned the second, third and fourth item in the list, respectively.

$$\text{Score of a topic: } \frac{n1*4+n2*3+n3*2+n4*1}{N}$$

where,

n1=Number of trainees who placed the topic on top of the list

n2=Number of trainees who placed the topic at second

n3=number of trainees who placed the topic at third

n4: number of trainees who placed the topic at fourth

For measuring fulfilment of expectation, a three-point continuum scale was used with the responses ranging from 3='To a great extent, 2='To some extent and 1='To a small extent. The individual 'expectation fulfilment' scores were also calculated by using the following formula.

$$\text{Individual score} = \frac{n1*3+n2*2+n3*1}{N}$$

n1=Number of trainees with score 3

n2=Number of trainees with score 2

n3=number of trainees with score 1

N=Highest possible score (Total number of trainees*3)

Further normalization of the scores was done with the same formula mentioned earlier.

Again, for measuring satisfaction with the physical facilities and resources, training atmosphere and methodology; three-point continuum scales were used with the responses ranging from 3=Fully satisfied, 2=To some extent and 1=Not at all satisfied. For measuring overall grading four-point continuum rating scale was used with the responses recorded as Excellent=4, Very Good=3, Good=2, and Average=1.

RESULTS AND DISCUSSION

A total of twenty-six trainees from eleven states of the country participated in the programme. Highest number of trainees were from Andhra Pradesh, i.e., 4, followed by West Bengal from which three officers participated. There were two participants each from Maharashtra, Odisha, Uttar Pradesh, Rajasthan, Arunachal Pradesh, Kerala, Jharkhand and Assam and one from Jammu and Kashmir. Most of the participants were State Fishery Department Officers (84.62%). The basic information about the trainees are presented in Table 2.

Table 2: Basic profile of the trainees

	Frequency (%)
Distribution based on Sex	
Male	25(96.15%)
Female	1(3.85%)
Distribution based on occupation	
State line Department Officers	22(84.62%)
Assistant Professors	2 (7.69%)
Scientists	2(7.69%)
Distribution based on educational qualification	
Graduate	11(42.31%)
Post graduate	12 (46.15%)
PhD/M Phil	3 (11.54)

Pre-training Perception of the Trainees: Assessment of the training need is the first step towards a successful training programme. Effective training depends on knowing what is required - for the individual, the department and the organisation as a whole (Bansal and Tripathy, 2017). In the first phase of the study, the perception of the trainees prior to the training programme was recorded by investigating their expressed expectation from the training, perceived need and the reasons for joining the programme. All the participants expressed that on the job training is required for them and the MTC on enclosure culture is relevant to their respective job responsibilities. The reasons for participation of the trainees and their expectation from the training programme were elucidated from the open-ended questions. The obtained reasons and expectations were studied and grouped together into five and four broad categories, respectively. Around 46 per cent trainees stated that they were participating in the programme because they wanted to explore the potential resources in their respective states for overall development of the state fisheries sector (Table 3). The second most reason was knowledge and skill enhancement for serving the stakeholders (26.92%). In case of expectations, around 34 per cent trainees expected that after undergoing the training programme they would be able to solve problems of their respective stakeholders by introducing new technologies (Table 4). The second highest expectation was for knowledge and skill development for enclosure culture (30.77%).

Table 3: Reasons for participation

Reason	Frequency	Rank
Potential resources to be explored in state for development of fisheries sector	12 (46.15%)	I
Knowledge and skill enhancement for serving stakeholders	7 (26.92%)	II
Research Project related activities	3 (11.54%)	III
Learning of a new concept	2 (7.69%)	IV
Priority area of the department	2 (7.69%)	IV

Table 4: Expressed Expectation from the training

Expectation	Frequency	Rank
Introduce new technology to stake-holders for solving their problems	9 (34.62%)	I
Knowledge and Techniques of enclosure culture	8 (30.77%)	II
Knowledge upgradation of inland open water fisheries	6 (23.08%)	III
Better aquaculture management	1 (3.85%)	IV

The pre-training need assessment using closed ended priority matrix technique revealed that highest training need was for cage culture in reservoirs, disease and feed management in enclosure culture followed by water quality management & species diversification in wetland (Table 5).

Training need scores of the trainees: The average training need scores of the participants was found to be 27.48 out of a total score of 33 which is 83.27%.

Table 5: Perceived Training Needs of the trainees

Perceived Training Needs	Priority matrix score	Rank
Cage culture in reservoirs	0.910256	I
Disease management in enclosure	0.910256	I
Feeding management in enclosure	0.910256	I
Water Quality Management	0.782051	II
Species Diversification in cages	0.74359	III
Carrying capacity and statistical tools	0.730769	IV
Participatory rural appraisal	0.730769	IV
Pen culture in wetlands	0.717949	V
Market chain	0.717949	V
GIS for water mapping	0.705128	VI
Institutional management	0.666667	VII

Table 6: Categorization of trainees based on their training needs

Categories	Frequency (%)
High training need (>30)	7 (26.92%)
Medium training need (25 to 30)	15 (57.69%)
Low training need (below 25)	4 (15.38%)

Categorization of the trainees was made based on mean+SD method. As reflected in Table 6, most of the trainees had medium level of need (57.69%) while 26.92 per cent were found to have high level of need.

Other Expressed Needs

***Post-training Assessment*:** After completion of the one-week training programme, the post training assessment was conducted based on trainees' perception. The perceived values of topics covered under the programme were measured using Rank Based Quotient (RBQ) method and the results are presented in Table 7. It was found that the trainees rated "disease management in enclosure culture" to be the most valuable session followed by Cage culture in reservoir and Feeding management in enclosure culture. The list of topics in the RBQ was same as the list of topics in the training need assessment. Therefore, an attempt was made to investigate if there was any association between the perceived training needs of the trainees and their perceived value of the training topics. Using Pearson Correlation coefficient, significant positive association was found between the normalized scores of expressed training needs of the topics and Rank Based Quotients (RBQs) of the perceived values of topics covered under the programme at 5 per cent level of significance (r=0.763, p=0.006).

Table 7: Trainees' perceived values of the training topics

Training topics	RBQ	Rank
Disease management in enclosure	212	I
Cage culture in reservoirs	211	II
Feeding management in enclosure	202	III
Water Quality Management	184	IV
Species Diversification in cages	164	V
Market chain	147	VI
Pen culture in wetlands	125	VII
Institutional management	117	VIII
Participatory rural appraisal	57	IX
Carrying capacity and statistical tools	51	X
GIS for water mapping	48	XI

Fulfilment of expectation of the trainees: In the next step, attempt was made to find out the extent of fulfilment of trainees' expectations from the training programme. In a three-point continuum rating scale, 54 per cent trainees stated that their expectation had been fulfilled to a great extent, followed by rest of the 46 per cent for whom somewhat fulfilment of expectation was noticed (Figure 1). The expectation fulfilment scores of the individuals were also calculated and significant positive association was found between the normalized scores of training need of individual trainees and expectation fulfilment scores of the trainees with the help of correlation coefficient at 5 per cent level of significance (r=0.632, P=0.000).

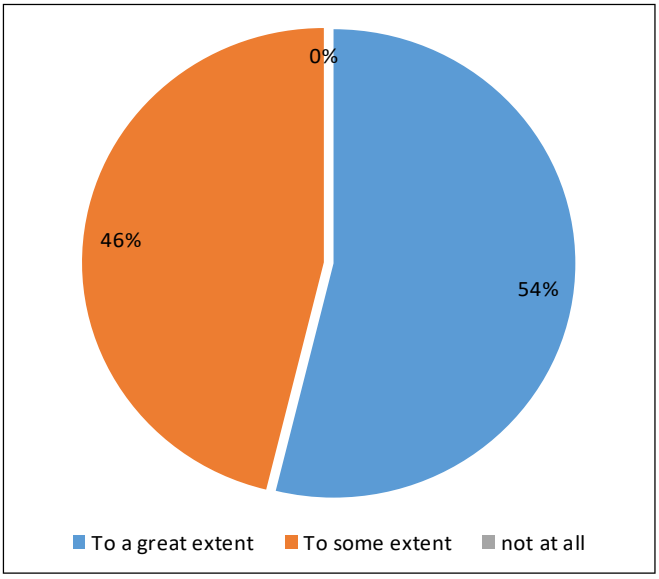

Figure 1: Extent of fulfilment of trainees' expectation

Table 8: Extent of satisfaction with training atmosphere and methodology

Training atmosphere and methodology	Fully Satisfied	To some extent	Not at all	% score
Atmosphere to exchange ideas freely with faculty members	24	2	0	97.4359
Medium of instruction	23	3	0	96.15385
Training methods	19	7	0	91.02564
Use of A.V. Aids	17	7	2	85.89744
Timely information of day to day activities	22	4	0	94.87179
Duration of the programme	16	8	2	84.61538
Relevance of contents	17	8	1	87.17949
Adequacy of contents	20	5	0	89.74359
Sequencing of contents	18	7	1	88.46154
Practical orientation	13	10	3	79.48718
Avg. score				**89.49**

Fulfilment of expectation:

Satisfaction with training atmosphere and methodology: Satisfaction of the trainees with various aspects of the training is important in overall effectiveness of the training. A study by Mansour *et al.,* (2017) showed that there is a positive relation between training satisfaction and readiness to transfer learning. Therefore, an attempt was made to find out extent of satisfaction of the trainees on 10 components. The scores of ten components of training atmosphere and methodology were collected based on trainees' perception and average score was calculated which was 89.49 indicating high overall satisfaction of the trainees with the training atmosphere and methodology (Table 8). Highest score was found for "Atmosphere to exchange ideas freely with faculty members" followed by "medium of instruction" and "timely information of day to day activities". Least scores were found for "practical orientation" followed by "duration of the programme", and "use of A.V. aids".

Figure 2: Grading of the training programme

Overall grading of training programme as perceived by the trainees: Out of total 26 trainees, 13 (50 %) stated that the training programme was excellent, 9(34.62%) stated that it was very good and 4 (15.38%) stated that it was good.

Action plan: The future action plans of the trainees based on their learning from the training were also asked using open ended questions and are reflected in Table 9. Around 65.54 per cent trainees expressed willingness to conduct training programmes for farmers at their respective work places and around 42.31 per cent stated they intended to conduct practical demonstration for their respective stakeholders. Some of the other future plans were motivating farmers for reservoir fishery, cage and pen installation, arrangement of meetings on several fish management practices in enclosure culture etc.

Suggestions for improvement: The suggestions were collected from the trainees for betterment of similar kind

Table 9: Future action plans of the trainees

Future action plans	Frequency (%)
Training of farmers	16(61.54%)
Practical demonstration	11(42.31%)
Persuading farmers for reservoir fishery	8(30.77%)
Cage and pen installation in respective districts	7(26.92%)
Conducting meetings on disease and feed management in enclosure culture	6(23.08%)
Setting up disease diagnostic lab	1(3.85%)
Setting up RAS	1(3.85%)

of trainings in future using open ended questions. The findings are presented in Table 10. Most of the trainees (65.38%) suggested for more practical activities in the field, provision of course material for prior reading (57.69%), following case study or role play method for training (53.85%), participatory approach in training (50%) etc.

Table 10: Suggestions of trainees for future improvement of the programme

Particular	Frequency(%)
More practical activities in the field	17(65.38%)
Course material for prior reading	15(57.69%)
Case studies or role play	14(53.85%)
Participatory approach in training	13(50.00%)
Reducing lecture element	12(46.15%)
Demonstration/ discussion	11(42.31%)
Computer-based learning	10(38.46%)

Future demands of the trainees: The trainees were also asked about the topics which they would like to include in the future training programmes conducted by ICAR-CIFRI. The areas of their demand are presented below:

- Practical demonstration on Pangasius breeding
- Overview on ecotourism development in reservoirs and wetland area
- Scope of value addition in Pangasius fish for better financial return
- Possibilities of cage culture in higher altitude
- Merit and demerits of aquatic wetlands
- Integrated multitrophic aquaculture in cages of open water
- Feed-mill construction
- Fish endocrinology
- Restoration of water resources
- Entrepreneurship building
- CIFRI intervention to establish cages in several places by providing handholding support

CONCLUSION

The model training course on enclosure culture was conducted for the state government officers with the aim of transfer of this technology to the respective end users. It was expected that fishermen of those eleven states from which officers participated would be indirectly benefitted by knowledge, skill and attitude developed by the participants in the MTC. In the present study, perception of the participant trainees was assessed both prior and post training. The findings of the study gave us an understanding about the training need, expectation and reasons of the trainee officers for joining the programme which is assumed to reflect the needs of their respective stakeholders to so extent as well. Most of the participants stated that they joined the training programme with an intent to utilise the potential fisheries resources of their states for livelihood security of the fishermen. The highest training need was found for cage culture, feed and disease management in enclosure culture. Besides need assessment through priority matrix, open ended questions were also asked to the respondents which revealed their training need for cage and pen culture in canals, riverine ecosystem and its management, tilapia culture in cage and pen, floating feed preparation with local ingredients, cage construction with local material, Re-circulatory Aquaculture System (RAS), culture of small indigenous freshwater fish, breeding programme of threatened fish species *etc.* After obtaining the post training perception of the trainees we could find a significant association between the training needs and perceived values of the thematic areas of the training. There was significant positive correlation between expectation and need of the trainees indicating that the training fulfils the needs of the trainees. Majority of the trainees were fully satisfied with most of the components of the physical resources and facilities and training methodology and graded the overall training programme as excellent. However, some limitations were noticed. There were scopes for more practical sessions, hands on demonstrations, participatory approach in training, including case study method to teach etc. to make the learning more effective. At the end of the programme, majority of the participants stated that they intended to conduct training and demonstration sessions for their clients on enclosure culture. The findings of this study would be useful in designing and improving similar kind of training programmes in future and measuring their impacts on the trainees. Further study is needed to investigate the long-term impact of the training programme on ground level practical knowledge and skill development of the participants and extent of reach of technology to the end users.

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Scale Construction to Identify Training Needs of Agripreneurs to Enhance their Competency for Value Chain Development: A Methodological Approach

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ABSTRACT

Recently, emphasis is given on beyond farmer production and productivity means from farm to fork, thus, many of the agripreneurs are involve in processing of agricultural produce to reduce post-harvest losses and adding value to produce in terms of quality and price. Therefore, identification of the areas of training needs of agripreneurs involve in processing was requisite. For that reason, a scale was constructed to measure the training needs of agripreneurs involve in processing to enhance their competency for value chain development based on Likert's summative rating technique of scale construction. The scale consisted of final 40 statements including 23 positive and 17 negative statements. Reliability of the scale was measured by using Spearman Brown formula (0.785) as well as Cronbach's alpha (0.855). The overall scale content validity index was 0.93. Thus reliability and validity of the scale indicates its consistency and precision of the results. The developed scale can facilitate planners, policy makers, institutions to determine the new areas of training and can help in identifying the training needs of agripreneurs beyond the study area with suitable modifications.

Keywords: Training, Agripreneurs, Likert's scale, Spearman Brown, Cronbach's alpha

INTRODUCTION

Agriculture is the largest private enterprise in India in over 600,000 villages and also 54.6 per cent of the population is engaged in agriculture and allied activities (Census, 2011). India hold good ranks globally in most of the agricultural commodities production. However, the post- harvest losses for agricultural commodities estimated to be high i.e. foodgrains (8-10%), horticultural products (20-40%) and animal and fisheries products (10-12%) (CIPHET, 2015). Around 76 per cent of the total fruits and vegetables production is consumed in fresh form, while wastage and losses account for 20 to 22 per cent. The insignificant proportion i.e. 2 per cent of vegetable production and 4 per cent of fruit production are being processed (MoFPI, 2016). So, the need of hour is to focus on beyond farm production and productivity, diversification of agriculture, developing farmers' capacity for processing and linking them with market and other supporting institutions. Therefore, development and promotion of an efficient value chain is critical for the accelerated development of agricultural sector and also for increasing producers' shares in consumer prices. Some of the processors or agripreneurs are engaged in value addition of different agricultural commodities. Thus, these agripreneurs help in reducing the post harvest losses of agricultural produce, developing different products out of agricultural produce therefore, enhancing the shelf life of produce, getting more profit and generating employment opportunity and meeting the demands of consumers. Many of the processors are performing well at commercial level but most of the processors are somehow managing at local and regional level. Hence, there is need to identify the training needs of agripreneurs involve in processing of agricultural commodities for enhancing their competency in value chain development. The identified training needs

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of agripreneurs involve in value addition, will facilitate planners, policy makers, institutions and practitioners for devising appropriate strategy to promote value chain development. Therefore, an attempt has been made to develop a scale for identifying the training needs of agripreneurs involve in processing of agricultural commodities to enhance their competency for value chain development.

MATERIALS AND METHODS

Training need is the difference between "what is" and "what should be" in terms of incumbents knowledge, skills, attitude and behaviour in the given situation and time. Training is a systematic process which involves improvement of knowledge and skills in order to helps the participants to function effectively and efficiently in their given task on completion of the training. In the present study, many of agripreneurs or processors are involve in processing of agricultural commodities at varying levels (local to national). So there is need to identify the training needs of agripreneurs involve in processing to assess their potential for development and in future provide the requisite training to meet their requirement. Thus the scale was developed following Likert method of summated rating (1932) to identify the training need of Agripreneurs as it proposes opportunities to select statements based on their discriminating power. Similar approach was used by Singh *et al.* in 2018 to construct the scale for measuring attitude of farmers towards IARI-voluntary organization partnership extension model. The compatibility of the Scale for the study is due to its nature of the most universal method for survey approach of data collection as well as the responses are easily quantifiable and subjected to statistical computation. The following procedures were considered for identification of the training needs of agripreneurs.

a) Defining the construct: A construct is a concept with added meaning, deliberately and consciously invented or adopted for a special scientific purpose (Kerlinger, 1973). In the present study construct was identifying training needs of agri-entrepreneurs for processing agricultural commodities to enhance their competency for value chain development.

b) Identification and operationalization of dimensions under the construct: Major dimensions identified under this construct were Marketing (product, price, place and promotion), Technical (input, infrastructure, finance, legal and managerial), Information and Social Responsibility.

c) Collection of items: Items simply means the statements representing each dimension of construct under study. Items related to the training needs of agri-entrepreneurs involve in processing of agricultural commodities were collected and developed based on review of literature, consultation with the experts from Division of Agricultural Extension, Ministry of Food Processing, Central Institute of Post Harvest Engineering and Technology, Krishi Vigyan Kendras and also based on the field experience of researcher. A tentative list of 135 statements consisting 100 positive and 35 negative statements were enlisted keeping in view the suitability of statements to the study area.

d) Editing of items: The statements collected were cautiously edited by following the 14 informal criteria suggested by Edwards (1957). Thus, a total of 110 statements were taken out of 135 statements.

RESULTS AND DISCUSSION

e) Relevancy test of items: Finally the 110 statements on a five point continuum *viz.,* Most relevant, Somewhat relevant, Relevant, Least relevant and Not relevant with the score of 5,4,3, 2 and 1, respectively and reverse for the negative statements were mainly sent by Google form survey and some were handed over personally to the total of 55 judges. The experts were from ICAR institutions, Agricultural Extension Division, and scientists of Centre for Agricultural Technology Assessment and Transfer. The judges were requested to make necessary modifications and addition or deletion of items if required. A total of 34 responses were obtained in time out of 55. The Relevancy Weightage (RW) and Mean Relevancy Score (MRS) were worked out for all the selected indicators individually by using the following formula:

$$Relevancy\ weightage = \frac{\begin{array}{c}(\text{Most relevant} \times 5) + (\text{Somewhat relevant } \times 4) + (\text{Relevant } \times 3) + \\ (\text{Least relevant} \times 2) + (\text{Not relevant } \times 1)\end{array}}{\text{Maximum possible score}}$$

$$Mean\ relevancy\ score = \frac{\begin{array}{c}(\text{Most relevant } \times 5) + (\text{Somewhat relevant } \times 4) + (\text{Relevant} \times 3) \\ +(\text{Least relevant } \times 2) + (\text{Not relevant} \times 1)\end{array}}{\text{Number of judges}}$$

Finally the statements having relevancy weightage of more than 0.82 and mean relevancy score of 4.14 or more than 4.14 were selected for item analysis. As a result, a total of 60 statements selected for the item analysis.

f) Item analysis: Item analysis is a critical step for the construction of valid and reliable scale by using Likert's rating technique of measurement. The item analysis is done to find those items that form an internally consistent scale and to remove those items that do not (Spector, 1992). The item analysis provides information about how well each individual item relates to the other items in the analysis. The 60 items which were selected after expert relevancy test were administered to a random sample of 40 processors in non-sample area. The items were rated on five point continuum from 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' with score of 5, 4, 3, 2 and 1 respectively for positive statements and reverse for negative statements. The overall score for each individual judge was computed by summing up the scores over all items.

g) Computation of 't' values: For computation of t value, the 60 items selected through judges opinion were administered to a random sample of 40 processors from non-sample area. Based on total individual score, the judges were arranged in descending order. Upper and lower 25 per cent of the judges i.e. 10 respondents (processors) of non-sample area with the highest total score and 10 of non-sample area processors with the lowest total score were selected. These two groups used as criterion groups to evaluate the discrete statements. The t value is a measure of the extent to which a given statement discriminates between the high and low groups of respondents for each statement was calculated by using the formula given by Edwards (1957).

$$t = \frac{\overline{X}_H - \overline{X}_L}{\sqrt{\frac{\sum(X_H - \overline{X}_H)^2 + \sum(X_L - \overline{X}_L)^2}{n(n-1)}}}$$

Where, $\sum(X_H - \overline{X}_H)^2 = \sum(X_H)^2 - \frac{(\sum X_H)^2}{n}$ and

$\sum(X_L - \overline{X}_L)^2 = \sum(X_L)^2 - \frac{(\sum X_L)^2}{n}$

$\overline{X}_H$ = Mean score of given statement in high group

$\overline{X}_L$ = Mean score of given statement in low group

$\Sigma(X_H)^2$= Sum of squares of the individual score on a given statement for high group

$\Sigma(X_L)^2$= Sum of squares of the individual score on a given statement for low group

ΣX_H =Summation of scores on given statement for high group;

ΣX_L = Summation of scores on given statement for low group

Computation of sample 't' value: The calculation of 't' value for assessing the difference in the mean response to statement by a high group and a low groups. In the Table 1, the calculation of only statement was shown likewise other statements were also worked out.

$$\overline{X}_L = \frac{\sum X_L}{n_L} = \frac{34}{10} = 3.4 \quad \overline{X}_H = \frac{\sum X_H}{n_H} = \frac{46}{10} = 4.6$$

$$\sum(X_H - \overline{X}_H)^2 = \sum(X_H)^2 - \frac{(\sum X_H)^2}{n} = 216 - \frac{(46)^2}{10} = 4.4$$

$$\sum(X_L - \overline{X}_L)^2 = \sum(X_L)^2 - \frac{(\sum X_L)^2}{n} = 120 - \frac{(34)^2}{10} = 4.4$$

$$t = \frac{4.6 - 3.4}{\sqrt{\frac{4.4+4.4}{10(10-1)}}} = \frac{1.2}{0.312} = 3.84$$

Table 1: Calculation of 't' value for statement first

Statement	Response category		Low group				High group		
		x	***f***	***fx***	***fx²***	**x**	***f***	***fx***	***fx²***
Designing or planning of	Strongly agree	5	1	5	25	5	7	35	175
types of value added products	Agree	4	2	8	32	4	2	8	32
that can be developed	Undecided	3	7	21	63	3	1	3	9
	Disagree	2	0	0	0	2	0	0	0
	Stronglydisagree	1	0	0	0	1	0	0	0
		Σ	10	34	120	Σ	10	46	216
			n_L	ΣX_L					ΣX_H^2

Where, X = Score assigned to the response category; f = Frequency

Table 2: **Standardized scale to identify the training needs of agripreneurs for value chain development**

S.No.	Statements	t value
A	**Marketing Dimension**	
I	**Product**	
1.	Selection of agricultural commodities	1.90
2.	Designing or planning of types of value added products that can be developed	3.84
3.	No need of training to determining features of value added product i.e. size, quality, appearance etc.*	2.56
4.	Technology used in processing and packaging value added products	1.92
5.	Determining branding of value added products	2.18
6.	Deciding nutritional value of products and using natural ingredients	2.19
II	**Pricing**	
7.	No need for training to estimate cost of value added products*	2.88
8.	Pricing of products and fixing discounts on it	3.76
9.	Identifying price differences among target customer groups	2.16
10.	Determining the competition for the products	1.94
III	**Place**	
11.	No need of training to identify enterprise opportunities and its premises*	2.47
12.	No need of training to identify distribution of product through direct selling or intermediaries involvement*	1.94
13.	No need of training to determine potential customer, point and volume of sale*	2.61
IV	**Promotion**	
14.	Strategies for promotion i.e. free sample, coupon, contests, incentives, loyalty programmes	2.10
15.	No need of training for online purchasing facility of value added products*	3.39
B	**Technical Dimension**	
I	**Inputs**	
1.	Determining sources, price trends, demand and supply of critical raw materials	2.06
2.	No need of awareness about international/national standards, regulations and laws of agricultural technology*	2.01
3.	No need of training to use appropriate and modern technology for processing*	1.79
4.	No need of training for developing innovative value added products or services*	2.68
II.	**Infrastructure**	
5.	No need of training to determine cost effectiveness of storage capacity*	2.2
6.	No need of training for estimating cost effectiveness of cold chain facility*	2.02
III	**Finance**	
7.	Effective financial planning including balance sheet etc	2.74
8.	Forecasting the need for additional capital for agri-enterprise	2.14
9.	Identifying appropriate sources for credits availability*	1.90
IV	**Legal**	
10.	Registration of agri-enterprise	3.16
11.	No need of training to obtained appropriate licenses*	2.86
12.	Knowing different food quality and safety standards	3.0
V	**Managerial**	
13.	Need of training for enhancing decisions making skills	2.07
14.	Need for exposure for networking skills	1.96

Table 2 contd.....

S. No	Information	t value
1.	Information and support for agri-start-up, its expansion and diversification	2.39
2.	Marketing information such as prices, flow of products, food processing units etc.	2.31
3.	Information regarding new technology from government etc.	2.27
4.	No need of information regarding post-harvest management of agricultural produce*	1.92
5.	No need of training for searching and utilising data from patent information, innovation information and other sources of knowledge*	2.09
6.	Understanding of the different ethical issues that exist in relation to enterprise and its utilisation	1.98
D	**Social Responsibility**	**t value**
I	**Towards Employees**	
1.	No need of training to provide conducive working environment for work culture*	3.20
II	**Towards creditor/ banker**	
2.	Effective utilization of funds and resources	2.10
III	**Towards community**	
3.	No need of training for prevention of environmental pollution*	1.78
4.	No need of training to reducing deleterious effects of industrial products on human health*	2.02
IV	**Towards Government**	
5.	To comply with government rules, procedures and legal requirements	2.92

*means negative statements

h) Final selection of item: Critical ratio ('t'- value) of each statement was calculated for the final selection of items. Items or statements were selected on the basis 't' value equal to or, more than 1.75 as this 't'value significantly differentiating between high and low groups of items. Therefore, 40 statements including 23 positive and 17 negative statements were retained in the final scale for measuring training needs of agripreneurs involve in processing for value chain development as shown in Table 2. Both positive and negative statements were considered to reduce the effects of social desirability and positive response bias.

(i) Standardisation of the scale: The present scale is standardised through reliability and validity which was ascertained using split half method as well as cronbach's alpha and content validity, respectively.

(i.a) Reliability of scale: Reliability of the testing instrument is the ability to give consistent, stable and accurate measurement score in repetitive testing with same instrument. It helps in assessing the homogeneity of items in scale.

The split half method is used to check the reliability of the present scale in which a scale is divided into two halves based on even and odd number of statements. The Pearson product moment correlation between odd and even scores was 0.647. This coefficient indicates split half reliability of scale. To adjust the split half reliability in to full test reliability, Spearman- Brown (1910) prophecy formula was used which is as follows;

$$R=\frac{2r}{1+r} = \frac{2\times0.647}{(1+0.647)} = 0.785$$

Where, R= Reliability coefficient of the whole scale
r = Pearson correlation between two halves

The whole test reliability was found to be 0.785 and significant at 1 per cent level of significance. Since the reliability coefficient of whole scale was more than 0.7, the present scale was considered to be highly reliable. Split half method is a widely held method of assessing reliability of a test mainly due to its benefit of single administration of the test and use of one sample. The major limitation of this method is there could be several ways of splitting a test and each method of split-half gives a different value of reliability. Rudner *et al.* (2002) observed that split-half reliability is a function of how the test was split. A solution to the problem is provided by Cronbach's alpha which is interpreted by many researchers as the average of all possible split-half correlations (Cortina, 1993). Cronbach's alpha also assumes that average covariance among non-

parallel items is equal to the average covariance among all parallel items. Thus in present study standardised Cronbach's alpha also used to get more stability and accuracy with the following formula:

$$\alpha_{standardized} = \frac{K\bar{r}}{(1 + (K-1)\bar{r}}$$

Where K is number of items in scale

$\bar{r}$ is mean of the {\displaystyle K(K-1)/2}K(K-1)/2 non-redundant correlation coefficients

The value of Cronbach's alpha calculated and found to be 0.855 which means scale was good consistent in measurement. A commonly accepted rule for describing internal consistency using Cronbach's alpha as shown in Table 3 (DeVellis, 2012).

Table 3: **Depicting the internal consistency using Cronbach's alpha**

Cronbach's alpha	Internal Consistency
$0.9 \leq \alpha$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

(i.b) Validity of scale: Validity means ability of an instrument to measure what one intended to measure. The developed scale was tested for content validity. According to Kerlinger (1987) content validity of scale is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. There are several methods to quantify the degree of experts' agreement towards content relevancy of a scale. The paper considered the most acceptable method as suggested by Lynns' in 1986. For quantifying the content validity, the 40 selected statements ('t' value >1.75) were given to 6 experts (processors). The 2 processors from each category were considered e.g. food grain, fruits and vegetables processors. The 6 experts were selected as with increase in number of experts the likelihood of achieving total agreement decreases. The 4-point scale was used to avoid a neutral and ambivalent midpoint as per Davis (1992) 1= not relevant, 2 = somewhat relevant, 3= quite relevant and 4= highly relevant. Then for each selected statements Content Validity Index i.e. I-CVI calculated to check its relevance to the underlying construct (Table 4). Then for computation of Content Validity Index for overall scale S-CVI worked out. The S-CVI/Ave which means the average of the I-CVIs for all the items of scale calculated to be 0.930. Thus, 93.00 per cent of items were judged content validity as per the Lynn's criteria for excellent content validity: I-CVI= 1.0 with 3 to 5 experts and a minimum I-CVI of 0.78 for 6 to 10 experts as well as SCVI/Ave $\geq$0.90.

j) Administration of the scale: The final scale consisted of 40 statements which would measure the training need of agripreneurs for processing of agricultural commodities to enhance the competency for value chain development. The scale can be administered on a five point continuums viz., strongly agree, agree, undecided, disagree and strongly disagree with a score of 5,4,3,2 and 1, respectively for positive statements and reverse scoring for negative statements. As Kumar *et al.* 2015 measured the level of satisfaction of trainees on five point continuum. The overall score of the individual respondent towards training need of agripreneurs for processing of agricultural commodities could range from 40-200.

CONCLUSION

The value chain development is one of the alternatives for increasing the income of farmers therefore there is need to focus on maximizing processing, value addition at each stage (farm to fork) and minimizing post harvest losses. Many of the agripreneurs or processors are involved in it but due to lack of awareness and information they are working locally and sporadically. Thus in order to strengthen this local processors there is need to identify the training need at present and then design the training programme to enhance their effectiveness and efficiency**.** Since the reliability and validity value of the scale shows the accuracy and consistency of the results. Thus, developed scale on training need of agripreneurs for processing of agricultural commodities will help the policy makers to the design training programme more effectively and address the problem of processors. Further, this scale can be used to measure the training need of processors in similar situation beyond the study area with suitable modifications.

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Table 4: A list of statements towards training needs of agripreneurs involve in processing for value chain development with their respective "I-CVI"

S.No.	Statements	Agreement	I-CVI*
1	Designing or planning of types of value added products that can be developed	6	1
2	Pricing of products and fixing discounts on it	6	1
3	No need of training for online purchasing facility of value added products	6	1
4	No need of training to provide conducive work culture	6	1
5	Training need for registration of enterprise	5	0.833
6	Knowing food quality and safety standards	6	1
7	To comply with government rules, procedures and legal requirements	6	1
8	No need for training to estimate cost of value added products	6	1
9	No need of training to obtained appropriate licenses	5	0.833
10	Effective financial Planning	6	1
11	No need of training for developing innovative value added products or services	6	1
12	No need of training to determine potential customer, point and volume of sale	5	0.833
13	No need of training to determining features of value added product i.e. size, quality, appearance etc.	6	1
14	No need of training to identify enterprise opportunities and its premises	6	1
15	Information and support for agri-start-up, its expansion and diversification	5	0.833
16	Marketing information such as prices, flow of products, food processing units etc.	5	0.833
17	Information regarding new technology from government etc.	6	1
18	No need of training to determine cost effectiveness of storage capacity	5	0.833
19	Deciding nutritional value of products and using natural ingredients	5	0.833
20	Determining branding of value added products	6	1
21	Identifying price differences among target customer groups	6	1
22	Forecasting the need for additional capital for agri-enterprise	6	1
23	Effective utilization of funds and resources	5	0.833
24	Strategies for promotion i.e. free sample, coupon, contests, incentives, loyalty programmes	5	0.833
25	No need of training for searching and utilising data from patent information, innovation information and other sources of knowledge	6	1
26	Need of training for enhancing decisions making skills	5	0.833
27	Determining sources, price trends, demand and supply of critical raw materials	5	0.833
28	No need of training to reducing deleterious effects of industrial products on human health	5	0.833
29	No need of training for estimating cost effectiveness of cold chain facility	6	1
30	No need of awareness about international/national standards, regulations & laws of agril. technology	5	0.833
31	Understanding of the different ethical issues that exist in relation to enterprise and its utilisation	6	1
32	Need for exposure for networking skills	6	1
33	Determining the competition for the products	5	0.833
34	No need of training to identify distribution of product through direct selling or intermediaries involvement	6	1
35	Technology used in processing and packaging value added products	6	1
36	No need of information regarding post-harvest management of agricultural produce	6	1
37	No need of Identifying appropriate sources for credits availability	5	0.833
38	Selection of agricultural commodities	6	1
39	No need for training in using appropriate and modern technology for processing	5	0.833
40	No need of training for prevention of environmental pollution	6	1
	S-CVI/Ave		0.930

*I-CVI means content validity index for each item

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Assessment of Wheat Cultivars under Limited Irrigation Condition in Vindhya Plateau Agro-Climatic Zone of Madhya Pradesh

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ABSTRACT

Temperature hike, moderate to severe water stress, land suitability and choice of suitable varieties, changes in sowing and harvesting dates are major limiting factors of wheat productivity in Vindhya Plateau Zone. In order to assess the site specific performance of wheat cultivars with improved production technologies, Krishi Vigyan Kendra Sagar conducted 31 farmers' participatory trials during 2008-09 to 2012-13 at different locations of limited irrigated areas. The improved limited irrigated wheat cultivars viz. JW 3020, JW 3211, HI1531 and JW 3173 with recommended practices i.e. seed rate, seed treatment, line sowing, recommended dose of fertilizers and proper weed management were comprised. The control plots were farmers practices (use of old variety C-306 and poor crop management practices). The findings of the experiment revealed that there was a technological gap between recommended and existing practices. All the wheat varieties i.e. JW 3020, JW 3211, HI 1531 and JW 3173 performed very well in all the locations as compare to farmers practice. The wheat varieties yielded 23.30 q/ha marketable yield over farmers practice (17.40q/ha). Increase in yield between wheat cultivars was ranging 23.08-47.98 per cent with a mean per cent increase of 31.62 as compared to traditional farming practices. This huge variation in yield was due to changes in weather, differences in land fertility in an area wise and differences in farmers' practices in different area. The average net profitability of worth Rs 22173.00/ha with benefit cost ratio 3.23 was recorded in assessed plots, while Rs 15410.00/ha with benefit cost ratio of 2.68 were obtained in existing practices. The suitable wheat varieties with recommended technologies showed a significant increase in yield over farmers practice and higher income too.

Keywords: Wheat cultivars, Seed treatment, Weed management, Yield and economics

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the world's most widely adapted crops. It is consumed by nearly 36 per cent of the world population with more than half of their calories and nearly half of their protein but also core part of animal feed as straw in most of the countries (Ullah *et al*., 2014). Wheat productivity is affected by continuous global climatic changes including rainfall pattern, temperature hike, moderate to severe water stress, lack of water resources, evaporation, worsening eco-environment, land suitability and choice of suitable varieties, changes in sowing and harvesting dates. Wheat is the second most important crop after rice and widely cultivated in India mainly under irrigated conditions, however a large area is covered under rain fed wheat where crop is produced without supplemental irrigation. In India, agriculture is substantially dependent on the south-western monsoon. The total area under the crop is about 31.20 million hectares in the country and producing 95.90 million tons with productivity 30.80 q/ha in 2013-14 (ICAR-DWR, 2014). Madhya Pradesh is the third largest wheat producing state and contributes 17.5 per cent share in the country after Uttar Pradesh and Punjab. It produced 15.52 million tons of wheat productivity in 2013-14 from an area of 5.98 million hectares with 26.02 q/ha productivity (NFSM- MP Report, 2014-15). Seed replacement rate of wheat in the state received 27.2 per cent in 2013-14. The area, production and productivity of wheat in Sagar district of Madhya Pradesh are 195.6 (000'hectares), 351.1(000' tons) and 17.95 q/ha, respectively (Mishra *et al*., 2015). The choice of suitable cultivars to be grown as well as crop management strategies i.e. seed treatment with fungicide, timely sowing by recommended methods, proper weed management,

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judicious use of fertilizers and controlling diseases/pests management to be followed are important factor for harvesting good crop in these areas dependent on rainfall/ limited irrigation conditions. Keeping this in view, the suitable wheat cultivars with recommended production technologies were assessed under limited irrigated condition of the district to harness their yield potential for improvement of economic situation of farming communities.

MATERIALS AND METHODS

The 31 trials on site-specific assessment of wheat cultivars with improved production technologies were conducted by Krishi Vigyan Kendra, Sagar of Vindhya Plateau agro-climatic zone of Madhya Pradesh. These site-specific on farm trials were conducted in an area of 9.2 hectares as replication wise in five villages i.e. Badaua, Baroda Chainpura and Salayiagazi of Jaisinagar block and Chitaura block of Sagar district during 2008-09 to 2012-13. The improved limited irrigated wheat cultivars viz. JW 3020, JW 3211, HI 1531 and JW 3173 with recommended practices i.e. seed rate (100 kg/ha), seed treatment (Carbendazim 50% WP/ Vitavax power 75% WP @ 2g/ kg seed for seed borne disease control; Chlorpyrofos 20% EC @1.5-2.0 ml/kg seed and Thiamethoxam 75% WS @ 4g/kg seed for termite and root aphid management, respectively), line sowing (23-25cm R x R), recommended dose of fertilizers (N:P:K:: 60:40:20 kg/ha), proper weed management (Sulfosulfuron 75% + Metsulfuron 5% WG @ 40 g/ha as post-emergence at 25-30 days after sowing) and need based plant protection measure were comprised. The control plots were farmers practices (use of old variety C-306 and poor crop management practices). The soil of the operational area in Vindhya Plateau Zone was generally deep shallow and medium black soil. All the demonstrations on farmers' fields were monitored by scientists of Krishi Vigyan Kendra, Sagar right from sowing to harvesting and made to guide them. The data were collected from demonstrated trials and existing practices (control plots). Performance of yield and economics of wheat crop was observed in terms of yield parameter and net returns in site-specific trials as well as existing practices (farmers' practice). Benefit cost ratio of each treatment was also assessed. Farmers reactions were also observed with the help of personal interview and data on quantitative parameters were recorded and per cent increase yield was calculated by using following formula.

$$\% \text{ increase yield} = \frac{\text{Demonstrated yield - Farmers practice yield}}{\text{Farmers practice yield}} \times 100$$

RESULTS AND DISCUSSION

Results of wheat crops during five years i.e. 2008-09 to 2012-13 (Table 1) elicited that yield of all the wheat cultivars increased successively over the farmers practice. The wheat cultivars yielded an average marketable yield of 23.30 q/ ha over farmers practice (17.64q/ha). The wheat cultivars JW 3020, JW 3211, HI 153, JW 3173 and JW 3211 performed very well in all the locations with an average yield of 20.37, 27.00, 20.17, 21.90 and 27.08 q/ha as compare to farmers practice i.e. 16.55, 19.80, 16.17, 17.38 and 18.30 q/ha during 2008-09, 2009-10, 2010-11, 2011-12 and 2012-13 respectively. The highest yield i.e. 27.08 q/ha was recorded with the cultivar JW 3211 during 2012-13and lowest was in HI 1531 (20.17 q/ha) during 2010-11. The average percentage increase in yield was 31.62 while cultivar wise variation was 23.08-47.98 over farmer's practices. This huge variation in yield was due to changes in weather, differences in land fertility in an area wise and differences in adaptation of practices by the farmers in different areas. The results are in conformity with the

Table 1: Performance of yield and economics of wheat crop under limited irrigated condition

Year withno of	Assessed cultivars	Yield (q/ha)		% increase	Net returns (Rs./ha)		BCR	
Demo.	with area (ha)	Demo.	EP	in yield	Demo.	EP	Demo.	EP
2008-09 (10)	JW 3020 (2)	20.37	16.55	23.08	22345.00	17365.00	3.72	3.33
2009-10 (05)	JW 3211 (2)	27.00	19.80	36.36	29310.00	22008.00	4.28	3.61
2010-11 (05)	HI 1531 (2)	20.17	16.17	24.74	15176.00	10236.00	2.37	1.95
2011-12 (05)	JW 3173 (2)	21.90	17.38	26.00	15802.00	10741.00	2.36	1.98
2012-13 (06)	JW 3211 (1.2)	27.08	18.30	47.98	28232.00	16700.00	3.44	2.55
Average		**23.30**	**17.64**	**31.62**	**22173.00**	**15410.00**	**3.23**	**2.68**

Demo.=Demonstration EP=Existing practices BCR=Benefit cost ratio

findings of Singh *et al.* (2010); Joshi *et al.* (2014) and Kumar *et al.* (2014).

Economic returns as a function of grain yield and maximum sale price of wheat varied during different years. The economic analysis reveals that the highest net profitability of worth Rs 29310.00/ha and with benefit cost ratio (BCR) of 4.28 was recorded with wheat cultivar JW 3211 during 2009-10 while lowest net income and BCR was Rs 15176.00/h and 1.95 with cultivar HI 1531 during 2010-11. The wheat cultivars i.e. JW 3211 and JW 3020 gave maximum net profitability during site-specific assessment of limited irrigated conditions. The average net profitability among wheat cultivars was recorded worth Rs 22173.00/ha with benefit cost ratio of 3.23 as compared to existing practices of Rs 15410.00/ha with benefit cost ratio of 2.68. The recommended technological interventions of wheat crop showed a significant increase in yield over farmers practice and higher income too. The maximum yield and net returns under site-specific assessment of wheat cultivars is quite encouraging to partner farmers as well as neighboring farmers of cluster villages. Similar findings were reported by the results confirm with the findings of front line demonstrations on wheat crops by Singh *et al.*(2010) and Kumar *et al.* (2014).

CONCLUSION

From the above findings it can be concluded that use of suitable limited irrigated wheat varieties with recommended technological interventions can reduce the technology gap to a considerable extent, thus leading to increased productivity of wheat crop in the district. Moreover, Krishi Vigyan Kendra in the district need to provide proper technical support to the farmers through different educational and extension methods to reduce the extension gap for better wheat production in the limited irrigated areas. The on farm trials was effective in changing attitude, skill and knowledge of recent technology for high yielding varieties, seed treatment, line sowing, balanced dose of the fertilizer and weed management of wheat crop including their adoption. This also improved the relationship between farmers and scientist and built confidence between them.

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Filling the Information Gap Through Developing and Validating Entrepreneurial Technical Information Packages (ETIPs) for Potential Agricultural Entrepreneurs

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ABSTRACT

Many potential entrepreneurs are not able to reap benefits of good technologies and protocols standardized at research institutes as they are not readily available to farmers for adoption in appropriate Entrepreneurial Technical Information Packages (ETIPs) form. An attempt was made to take up action research to develop such packages including the thorough technical analysis and precise in terms of projects inputs (supplies) and outputs (production). Perception of practitioners and experts on information needs of an enterprise was considered as the basis for the development of such packages. The exploratory part of the study was carried out in NCR of Delhi. On the basis of need analysis and potential of the area, six implementable agricultural technologies; mushroom production, vermicomposting, hybrid tomato seed production in net house, baby corn cultivation, apiary and honey bee production and protected crop cultivation, were selected. To proceed for designing of implementable ETIPs the strength of relevance of information and need for agri enterprise creation was established. The data from established entrepreneurs, experts in the subject matter, journalism experts were collected through survey and case study method. These technological packages were tested and refined. Farmer's practices in planning, management of their farm enterprises and their information needs were made part of the final packages. Exploratory methods were used for assessing opinions of all stakeholders. The final package was found effective on almost all the journalistic parameters including content, format and illustrations.

Keywords: Journalistic parameters, Strength of relevance, Information need, Content, Format, Illustrations

INTRODUCTION

Planning is extremely important in the early stages of any venture as, developing a business idea, there is a need for potential entrepreneur to adopt a carefully moderated and intelligent technical approach. Different types of technical information that may be part of any business operation include; designing of premises, products, nature of products/services you will like to engage in, tools and equipment you require or materials needed for your production process. It may also be technology choice or advice on location and premises. One of the most often overlooked areas of information for entrepreneurship development is the financial information because when one having proper financial information then only one will know the amount of capital required for the kind of business and ways of sourcing it.

Farmers and rural youth desirous for starting their own agri-enterprises face a major problem of lack of information about the exact procedures to be adopted and how much to be invested. Timely availability of inputs, ease of credit facilities and use of Information and communication technology for bringing a trickle down revolution was highlighted by Kumar and Nain 2012. Several studies have highlighted the need for developing information packages for would be entrepreneurs, wherein they get not only the information regarding technical methods but also about the economic feasibility and expected profits from the endeavor. For farmers to become entrepreneurs, they need to learn the skill to manage their businesses as sustainable long-term ventures. They must be able to identify opportunities and seize them. Depending on the level of resource support, entrepreneurial policies can be classified as being hard or

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soft (Storey, 2005). Hard policies usually provide assistance in the form of finance (loans and grants) while soft measures include counselling activities to entrepreneurs before business start-up and at the start-up phase, facilitating financial assistance, enhancing technology and access to technology and improving access to physical infrastructure, or advice after the start. Mayberry, 2007 suggested research framework for various aspects of educational material from perspective of impact on learning and subsequent change in practice. In many cases an appropriate Entrepreneurial Technical Information Packages (ETIPs) which may facilitate the famers to get information on soft and hard policies are not readily available for adoption. Due to this gap, many farmers are not able to reap benefits of good technologies developed by research institutes (Nain *et al.,* 2012; Singh *et al.,* 2015). An attempt was made to take up an action research to develop such packages including project framework defined clearly enough to permit the technical analysis in thorough and precise way in terms of projects inputs (supplies) and outputs (production). Perception of practitioners and experts on information needs of an enterprise was considered as the basis for the development of such packages.

Developed business ventures protocols and information packages aim at designing and modeling entrepreneurial support tools for the transfer and distribution of business venture information. These packages may create an enabling environment and an economical information support services to entrepreneurs, policy designers and learning establishments in rural areas. Furthermore, they will provide valuable information to promote, develop and participate in intensive information and technology based assignments mostly in business incubators. To promote implementable farm innovations into commercial ventures with full participation of the local people, the strength of relevance of information and their need for consideration during designing of ETIPs was measured and on the basis of expressed strength six ETIPs were developed, validated and refined. The paper presents the process and the results of the action research.

MATERIALS AND METHODS

On the basis of discussion with the concerned scientists, micro screening exercises conducted in the villages of National Capital Region, and arrived at a decision to take up six implementable technologies namely; protected cucumber cultivation, tomato seed production, baby corn cultivation, mushroom cultivation, vermicomposting, and bee-keeping for designing and validation of the ETIPs as the expertise for the said technologies existed at Indian Agricultural Research Institute, New Delhi. The strength of information need was assessed based on the opinion of 30 practicing farmers and ten scientist experts for each of the technology. Thus a total of 180 farmers and 60 scientist experts were sampled for the study. The strength of felt need was assessed on five point continuum in increasing order (higher the score more the strength). The data were analyzed with weighted mean score and prioritization through ranking. On the basis of these assessed need strength, the content of the implementable technologies was designed in two languages (English and Hindi), validated and standardized. The effectiveness of the ETIPs was also measured. The effectiveness was measured on three major dimensions (each divided into sub dimensions) namely; content, format and illustrations. The perceived effectiveness was measured on five point continuum ranging from one to five. The data for effectiveness were collected from five experts and twenty potential entrepreneurs for each ETIP, making a total of 30 experts and 120 potential entrepreneurs as sample for the validation study.

RESULTS AND DISCUSSION

The study results are presented in two steps viz., the strength of relevance of information and their need for consideration during designing of ETIPs and the perceived effectiveness of the ETIPs by the stakeholders (experts and the potential entrepreneurs) after their design. The strength of information need of two types of stakeholders was recorded and presented in Table 1. It is clear from data that the strength of need of the different components were perceived differently by both the stakeholders (experts as well as farmers). The experts concentrated on accuracy of information, practicability of information, use of language, profitability, clarity of information, economic parameters, technical details and procedural details in order as prime focus. Whereas the farmers expressed the high relevance for materials required, language/readability of the ETIPs, technical details, precautions to be taken, clarity of Information, procedural details, accuracy and practicability of information and use of illustrations in decreasing order as major considerations. However, subject introduction, font size, logical presentation and details of risk involved could find rear seat in the perceived strength of the need by both types of stakeholders. Similar nature of finding were reported by Nain and Trikha (2009) during

Table 1: Perceived strength of relevance of information and their need for agri enterprise development

S.No.	Items	Strength of relevance of information (1-5 in increasing order)			
		Experts (n=60, ten in Each Enterprise)		Farmers (n=180, thirty in Each Enterprise)	
		Weighted mean score	Rank	Weighted mean score	Rank
1.	Subject Introduction	3.7	7	3.75	10
2.	Materials Required	4.7	4	4.95	1
3.	Procedural Details	4.9	2	4.85	3
4.	Technical Details regarding Diseases and Pest Management	4.9	2	4.90	2
5.	Details regarding risks involved	4.2	6	4.50	7
6.	Precautions to be taken	4.8	3	4.90	2
7.	Economic Parameters (Plant &Machinery , Raw Material, Manpower, Working Capital and Overall Project Economics)	4.9	2	4.60	6
8.	Relevancy of information	4.9	2	4.60	6
9.	Accuracy of information	5.0	1	4.75	4
10.	Information on profitability analysis	4.9	2	4.60	6
11.	Practicability of information	5.0	1	4.65	5
12.	Quantity and sufficiency of information	4.8	3	4.60	6
13.	Clarity of Information	4.9	2	4.85	3
14.	Logical Presentation	4.2	6	3.95	9
15.	Type size	4.6	5	4.00	8
16.	Use of Illustrations	4.7	4	4.75	4
17.	Use of Language/ Readability	5.0	1	4.95	1

analysis of training needs of farm journalists and found that layout, designing, editing farm periodicals, writing press release, analysis of target audience and use of graphics in the articles were the sub areas which need emphasis in human resource development activities. Surprisingly, the strength of relevance of information on economic parameters and profitability analysis were rated lower by the farmers in comparison with experts, it may be due to the fact that the data was collected from practicing entrepreneurs and they might be well versed with such information during their course of practice and have rated accordingly.

Table 2 shows the level of effectiveness measured from different stakeholders of the prepared ETIPs. It is clear from the data that both the stakeholders rated the content, illustrations and format as effective with slight variations in their response. In most cases the experts rated more effective than the potential entrepreneurs. Although the sub components of content were rated effective by potential entrepreneurs but the clarity and the relevance of the information were somewhat grey areas, this may be due to differential background of the respondents. In case of format of the ETIPs *use of sub titles* and *organisation of content* was rated somewhat less effective by the potential entrepreneurs and additionally *use of white space* by the experts. As far as the use of illustrations is concerned almost all the sub components were rated as effective, however the attractiveness of the illustrations and the size of illustrations need to be looked into to make it more effective. As the illustrations used in the content were of technical nature and the photographs depicted the action in technological intervention as such might not have attracted the attention of the potential entrepreneurs.

In overall it may be concluded that the content, format and illustrations of the prepared ETIPs were perceived as highly effective on journalistic parameters. Sorce and Dewitz (2007) reported that even in the internet age also, printed advertising was the most influential source of information for consumers who purchased personal care / home care products, and the second most influential

Table 2: Effectiveness of ETIPs on Journalistic parameters

Dimension	Sub-Items	Effectiveness of information (1-5)	
		Experts (n=30, five in Each Enterprise)	Potential Entrepreneurs (n=120, twenty for Each Enterprise)
Content	Relevancy to region/ area	4.8	4.90
	Market orientation of information	4.6	4.80
	Utility value of the content	4.5	4.70
	Accuracy of information	4.9	4.80
	Profitability analysis	4.7	4.70
	Readability of information	4.9	4.60
	Practicability of information	4.9	4.80
	Relevance to the need of the readers	4.9	4.25
	Adequacy of information	4.6	4.55
	Clarity of information	4.7	4.15
	Sequence of Presentation	4.8	4.90
	Explanation of technical terms	5.0	4.75
	Average of content	**4.78**	**4.66**
Format	Use of sub titles	4.4	4.2
	Use of tables and graphs	4.5	4.4
	Paper quality	4.9	4.9
	Font size	4.9	4.8
	Type size	4.8	4.8
	Use of white space	4.2	4.5
	Objectivity	4.6	4.6
	Organisation of the content	4.4	4.2
	Average of format	**4.59**	**4.53**
Illustrations	Appropriateness	4.9	4.6
	Attractiveness	4.5	4.5
	Use of colour combinations	4.7	4.8
	Layout	4.8	4.9
	Number	4.7	4.8
	Size	4.3	4.5
	Average of illustrations	**4.65**	**4.68**

source for those purchasing consumer electronics and home improvement products. Rehman *et al.* (2011) found the quality of information, newness, farmers' interest, and timeliness to be the major determinants of effectiveness of print media in the dissemination of agricultural information among farmers. Similarly, the designed ETIPs were perceived effective in terms of content, presentation and illustrations by potential entrepreneurs as well as the experts in the subject, as such it may be inferred that the exposures to the content of ETIPs have the potential to motivate the farmers for taking up income generating activities and ultimately the agri entrepreneurship development.

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Scientifically Validated ITK for Managing Plant Pathogenic Fungi

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ABSTRACT

In the present investigation a biopesticide formulation (BPF) was prepared indigenously from various plant based and natural ingredients, by standardizing their ratio and proportions, in indigenous cow-urine as solvent, and evaluated for its *in-vitro* bio-efficacy against various plant pathogenic fungi. The main aim of this study was to validate scientifically the traditional practices for managing diseases of vegetable crops thereby reducing load of synthetic chemical pesticides. One percent of BPF could inhibit the growth of *Rhizoctonia bataticola* by 75 per cent *Sclerotinia. Sclerotiorum* 50 per cent and *Pythium aphenidermatum* pathogenic fungi by 85 per cent compared with check untreated experiments under laboratory conditions. The organic solvents extracts of BPF were also bio-assayed against various plant pathogenic fungi. The antifungal activity of ethyl acetate extract was observed more promising than that of hexane extract. 100 ppm (0.1%) ethyl acetate extract could inhibit the growth of *Alternaria alternata* (78%), *Sclerotinia rolfsii* (88%), *Phytopthora infestence* (55%); and *R. bataticola* & *F. oxysporum* (80-90% with 1000 ppm).

Keywords: Cow urine, Biopesticide, Plant pathogens, Fungitoxicity

INTRODUCTION

For adoption of a useful and promising ITK, much needed attention should be paid for its documentation and scientific validation for the benefit of our farming community (Kumar *et al.,* 2017). The present study is based on integration of modern scientific knowledge with ITK, to generate new ideas and practices for the betterment of farming community. Plant diseases is one of the major bottlenecks in agricultural production particularly in irrigated crops, in monoculture cultivations and in certain widely grown rainfed crops as well (Indiaagronet.com 2012). The global agricultural production sustains annual loss of about 20 to 30 per cent on an average due to plant diseases. Occasionally, the losses rise even to 100 per cent in the most pathogenic-favorable circumstances with no control measures, in case of some important diseases.

Synthetic chemicals may be used to plant protection programs to limit crop damage by pests and pathogens. But because of growing concerns about health and environmental safety, the use of toxic, carcinogenic, and/or harmful chemicals is being discouraged. These chemicals leave toxic residues in many of the consumable agricultural commodities. The survey of monitoring of farm-gate samples in different parts of the country recorded pesticide residues levels above Maximum Residue Limit (MRL) (Madan *et al.,* 1996; Mandal and Singh 1996; Kole *et al.,* 2002).

Even though farmers and sometimes researchers use persistent and toxic synthetic pesticides due to their instant action in controlling crop pests (exceptional cases for resistance development) along with their economical and easy access, there is a definite reason for diversion from synthetics to organics and botanicals. The individual botanicals can be effective as one of the components of either Integrated Pest Management (IPM) or with other control measures for pest management. Moreover, many farmers are following indigenous practices since years for pest management. Many of those are observed as quite promising in plant protection. Therefore, a need was felt to scientifically validate one of the indigenous knowledge practiced by farmers. The indigenous biopesticide formulation (BPF) under the experimental consideration was prepared by mixing nine natural ingredients of bio-botanical origin, with one naturally occurring mineral salt along with two animal products (Table 1). These natural products namely, onion, ginger, ocimum, neem etc. individually, are reported for their *in-vitro* efficacy (Chowdhury *et al.,* 2000; Jacques *et al.,* 2004; Ogechi and Marley 2006; Alan *et al.,* 2008), but their efficacy at field level are reported not at par with synthetic or combination

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of these ingredients (Sadawarte and Sarode, 1997; Hegde and Nandihalli, 2009). Though all these have been used separately for sporadic pest control but these have never showed individual ability to manage pest menace, if it is above Economic Threshold Level (ETL). The ratio and proportions of the ingredients in present formulation were standardized, leading to a reliable biopesticide formulation, which could be applied even at the time of epidemic, when insect or pathogen pressure is high on the crop. The indigenously prepared bio-pesticide considered for study (Arora *et al.,* 2012) is bio-degradable, environmentally sound, nature friendly and economical, which has been patented in India (Arora *et al.,* 2018). The technology is under commercialization stage. It is bio-assayed for its *in-vitro* efficacy against important plant pathogenic fungi viz. *Rhizoctonia bataticola*, *R. solani, Fusarium oxysporum*, *Alternaria alternata*, *Sclerotinia rolfsii* and *Phytopthora infestence*. The plant pathogens selected for bio-assay testing, in present study, cause a variety of diseases. *R. bataticola* (Taub) Butler, is considered to be causal organism of dry root rot diseases in pulses and vegetables and *P. aphanidermatum* (Edson) Fitzp. is responsible for damping off in vegetables (Sharma *et al.,* 2003). *Sclerotinia sclerotiorum* (Lib) De Bary., causal fungus of Sclerotinia stem rots in Mustard, may be managed by using chemical pesticides (Rana *et al.,* 2017). These pathogenic diseases are responsible for greater yield loss in vegetables.

MATERIALS AND METHODS

Preparation of bio-pesticide formulation: This biopesticide formulation comprised of twelve ingredients, nine of which bio-botanical in origin (amla, turmeric, onion, garlic, calotropis, tomato, ferula, neem and tulsi) and one naturally occurring mineral salt (allum) along with an animal product (cow dung), in specific ratios in 12th ingredient, a liquid, another animal product (cow urine). Ratios of ingredients for preparing 1000 ml of bio-pesticide formulation (Arora *et al.,* 2012) are listed in Table 1. As per patented technology (Arora *et al.,* 2018), the raw materials used for this formulation were mashed and mixed thoroughly in urine of indigenous breed cow in an earthen pot. The pot was then buried in soil for 30 days for fermentation. The earthen pot was taken out and the content was mixed thoroughly and this solution was considered as 100 percent stock solution.

Table 1: Composition of bio-pesticide formulation (BPF)

Phyllanthus emblica (amla) fruit	4%
Curcuma zedooria (turmeric)	6%
Allum (phitkari)	5%
Allium Ceppa (onion) bulb	3.5 %
Allium Sativum Linn (garlic) bulb	4%
Calotropis procera	5%
Fresh cow-dung extract	3%
Lycopersicon esculantum (Tomato) leaf extract	6%
Ferula narthexboiss	2%
Azadirachta indica leaves	5.5 %
Ocimum canum (tulsi leaves)	4%
Cow urine	52%

Laboratory studies

Bio-assay studies of BPF: Eight concentrations (0, 0.1, 0.2, 0.5, 1.0, 2.5, 5.0 and 10.0%) each with five replicates including control were prepared from the stock solution of BPF, by serial dilution with distilled water. For evaluation of fungi toxicity of this formulation, *in-vitro* bioassay studies were carried out using poisoned food technique method (Arora and Gopal, 2006). The Potato Dextrose Agar (PDA) media was spiked with different amounts of BPF and the test fungi namely *R. bataticola*, *S. Sclerotiorum* and *P. aphenidermatum* were allowed to grow on that medium. The inhibition of fungal growth in treated medium, compared to control (not treated with bio-pesticide) gave the evaluation of fungitoxicity of BPF. Each treatment including control was replicated five times. After inoculation, the petriplates were sealed with paraffin and were kept in a BOD chamber at 25°C.

The fungi toxicity of extracts in terms of percent inhibition of mycelial growth was calculated by using the formula:

$$\% \text{ inhibition} = dc - dt/dc \times 100$$

Where,

dc = Average increase in mycelial growth in control

dt = average increase in mycelial growth in treatment (Arora and Gopal, 2006).

The cultures of these test fungi were procured from Plant Pathology Unit, NCIPM, where these were sub cultured on PDA. The colony growth of these pathogens at each concentration was recorded after initiation of its growth in control.

Bio-assay studies of BPF extracts in organic solvents: The BPF formulation (250 ml) was extracted in ethyl acetate and hexane solvents (3 X 100 ml), separately. After

solvent evaporation, using rotary evaporator to dryness, stock solutions (1000 ppm) of hexane and ethyl acetate solvent extracts were prepared separately, in acetone solvent. Each stock solution was diluted to desired concentrations using serial dilutions in acetone solvent. The control experiment was set in acetone solvent. As a test experiment, three concentrations (250, 500 and 1000 ppm) each with five replicates including control were taken for bio-assay, against the growth of two pathogens namely *R. bataticola* and *F. oxysporum*. After observation of this test experiment, another experiment was set for which six concentrations (4, 8, 20, 40, 80 and 100 ppm), each with five replicates including control, were prepared from stock solutions of both organic extracts of BPF, by serial dilution. These were bio-assayed against the growth of three pathogens namely *A. alternata*, *S. rolfsii* and *P. infestence.* The radial colony growth of all the pathogens at each concentration was recorded at two days intervals.

RESULTS

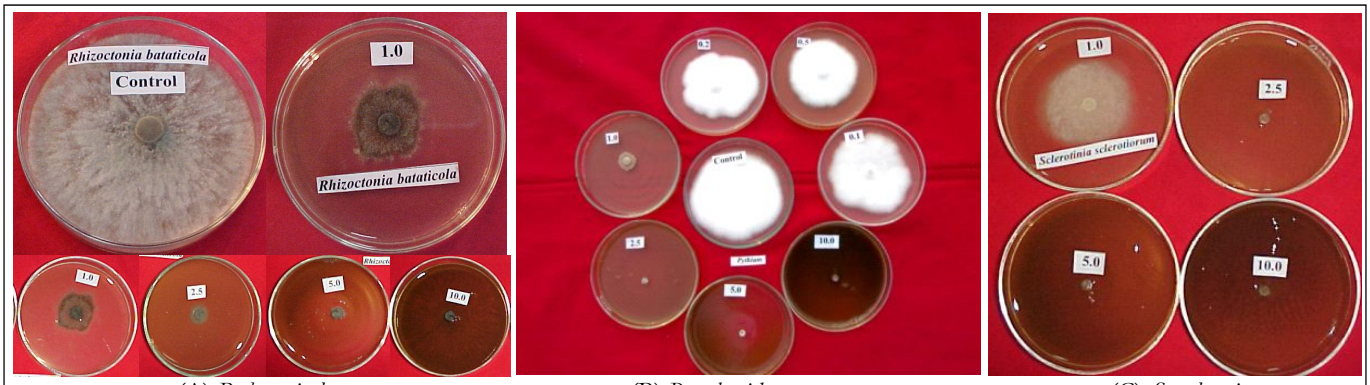
Crude BPF: One percent of crude BPF inhibited more than 70 per cent of *Rhizoctonia bataticola*, around 50 per cent of *Sclerotinia sclerotiorum* and more than 85 per cent of *Pythium aphanidermatum* in 5 days (Table 2) (Figure 1). The growth of Pythium was inhibited by more than 83 per cent compared with growth in control after 10 days of incubation. At higher concentrations, growth of these fungi was highly inhibited compared to control. Almost 100 per cent inhibition of tested fungi was observed with 2.5 per cent, a slightly higher concentration of BPF.

The EC_{50} value of BPF against *R. bataticola*, *S. sclerotiorum* and *P. aphanidermatum* was found as 11500, 9750 and 4250 ppm, respectively. Although the values seem to be high but the biopesticide formulation is in crude form and is safer to environment.

Organic extracts of BPF: The organic extracts were bio-assayed initially against two fungi *Rhizoctonia bataticola* and *Fusarium oxysporum* at three concentrations, 250, 500 and1000 ppm, but promising inhibition could be observed at higher concentration (Table 3). The ethyl acetate extract gave inhibition of more than 65% and 90% for *R. bataticola*, at 500 and 1000 ppm, respectively, in comparison with 45% and 75% inhibition by hexane extract (Figure 2) for

Table 2: Radial growth inhibition of fungi by BPF

Treatment concentration of formulation (%)	Percent inhibition of pathogens						
	Rhizoctonia bataticola		*Sclerotinia sclerotiorum*		*Pythium aphanidermatum*		
	3 days	5 days	3 days	5 days	3 days	5 days	10 days
0.1	26.2	0.0	21.4	0.0	75.36	59.4	21.0
0.2	28.9	2.0	20.6	1.2	77.26	63.4	22.9
0.5	49.3	7.0	22.7	4.9	76.63	65.8	27.7
1.0	74.5	70.0	65.6	49.1	86.5	84.8	83.4
2.5	88.4	81.5	100	100	100	100	100
5.0	100	82.2	100	100	100	100	100
10.0	100	100	100	100	100	100	100
Check growth	74.7	100	79.1	100	27.1	48.4	100

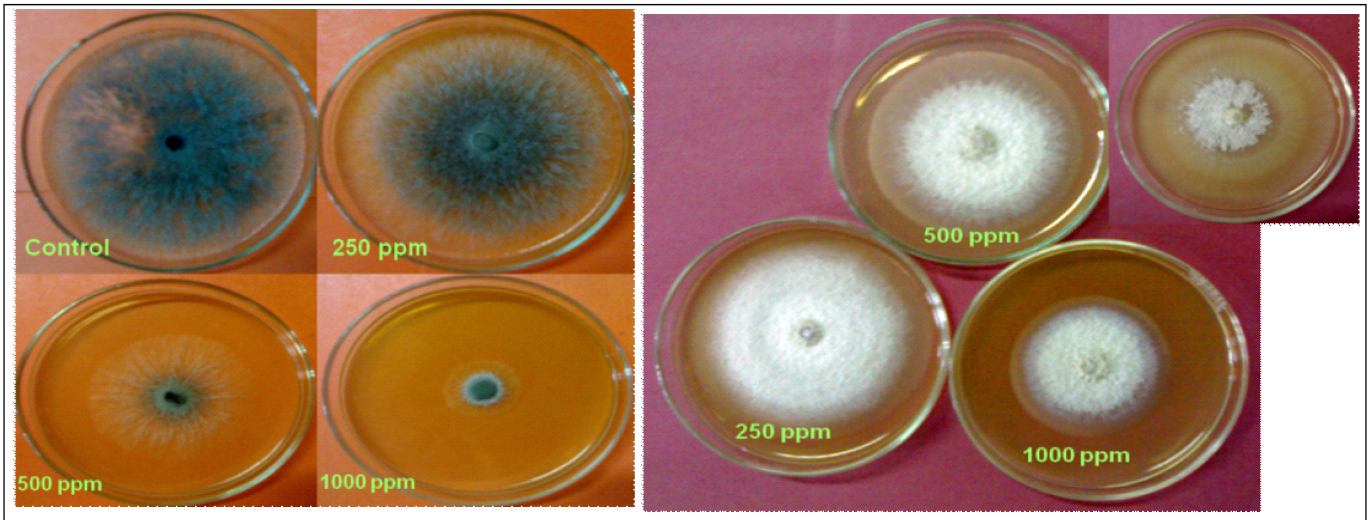


(A) *R. bataticola* (B) *P. aphenidermatum* (C) *S. sclerotiorum*

Figure 1: Inhibition of fungi with crude BPF

Table 3: Radial growth inhibition of fungi by organic extract of BPF

Concentration of BPF extracts (ppm)	Percent inhibition of pathogens			
	Rhizoctonia bataticola		*Fusarium oxysporum*	
	Ethyl acetate extract	Hexane extract	Ethyl acetate extract	Hexane extract
0.0	0.0	0.0	0.0	0.0
250	27.0	23.0	0.0	18.0
500	67.0	45.0	25.0	32.0
1000	90.0	75.0	52.0	60.0



(A) *Alternaria alternata* (B) *P. aphenidermatum*

Figure 2: Inhibition of fungi using hexane extract of BPF

same concentrations against tested fungi. But for *F. oxysporum*, the inhibition was almost similar (50-60%) for both hexane and ethyl acetate extracts at 1000 ppm.

For Fusarium and *R. bataticola,* inhibition was observed only at higher concentrations for the organic solvents. Therefore, the bio-assay experiment was repeated with lower concentrations for other fungi. Both organic solvent extracts were diluted, separately, to 6 concentrations (4, 8, 20, 40, 80 and 100 ppm) using serial dilutions in acetone solvent. The ethyl acetate extract of BPF was again observed to give promising inhibition of the growth of various fungi. 100 ppm (0.01%) of ethyl acetate extract could inhibit more than 78 per cent of Alternaria, around 88 per cent of Sclerotinia and above 55 per cent of Phytopthora (Table 4) (Figure 3), while same concentration of hexane extract could inhibit these fungi only up to 27, 39 and 14 per cent, respectively, against tested fungi (Table 4).

DISCUSSIONS

The BPF had been observed with promising antifungal activity against various plant pathogenic fungi, responsible for important diseases of vegetables and other crops. The ethyl acetate extract of BPF was also observed to give good inhibition of almost all fungi in comparison with hexane extract of same concentrations. The inhibition concentrations of ethyl acetate extract of BPF was calculated using EC_{50} calculator software. The IC_{50} (50% Inhibition concentration) for Alternaria, Sclerotinia and Phytopthora was observed to be 40, 47 and 78 ppm, respectively. The IC_{50} value of this extract is surprisingly low, so highly promising and better than the crude BPF. It is far better than many synthetic pesticides, which leave toxic residues on environment. Statistical analysis of data using SAS package (version 9.2) proved that 2.5, 5.0 and 10 per cent of crude BPF concentrations, did not show any significantly different results. Almost all these concentrations gave 100% inhibition of tested fungi (Table 5). Similarly, 0.1, 0.2 and 0.5% concentrations of crude formulation did not give significantly different inhibition of fungi. But 1% of crude BPF could give significantly different results for fungi inhibition, although it gave best inhibition for Pythium (83%), Rhizoctonia (70%) and Sclerotinia (42%) fungi.

Table 4: Radial growth inhibition of fungi by organic extract of BPF

Treatment concentration of organic extracts (ppm)	Percent inhibition of pathogens					
	Alternaria alternata (10 days)		*Sclerotinia rolfsii* (6 days)		*Phytopthora infestence* (20 days)	
	Ethyl acetate extract	Hexane extract	Ethyl acetate extract	Hexane extract	Ethyl acetate extract	Hexane extract
0.0 (control)	0.0	0.0	0.0	0.0	0.0	0.0
4.0	26.3	0.0	22.7	0.0	14.3	0.0
8.0	27.7	0.0	25	0.0	42.3	0.0
20.0	36.9	5.3	27.6	4.8	43.4	0.0
40.0	42.1	8.4	33.3	17.8	43.8	4.9
80.0	61.2	17.9	81.2	33.7	49.3	10.1
100.0	78.3	27.4	88.1	39.0	56.2	14.0
Inhibition concentration (ppm) for ethyl acetate extracts						
IC_{50}	40		47		78	
95% confidence intervals	35.8 - 44.1		35.2 – 62		77.6 - 94	
IC_{10}	14		14		5	
IC_{20}	21		22		14	

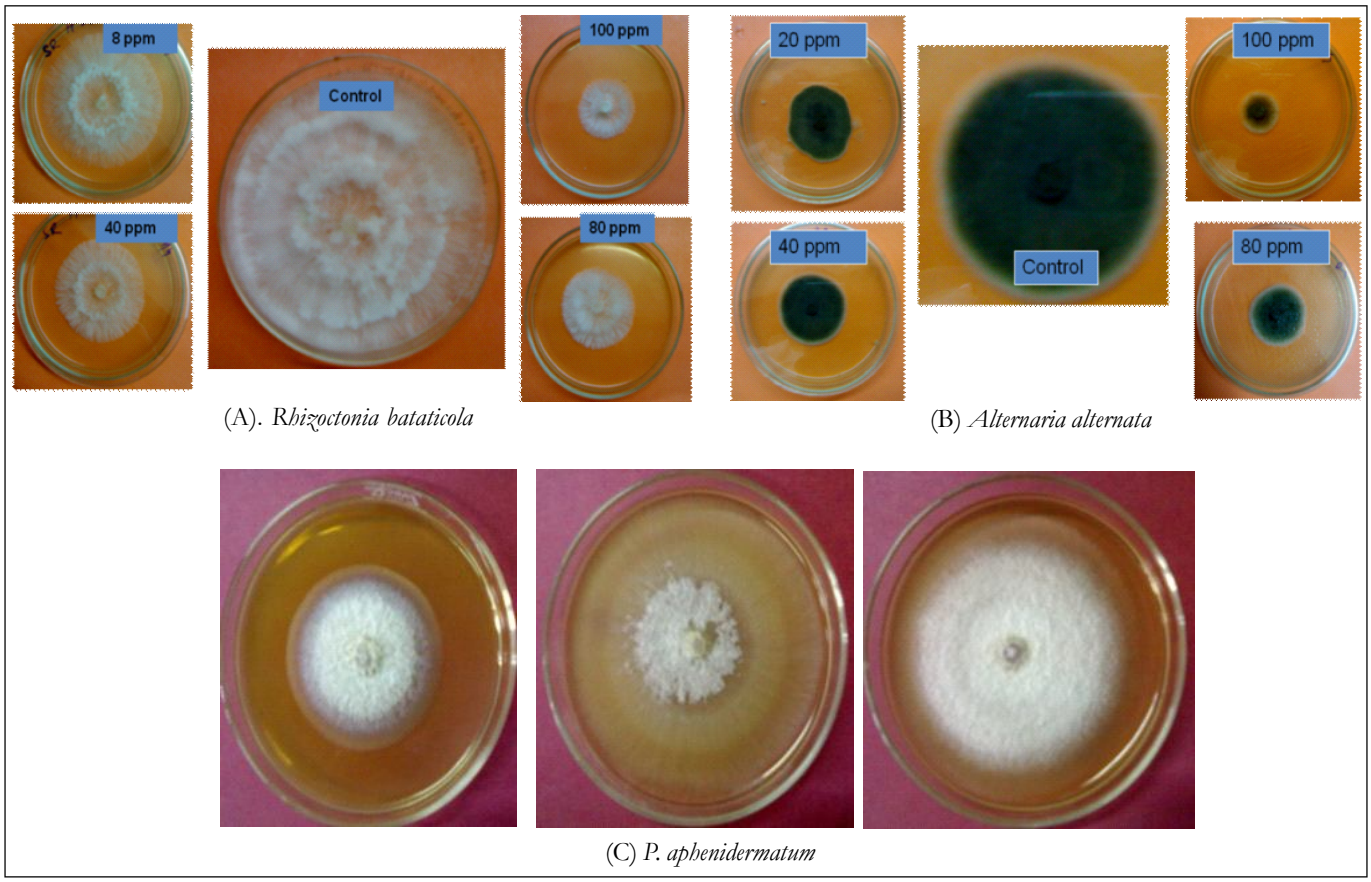


Figure 3: Inhibition of fungi using ethyl acetate extract of BPF

Table 5: Statistical analysis of bio-assay of crude biopesticide formulation

Concentration (%)	*Rhizoctonia bataticola*			*Sclerotinia sclerotiorum*			*Pythium aphenidermatum*	
	t Grouping	Mean	N	t Grouping	Mean	N	t Grouping	Mean
10	A	100.0000	5	A	100.0000	5	A	100.000
				A			A	
5	B	81.9000	5	A	100.0000	5	A	100.000
	B			A			A	
2.5	B	81.5000	5	A	100.0000	5	A	100.000
1	C	69.9000	5	B	41.9000	5	B	83.380
0.5	D	0.0000	5	C	0.0000	5	C	22.940
	D			C			C	
0.2	D	0.0000	5	C	0.0000	5	D C	21.080
	D			C			D	
0.1	D	0.0000	5	C	0.0000	5	D	15.380
	D			C				
0	D	0.0000	5	C	0.0000	5	E	0.000

Source	d.f.	Anova SS	Mean Square	F Value	Pr > F
Concentration	7	71748.79375	10249.82768	6596.83	<.0001

Table 6: Statistical analysis of bio-assay of ethyl acetate extract of crude biopesticide formulation

Concentration	*Aletrnaria alternata*			*Sclerotinia rolfsii*		*Phytopthora Infestence*	
	N	t Grouping	Mean	t Grouping	Mean	t Grouping	Mean
100	5	A	78.0000	A	87.8400	A	56.2600
80	5	B	61.4000	B	81.1600	B	49.1000
40	5	C	42.0800	C	33.4000	C	43.4800
20	5	D	36.8000	D	27.8600	C	43.4200
8	5	E	27.5000	E	25.6200	D	41.9200
4	5	F	25.7000	F	22.5400	E	14.3400
0	5	G	0.0000	G	0.0000	F	0.0000

Source	d.f.	Anova SS	Mean Square	F Value	Pr > F
Concentration	6	19334.48171	3222.41362	3987.43	<.0001

The promising bioactivity of ethyl acetate extract shows the bio-active ingredients present in this formulation are polar in nature, which got extracted in polar organic solvent, ethyl acetate, not in hexane, a non polar solvent. All concentrations of ethyl acetate extract of crude BPF were found significantly different from each other for all tested fungi, as per statistical analysis using SAS software. But 100 ppm of ethyl acetate extract gave best inhibition for all tested fungi, i.e. 78% for Alternaria, 88% for Sclerotinia and 56% for Phytopthora fungi (Table 6).

As per Arden and Alan (1986), pest control measure should not aggravate other pest problems in the operation, and when possible should compliment other production practices. The control measure must not be too complicated or dangerous to use and cost of control measure must be less than the expected return. To supplement these principals, the BPF and its organic extracts fits well to have all expectations desired from an ideal pesticide. The BPF comprised of easily accessible botanicals, which are reported for their bioactivity against various plant pathogens. Bio-pesticides can be effective in small quantities and decompose quickly, when used as a component of IPM programs. Allan *et al.* (2008) reported that allicin from garlic effectively controlled seed-borne *Alternaria spp.* in carrot, Phytophthora leaf blight of tomato

and tuber blight of potato as well as Magnaporthe on rice and downy mildew of Arabidopsis. The effect of crude extracts of neem (*Azadirachta indica*) leaf, neem seed and garlic (*Allium sativum*) at concentrations ranging from 5% to 30% of the material in 100 ml of Potato Dextrose Agar on mycelial growth of *Fusarium oxysporum* f. sp. *lycopersici* was assessed. All the extracts inhibited mycellial growth at various levels. Dry neem seed extract gavel 100% inhibition of mycelial growth (Ogechi and Marley, 2006).

The plant pathogenic fungi like *F. oxysporum* and *A. alternata* are causal agents for seed borne and various rot diseases in plants resulting in deterioration of fruits and vegetables. *F. oxysporum* is transferred from seed to soil and penetrates the soil for longer or shorter period and then to host as local or systemic infection. The fungus is responsible for basal rot potential of soil under field conditions (Mukerji, 2004), so needs to be controlled, for which BPF may be used as ideal pesticide.

Besides its antifungal activity, the BPF was also bio-assayed against insect pests under laboratory as well as field conditions especially for tomato crop for two seasons. This formulation was observed to control 70-80 per cent of fruit borers in tomato field crop, as compared to check plots resulting in enhanced fruit yield of 35 t/ha as compared to 15 t/ha in check plots, with zero inputs (Arora *et al.,* 2012). The BPF was analyzed for its nutrient analysis based on its amazing performance at lab and field levels. It was observed to be a plant growth regulator based on its report (Table 7). The impact analysis of this formulation in terms of its economics and environmental safety was found far better than treatments using conventional pesticides application and even organic treatments.

There is further scope for isolation and characterization of chemical constituents responsible for bioactivity against crop pests. But our main aim is to replace the synthetic pesticides with biopesticides so as to reduce load of hazardous pesticides on environment. Moreover there is need to recognize our old wisdom, the indigenous technical knowledge, lying for past many years and validate them scientifically.

Table 7: Report of nutrient analysis of 001 cow urine based formulation

Macronutrients	Available element in soluble ionic form
N (nitrogen)	37900 ppm (3.79%)
K (potassium)	8250 ppm (0.8%)
Micronutrients	
Zn	4.36 ppm
Cu	0.27 ppm
Fe	45.3 ppm
Mn	5.75 ppm
Mg	76.4 ppm
Other secondary nutrients	
Ca	60.9 ppm
Na	1631 ppm
The amount of micro-nutrients available to plants is	
Zn	1.00 ppm (<0.6 ppm, it is said to be deficient in zinc)
Cu	0.5 ppm (<0.2 ppm, it is said to be deficient in copper)
Fe	10-15 ppm (<4.5 ppm, it is said to be deficient in iron)
Mn	5.00 ppm (<2.0 ppm, it is said to be deficient in manganese)

CONCLUSION

The indigenous formulation BPF and its organic extracts were observed to give promising results in controlling major and important pathogens of crop plants. There is lot of scope for its bioactive extracts for further work on same lines. The technique may be validated against other pathogens, as it is economical, socially acceptable, leaves no toxic residues in environment, uses easily accessible inputs and therefore can strengthen National IPM programs. Inclusion of such knowledge in pest management programs may be assured as they affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides. Moreover, this kind of work can save animals, like cow, for valuable products derived from it, which not only have medicinal properties but also bioactive molecules for plant protection.

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Development of Test to Measure Knowledge Level of Farmers Producer Organization members about Improved Hill Agricultural Practices

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ABSTRACT

A test was developed to measure the knowledge level of Hill farmers of Uttarakhand about improved agricultural Practices. The items on improved hill agricultural practices were taken from experts and literature reviews. Total 30 items were selected first and then again it was administered to other group of experts, having experience about hill agriculture. Based on experts responses 25 questions were selected. These 25 questions were administered to 96 farmers. Finally, 15 knowledge items were included in the final format of the knowledge test based on the difficulty index (43 to 79), discrimination index (0.242 to 0.606) and point-biserial correlation coefficient (0. 268). This final knowledge test was administered to 35 hill farmers for assessing the reliability of the test. The reliability of the knowledge test was measured by Kuder-Richardson Formula 20 and reliability coefficients were found 0.654. The test battery was used for assessing the knowledge level of Hill based FPO members and found that the majority of the respondents (34.3%) were in medium knowledge level followed by high 28.6 per cent.

Keywords: Difficulty index, Discrimination index, Reliability, Kuder-Richardson formula 20, Farmers producer company

INTRODUCTION

Hill agriculture is different from agriculture at plains, regarding climate, land type, altitude, crops grown etc. Apart from the climatic and geographical factors, fragmented land holding, harsh climate, lack of inputs and, non-adoption of improved agricultural practices are the important factors responsible for its low productivity. Hill rural areas offer most harsh working and living conditions for its inhabitants. Due to geographical condition, only a small per cent of area in hills is available for cultivation. In hills, about 75-85 per cent of the inhabitants depend on agriculture for their livelihood. Thus, the per capita availability of arable land is extremely low in hills in spite of very low population density (Partap, 2011; Chandra *et al.*, 2018a). Besides these rapidly increasing incidences of wildlife menaces (Mukherjee, 2015); sloppy marginal, fragmented and scattered lands have made hill agriculture unsuitable for practicing modern farming methods (Partap, 1999; Mukherjee *et al.*, 2016).

Improved agricultural technologies suitable for North Western Himalayan hills have already been developed through continuous research and further assessment and refinements of technologies are going on through deliberate extension efforts by ICAR-VPKAS. For the development and improvement in hill agricultural practices dissemination of knowledge and awareness is crucial. For this, the institute has taken up several extension activities such as trainings, FLDs, farmers interaction meets, Farmer fair etc. Modern Agricultural Technologies over the period have potential to transform the village economy if sincere efforts are made to transfer these technologies to the field. In this modern era of agriculture a progressive farmers in the hilly areas required to have knowledge on every aspect of improved hill farming practices (Chandra *et al.*, 2018b). This may increase the agricultural yields of the area and provide food and nutritional security to the rural families.

'Knowledge - cognitive behaviour of human' is acquired when an individual is exposed to an innovation and gains some understanding of its use. Seeking of knowledge is very natural for an individual and it is highly related to the social system to which the individual belongs. An individual tends to retain the knowledge which are

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consistent with one's existing attitudes and beliefs and avoid those which are not in line with them. At the same time, a felt need may be a motivating factor for an individual to develop knowledge about an innovation.

The producer company concept has emerged as a new generation farmer's organization in India. It was introduced in 2002 as a new part IX A in to the Companies Act 1956 under the chairmanship of economist (Alagh, 2007; Singh, 2008 and Mukherjee *et al.,* 2018a). Since then Indian farmers got a new opportunity to start expedition towards livelihood sustainability (Mukherjee *et al.,* 2018b). The main objectives of Producer Company are procurement of inputs, production, harvesting, grading, pooling, handling, storage, marketing, selling or exporting the primary produce of the company members or import of goods or services for them in addition, processing of produce of members, manufacturing, sale or supply of machinery, consumables, conducting training and awareness programme, insurance of crop and livestock and providing guidance for efficient natural resource management etc to members (ASA, 2009; Chauhan, 2015). There are several FPCs working in India. More than fifty are working mainly in hilly region. There is a basket of technology available in hill agriculture capable of transforming its complex, diverse and risk-prone nature to a profitable and productive nature. These technologies are developed considering the mind set up of the hill farmers. Hill farmers are key stakeholders of agricultural system and critical end users of technology (Kumar *et al*., 2018). The farmers of hill region are in a serious need of applying these improved agricultural technologies in their fields to change their major man-made ill fate. Extension agencies are trying their level best to inform and make farmers aware about the latest advances in agricultural research to change their behaviour. Hill farmers are highly experienced and they are very much used to traditional farming. If there is a blend of traditional farming with modern farming made in hills, then there is no doubt that hill farmers will be benefitted at their best through more remuneration and yield. It is not that the farmers of hills do not know anything about modern agricultural technologies but there must be a level which needs to be identified for better planning of development programmes. In this regard, there is a need to understand the existing knowledge level of farmers to identify the strong and weak areas. The strong areas need to be exploited and the weak areas need to be developed for further adoption of the technologies. For this reason, a standardized knowledge test is very much required to test the knowledge level of farmers. There are many standardized knowledge test already available in the field of extension. But they are very much general in nature. So there is a requirement for a specific knowledge test for hill farmers. In the present study, an attempt has been made to develop a standardized knowledge test for the members of Mahila Umang Producers Company, Almora regarding improved agricultural practices. Mahila Umang Producer Company is established at Almora district of Uttarakhand, India. The organization is fully operated by the hill women of Uttarakhand. There were 1464 members associated in this company. The company was established as a formal Farmer Producer Company in the year 2009 by the help of the promoting Non-government Organisation 'Grassroots'. Before that it was working as a conglomerate of SHGs. Umang started the journey with the hand holding of Grassroots which helped them a lot to mobilize the hill women to explore their potential. Umang is working with 208 SHGs in 100 villages. The villages are selected based on the watershed area. There are 12 watershed area in which a range of 11-22 SHG each are formed. As the FPO, Mahila Umang Producer Company working on hill agriculture the knowledge on improved hill agricultural practices can help them a lot in crop production and protection. To study the level of knowledge of the members of the FPO the present study was conducted

MATERIALS AND METHODS

For developing a specialized knowledge test for improved hill agricultural practices, the procedure followed by Yadav *et al.* (2009) was adopted with desired modification.

Collection of items: Items about improved hill agricultural practices were collected from the pertinent literature, personal experience, discussions held with the experts and pilot study conducted in the area of investigation. Finally 30 items covering all the knowledge aspects of hill agricultural practices were collected. The items were edited and drafted in such a way that each item highlighted only one idea and did not have any ambiguity and with a logical sequence.

Jury opinion: These 30 items were sent to the experts. The experts were requested to check each item carefully whether the items were really capable to measure the knowledge of the respondents about improved hill agricultural practices considered or not. They had been given full liberty to add / delete or modify those item/ items based on the suitability. After considering the opinion

of the experts, 25 items were retained in the final knowledge test.

Item analysis: The item analysis was done based on three kinds of information viz., index of item difficulty, index of item discrimination and index of item validity.

The index of item difficulty indicated the extent to which an item was difficult to understand while the index of item discrimination was to find out whether an item really discriminated a well-informed farmer from a poorly informed one. The index of item validity provided the information on how well an item measured or discriminated in agreement with rest of the test. The 25 items were administered to 96 identical respondents who were not included in sample but they were included in pre-testing. The whole test was consisting of multiple choice questions, fill in the blanks and true false. Each question was having two response categories either correct or wrong. Each correct answer was given '1' score while wrong answer was awarded '0' mark. Thus total score secured by all individual respondents on 25 items for correct answers was the knowledge score.

The scores obtained by 96 identical respondents were arranged in descending order and divided into six group's i.e. 16 respondents in each group. The groups were named as G1, G2, G3, G4, G5 and G6. For the purpose of item analysis, the middle two groups G3 and G4 were eliminated keeping four extreme groups with high and low scores. The data containing to the correct response for all the items in respect of these four groups were tabulated for calculating the difficulty and discrimination indices.

Item difficulty index (P): The index of item difficulty was worked out as the percentage of the respondents answered on items correctly. The assumption behind this item difficulty index was that the difficulty is linearly related to the level of respondents' knowledge about improved hill agricultural practices. It was assured that when a respondent answered any item, the item was less difficult than his ability to cope with it. In this study with this assumption, the items with P values ranging from 43 to 79 were considered for final selection of knowledge battery. It was calculated by following formula:

$$P = \frac{\text{No. of respondents answered correctly}}{\text{Total no. of respondents}} \text{ X } 100$$

To illustrate, P let us take one example from item no.10 (Table 1) was worked out in this way

$$P = \frac{76}{96} \text{ x } 100$$

P = 79.20 per cent of respondents answered correctly

Discrimination index (E1/3): The second criterion for item selection was the discrimination index which is indicated by E1/3 values of item. In the present study, the items with E1/3 values ranging between 0.242 to 0.606 were considered for final selection. This index (E1/3) was calculated by the following formula:

$$E1/3 = \frac{(S1+S2) - (S5+S6)}{N/3}$$

Where, S1, S2, S5 and S6 are frequencies of correct answer in the group of G1, G2, G5 and G6, respectively.

N= Total number of respondents in the item Analysis

To illustrate, E1/3 let us take one example from item no.21 (Table 1) was worked out in this way

$$E1/3 = \frac{14 - 12}{33}$$

E1/3 = 0.601

Biserial correlation*:* For the purpose of judging the validity of test items, point biserial correlation was done. The criterion of validity is regarded as internal consistency that is the relationship of total score to a correct / incorrect response to any given item. It was worked by the following formula suggested by Guilford and Fruchter (1978).

$$r_{pbi} = \frac{\overline{X_p} - \overline{X_q}}{S_t} * \sqrt{p * q}$$

Where,

r_{pbi} = Point-biserial correlation coefficient

$\overline{Xp}$ = Mean score on continuous variable of successful group on dichotomous variable

$\overline{X_q}$ = Mean score on continuous variable of unsuccessful group on dichotomous variable

St = Standard deviation on continuous variable for total groups

p = Proportion of respondents who answered correctly on dichotomous variable

q = Proportion of respondents who answered wrong on dichotomous variable

As for example, point biserial correlation was worked out for the item no.22 (Table 1) the following way

$$0.521 = \frac{0.813 - 0.406}{0.448} * \sqrt{0.8 * 0.4}$$

The item with rpbi value more than or equal to 0.268 was considered for the selection in the final knowledge test. Finally, 15 items were selected in the knowledge test by considering the objective criteria as stated above.

Representative of the test: Though, the above-mentioned criteria were the main contemplations for the final selection of the knowledge items, thus far, care was taken not to eliminate the important aspects if any as a test item. For this purpose experts' opinion about the items was reconsidered. Thus, in light to the four criteria, described above, 15 items were finally selected, which formed actual (final) format of the knowledge test.

Reliability: The Kuder-Richardson method was used to estimate the reliability of the knowledge test by using their formula known as Kuder-Richardson Formula 20 (Guilford and Fruchter 1978). The reliability coefficient of the test was found to be 0.654, which was also found to be significant.

$$r_{tt} = \left(\frac{n}{n-1}\right)\left(\frac{s_t^2 - \sum pq}{s_t^2}\right)$$

Where,

r_{tt} = reliability coefficient of the test

n = number of items in the test

p = proportion of respondents who answered a test item correctly

q = 1-p

s_t^2 = variance of the test

The reliability coefficient provides an estimate of the internal consistency of the test and thus the dependability of the test scores. On the basis of reliability coefficients determined by the methods indicate that this knowledge test is quite reliable.

Validity: The biserial correlation (rbis) was considered as a measure of test items validity. Highly significant biserial correlation coefficient (rbis) values proved the construct validity of the items included in knowledge test battery.

Method of scoring knowledge: The final knowledge test had 15 items relating to improved hill agricultural

Table 1 : Difficulty index, discrimination index and point-biserial correlation coefficient of knowledge items related to improved agricultural practices

S.No.	Knowledge Items	Difficulty Index (P)	Discrimi-nation Index (DI)	Point-biserial correlation coefficient (rpbi)
1	Recommended dose of Nitrogen per hectare for irrigated rice cultivation in Mid-Hills of Uttarakhand	23.96	0.576	0.000
	a. 20 kg b. 50 kg c. 70 kg d. 100 kg			
2	Pre emergence weedicide for rice	20.83	0.485	0.000
	a. 2-4-D b. D D T c. Butachlor d. Glyphosate			
3*	Seed rate of Rain fed rice crop in Uttarakhand per hectare	45.83	0.606	0.535
	a. 100 kg b. 250 kg c. 350 kg d. 500 kg			
4	Name two varieties of rice suitable for rain fed condition in hills	32.29	0.818	0.000
5	Name two varieties of rice suitable for irrigated condition in hills	32.29	0.818	0.000
6*	Which of the following long day onion variety is suitable for hills	72.92	0.606	0.865
	a. Nasik Red b. Pusa Red c. VL Pyaj-3 d. Arka red			
7	What should be done to ward off Damping off disease in vegetable crops	21.88	0.212	0.105
	a. Seed treatment with Thiram/captan 2-3 gram/kg seed			
	b. soil treatment with Thiram/captan 5-6 gram/square meter soil			
	c. Carbendazim 1gm/liter of water			
	d. All of these can be applied as per need			

Table 1 contd.....

S.No.	Knowledge Items	Difficulty Index (P)	Discrimi-nation Index (DI)	Point-biserial correlation coefficient (rpbi)
8	What is the seed rate of garden pea per hectare	12.50	0.121	0.000
	a. 55 kg b. 60 kg c. 75 kg d. 80 kg			
9*	Select the best combinations of vegetable crops suitable for poly house condition in hills	79.17	0.515	0.901
	a. Wheat, Pigeon pea, Mustard c. Millets, Soybean			
	b. Cauliflower, Okra, onion d. Tomato, Capsicum, Cucumber			
10*	Best time of sowing for Fenugreek in mid-hills	79.17	0.242	0.478
	a. July-Aug. b. Oct-Nov. c. March-April d. April-May			
11*	Seed rate of Cauliflower per hectare	57.29	0.303	0.402
	a. 100-200 gm b. 375-400 gm c. 75-100 gm d 80-150 gm			
12*	Best time of sowing for Pigeon pea in hills			
	a. 10 July-5 Aug. b. 20 Oct.-30 Nov. c. 20 May	39.58	0.394	0.365
	b. – 10 June d. 15 March- 10 April			
13*	Best time of sowing for Field pea in hills	40.63	0.424	0.268
	a. First fortnight of May c. First fortnight of July			
	c. Second fortnight of October d. Second fortnight of March			
14*	Name one variety of Pigeon pea suitable for rain fed condition in hills	32.29	0.394	0.291
15*	Name one variety of Field pea suitable for rain fed condition in hills	50.00	0.455	0.429
16	What should be the spacing of Pigeon pea	22.92	0.303	0.114
	a. 25*10 cm b. 35*20 cm c 45*30 cm d. 45*20 cm			
17	What should be the spacing of Field pea	45.83	0.182	0.148
	a. 20*10 cm b. 30*10 cm c 40*10 cm d. 50*10 cm			
18*	Best time of sowing for Wheat in hills	83.33	0.394	0.846
	a. First fortnight of May c. First fortnight of July			
	b. Second fortnight of October d. Second fortnight of March			
19*	Seed rate of Wheat per hectare in hills	69.79	0.333	0.537
	a. 100 kg b. 250 kg c. 350 kg d. 500 kg			
20	Which of the following chemicals is effective against smut disease of wheat	19.79	0.030	0.018
	a. Azoxystobin b. Sufosulfuran c. Butachlore d. Imidaclorprid			
21	If only one irrigation is available for wheat then what will be the schedule	45.83	0.061	0.051
	a. 40-50 DAS b. 25-35 DAS c. 10-15 DAS d. 7-10 DAS			
22*	White grub affects which of the following crop	71.88	0.394	0.521
	a. Rain fed rice b. irrigated rice c. both d. none			
23*	Blister beetle is pest of	44.79	0.576	0.456
	a. Pigeon pea b. okra c. beans. d. all			
24*	Fruit borer attacks tomato crop	86.46	0.242	0.591
	a. yes b. no			
25*	Aphid is a devastating pest for cauliflower and Mustard	80.21	0.303	0.604
	a. yes b. no			

Note: * indicates the items selected in final knowledge test

practices. Equal weightage was given to each item. For correct answer '1' score was awarded and '0' for wrong answers. Thus, knowledge test was ready for administering to the actual respondents.

Administration of the knowledge test Items: For easy to understand by the farmers the knowledge test instrument was translated in Hindi (common language). The test instrument was administered to the 35 member farm women of Mahila Umang Producer Company by following personal interview method. During the test care was taken to reduce the influence of interviewers and colleagues.

RESULT AND DISCUSSION

The test was administered to 35 members of Mahila Umang Producers Company the results are described at Table 2. There were three questions regarding seed rates of crops. Majority of the respondents (more than 70%) answered those questions correctly. In case of variety related queries 65.7 to 68.6 per cent of the respondent answered

Table 2: Knowledge score of hill farm women associated with Mahila Umang Producers Company

S.No.	Knowledge Items	Score of Umang FPC members (n=35)
1	Seed rate of Rain fed rice crop in Uttarakhand per hectare	28 (80.0%)
	b. 100 kg b. 250 kg c. 350 kg d. 500 kg	
2	Seed rate of Cauliflower per hectare	25 (71.4%)
	b. 100-200 gm b. 375-400 gm c. 75-100 gm d 80-150 gm	
3	Seed rate of Wheat per hectare in hills	34 (97.1%)
	b. 100 kg b. 250 kg c. 350 kg d. 500 kg	
4	Which of the following long day onion variety is suitable for hills	24 (68.6%)
	b. Nasik Red b. Pusa Red c. VL Pyaj-3 d. Arka red	
5	Name one variety of Pigeon pea suitable for rain fed condition in hills	24 (68.6%)
6	Name one variety of Field pea suitable for rain fed condition in hills	23 (65.7%)
7	Select the best combinations of vegetable crops suitable for poly house condition in hills	28 (80.0%)
	c. Wheat, Pigeon pea, Mustard c. Millets, Soybean	
	d. Cauliflower, Okra, onion d. Tomato, Capsicum, Cucumber	
8	Best time of sowing for Fenugreek in mid-hills	26 (74.3%)
	b. July-Aug. b. Oct-Nov. c. March-April d. April-May	
9	Best time of sowing for Pigeon pea in hills	21 (60.0%)
	c. 10 July-5 Aug. b. 20 Oct.-30 Nov. c. 20 May – 10 June d. 15 March- 10 April	
10	Best time of sowing for Field pea in hills	23 (65.7%)
	d. First fortnight of May c. First fortnight of July	
	e. Second fortnight of October d. Second fortnight of March	
11	Best time of sowing for Wheat in hills	29 (82.8%)
	c. First fortnight of May c. First fortnight of July	
	d. Second fortnight of October d. Second fortnight of March	
12	White grub affects which of the following crop	33 (94.3%)
	b. Rain fed rice b. irrigated rice c. both d. none	
13	Blister beetle is pest of	20 (57.14%)
	b. Pigeon pea b. okra c. beans. d. all	
14	Fruit borer attacks tomato crop	23 (65.7%)
	b. yes b. no	
15	Aphid is a devastating pest for cauliflower and Mustard	18 (51.4%)
	b. yes b. no	

correctly. For the questions regarding sowing time, the responses were mixed. The more accurate answers were found in case of sowing time of wheat (82.8%), followed by Fenugreek (74.3%), Pigeon pea (65.7%), Field pea (60.0%). Similar responses were also found in case of pest and disease related questions. The highest score was obtained for the question related to White grub attacks (94.3%) followed by fruit borer attack (60 5.7%); and knowledge about blister beetle 57.14 per cent.

Table 3: Categorization of Umang FPC farm women based on knowledge level

Knowledge level	Frequency	Percentage
Very high (81-100%)	7	20
High (61-80%)	10	28.6
Medium (41-60%)	12	34.3
Low (21-40%)	5	14.3
Very low (0-20%)	1	2.8

The Table 3 indicates the categorisation of the Mahila Umang Producers Company members based on their knowledge level. It was found that the majority of the respondents were in medium category i.e. 34.3 per cent, followed by high 28.6 per cent, very high 20 per cent and low 14.3 per cent. Only one member was found with very low score falls under 2.8 per cent. The Mahila Umang Producers Company is mainly focused on the crops of traditional hill crops such as finger millets, barnyard millets and pulses other than the main staple cereal crops like rice, wheat and maize. Therefore it is very much important for the members to have sufficient knowledge regarding the improved hill agricultural practices. As per the test, only 20 per cent of the respondents scored more than 80 and were fall in very high category. The FPO with commercial outlook needs to enhance its member's knowledge through continuous training and meetings with farm women regarding the activities of agriculture and traditional hill crops. Generally three to five days on-campus trainings in KVKs, ICAR institutes or in agricultural universities can be better to have hands-on experience about the improved hill agricultural practices.

CONCLUSION

The climatic condition of hills is different from plains and thus hill agriculture differs much with plains. In the harsh environment of hill several FPOs are working with hill women for their empowerment. To know about the knowledge levels of hill farm women regarding improved hill agricultural practices a knowledge test has been developed which consists of 15 test questions. The difficulty index of the knowledge test 43 to79 the discrimination index 0.242 to 0.60 6 and point biserial correlation coefficient was 0.268. The reliability of the test was found quite well with KR Formula 20 value 0.654. Using that is battery, it was found that the members of FPO, Mahila Umang Producer Company have moderate to high level of knowledge about improved Hill agricultural practices. There is need for practical field based trainings for improving the status from moderate to very high. In future several other studies can be conducted on their knowledge level about processing, climate change, health and nutrition.

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Determinants of Adoption of drip irrigation system in Maharashtra

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ABSTRACT

Micro irrigation is a proven workable technology for efficient use of groundwater, recognizing this Government of India launched the Centrally Sponsored Scheme on Micro Irrigation in 2006. However, issues relating to its pattern of development and inclusiveness have not been fully investigated, therefore, this study aimed to assess spatial and temporal development of drip irrigation system, and adoption behavior of farmers in Maharashtra state. The results show that there is a notable growth in area under drip irrigation across the country, particular as a result of scheme on micro irrigation. It has been observed that the adoption of drip irrigation is not inclusive but favouring large farmers. Declining water table and allocation of sizable area under horticultural crops were identified as key factors determining adoption of drip irrigation system, and as the farmers' preference to adopt as mitigating strategy in view of depleting groundwater resource. Therefore, there is a need to make efforts to achieve inclusiveness particularly by enhancing the rate of adoption of drip irrigation for small and marginal farmers to realize its potential benefits.

Keywords: Adoption, Drip irrigation, Maharashtra, Logit model

INTRODUCTION

Conversation of natural resources through resource conserving and climate resilient technologies is vital for sustaining crop production (Singh *et al.,* 2010; Jasna *et al.,* 2017). The irrigation system in India has undergone drastic changes in the recent past. The most significant changes have been the adoption of micro irrigation on account of scarce water resources and poor water use efficiency in flood irrigation method. To promote micro irrigation, Government of India launched the Centrally Sponsored Scheme on Micro Irrigation in 2006. For enhancing the water use efficiency in agriculture, appropriate technological interventions like drip and sprinkler methods of irrigation were promoted (Narayanamoorthy, 2003 and Kumar and Palanisami, 2011). Scheme on Micro Irrigation was up-scaled to National Mission on Micro Irrigation in 2010 and subsumed under National Mission on Sustainable Agriculture during 2014 and implemented as 'On Farm Water Management'. Further, micro irrigation component of the 'On Farm Water Management' has been subsumed with *Pradhan Mantri Krishi Sinchayee Yojana* from 2015. Evidences show that in India 86.27 lakh ha area was under micro-irrigation in 2016, of which, Maharashtra alone contributed 15 per cent (GOI, 2016). New demand management technologies for water saving such as drip have been introduced in Maharashtra aimed to improve the water use efficiency backed by subsidy programmes. Presently, Maharashtra shares major area under drip irrigation system, however, only few studies have attempted to find the inclusiveness of its adoption under different farm sizes. Therefore, the broad objective of the study is to access the spatial and temporal development of drip irrigation, and to examine the determinants of adoption of drip irrigation.

MATERIALS AND METHODS

Primary as well as secondary data on drip irrigation were utilized. The tabular analysis was used to study the spatial and temporal distribution of drip irrigation in India and beneficiaries of drip irrigation (inclusiveness) among the farm size groups in Maharashtra state. All the farmers were classified into three groups, according to their farm sizes as marginal (up to 1ha), small (1-2 ha) and large (more than 2 ha) categories to examine the inclusiveness of adoption of drip irrigation. For analyzing the determinants of adoption of drip irrigation system and their quantitative significance an appropriate data, model and with a precise definition of adaptor was required. Therefore, the primary data were collected from 80 drip adopter and 40 non-adopter farm households from the purposively selected Jalgoan and Nashik districts of Maharashtra.

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In the present context, drip irrigation adoption is a dependent discrete dichotomous variable. Under such conditions, where the adoption variable is binary (0/1), logit and probit models are most commonly used to analyze technology adoption processes (Aldrich and Nelson 1984; Namara *et al.*, 2007). Therefore, the logit model has been used to explain the drip irrigation adoption process. Assume a latent variable y* raging from -∞ to ∞ that is related to the observed independent variables by the structural equation

$$y_i^* = \alpha + x_i\beta + \varepsilon_i$$

Where i indicates the observation and ε is an error term. The link between the observed binary y_i and y_i^* is made with a simple measurement equation:

$$y_i = \begin{cases} 1, y_i^* > 0 \\ 0, y_i^* \leq 0 \end{cases}$$

Cases with the positive value of y^* were observed as $y = 1$, while the cases with the negative or zero values of y^* are observed as $y = 0$.

$$\Pr(y = 1 \mid x) = \Pr(y^* > 0 \mid x)$$

Substituting the structural model and rearing terms

$$\Pr(y = 1 \mid x) = \Pr(\varepsilon > [\alpha + bx] \mid x)$$

Now, ε is assumed to be follow the logistic distribution, then

$$\Pr(y = 1 \mid x) = \Lambda(\chi'\beta)$$

Λ(.) to indicate the logistic cumulative distribution function

The marginal effect, change in the probability in favour of adoption of drip irrigation in response to a unit change in the explanatory variable, in the logit model for continuous variable is:

$$\frac{\partial Pr(y=1 \mid x)}{\partial x_k} = \Lambda(\chi'\beta)[1-\Lambda(\chi'\beta)]\beta_k$$

The marginal effect (change in the probability in favour of adoption of drip irrigation in response to a change in the explanatory variable from zero to one) for the discrete variable is:

$$\frac{\Delta Pr(y=1 \mid \overline{x})}{\Delta x_k} = Pr(y = 1 \mid \overline{x}, x_k = 1) - Pr(y = 1 \mid \overline{x}, x_k = 0)$$

Some discrete variables, namely nature of the crop; whether a farmer is irrigating seasonal and other types of crops (perennial and other horticultural crops) was considered expecting to have a bearing on the adoption of drip irrigation. Since the pattern of cropping pattern followed by farmers directly determine the demand of irrigation water, which in turn governs the adoption of drip irrigation system. Other binary variables *viz.,* participation in water market and status of farmers whether loan was availed or not were also taken into account to explain the drip irrigation behavior of the farmers. It is expected that as the age of the farmer increases, the adoption of drip irrigation decreases. Similarly, it is also assumed that distance from the market negatively influences the drip irrigation due to poor access to market. Membership of any organization and number of years of schooling is expected to increase the adoption of drip irrigation systems among the farmers. As such age, distance from market, organizational membership and education were made part of the variables.

RESULTS AND DISCUSSION

Spatial and Temporal Development of drip Irrigation in India: The area under drip irrigation was 39.2 lakh ha in 2016 and contributed 45 per cent of total micro irrigated area in India (Table 1). The growth in the drip irrigated area was found to be impressive between 2010 and 2016 and as a result, the area under drip irrigation was more than double during the last six years. State-wise distribution of micro irrigation showed that Andhra Pradesh (including Telangana) accounted highest share (26%) of drip irrigation in the country in 2016 followed by Maharashtra (26%), Gujarat (14%), Karnataka (12%) and Tamil Nadu (8%). However, Maharashtra had the highest (32%) drip irrigated area in 2010. Although, Jharkhand, Bihar, Rajasthan, Madhya Pradesh, West Bengal, Gujarat, Karnataka, Haryana, Tamil Nadu, Punjab and Kerala states witnessed an impressive increase in the area under drip irrigation between 2010 and 2016, the shares of West Bengal, Bihar, Jharkhand, Punjab Kerala, Uttar Pradesh and Odisha states were found to be very poor in total drip irrigated area in the country. It can be concluded that there was an impressive increase in the area under drip irrigation after the launch of National Mission on Micro Irrigation in the country in the country, however this increase was not evenly distributed among the states.

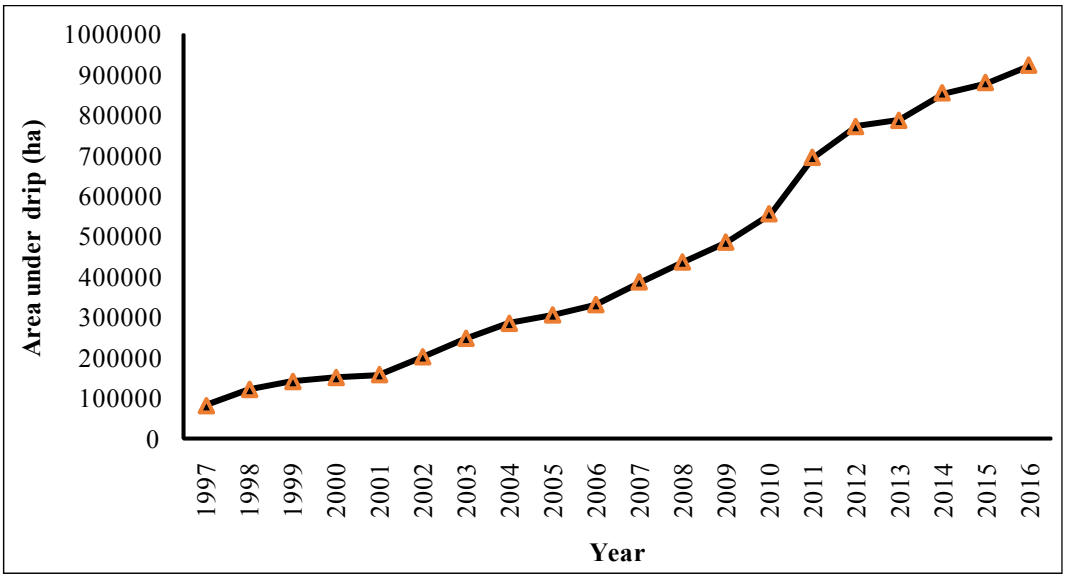
Trend in drip irrigation in Maharashtra: Trend in area under drip irrigation in Maharashtra from 1997 to 2016 is depicted in Figure 1. There was a continuously increasing trend in the area under drip irrigation in the state. However, the impressive increase in drip irrigated area was observed

Table 1: Spatial and temporal development of drip irrigation in India

States	2010		2016		Increase in 2016 over 2010	
	Area (ha)	Share (%)	Area (ha)	Share (%)	Area (ha)	(%)
A.P. & Telangana	505205	26.63	1028347	26.23	523142	103.55
Bihar	301	0.02	9761	0.25	9460	3142.86
Chhattisgarh	6360	0.34	18081	0.46	11721	184.29
Gujarat	226773	11.95	534554	13.64	307781	135.72
Haryana	11351	0.60	24615	0.63	13264	116.85
Jharkhand	208	0.01	10831	0.28	10623	5107.21
Karnataka	209471	11.04	486936	12.42	277465	132.46
Kerala	15885	0.84	22879	0.58	6994	44.03
Madhya Pradesh	51712	2.73	224482	5.73	172770	334.1
Maharashtra	604440	31.86	924446	23.58	320006	52.94
Odisha	11046	0.58	19381	0.49	8335	75.46
Punjab	17925	0.94	34685	0.88	16760	93.5
Rajasthan	30047	1.58	203681	5.20	173634	577.87
Tamil Nadu	153437	8.09	328411	8.38	174974	114.04
Uttar Pradesh	12636	0.67	16809	0.43	4173	33.02
West Bengal	247	0.01	604	0.02	357	144.53
Others	38600	2.03	46777	1.19	8177	21.18
India	1897282	100	3919781	100	2022499	106.6

Source: Ministry of Agriculture & Farmers Welfare, GOI, 2016

Figure 1: Trend of drip irrigated area in Maharashtra



after 2010 after the launch of National Mission on Micro Irrigation. The drip irrigated area in Maharashtra state was 0.82 lakh ha in triennium average ending (TE) 1997 and its contribution to net irrigated area was only 2.08 per cent in the state (Table 2). It has increased to 9.2 lakh ha in TE 2016 and accounted for nearly one-fourth of the net irrigated area in the state. There was a moderate increase in the drip area between 1997 to TE 2006. However, after launch of Centrally Sponsored Scheme on Micro Irrigation in 2006, there was an impressive increase in drip area in the state. A phenomenal rise in net irrigated area dependent on drip irrigation in the state was observed during TE 2010 to TE 2016 i.e., after the launch of National Mission on Micro Irrigation in the country. The compound annual

Table 2: Growth in drip irrigated area in Maharashtra

Year	Drip irrigated area (ha)	Net irrigated area under drip irrigation (%)
TE 1997	81989	2.08
TE 2000	151845	3.85
TE 2006	332190	8.42
TE 2010	556871	14.11
TE 2016	924446	23.42
Compound annual growth rate (%)		
1995-2005	16.59	
2006-2016	11.22	

growth rates during 1995-2005 and TE 2006-2016 were found to be impressive and recorded as 17 and 11 per cent, respectively.

Distribution of drip beneficiary farmers in Maharashtra: Total drip beneficiary farmers were 1.64 lakh during 2006-07 to 2016-17 in Maharashtra. The farm size-wise distribution of the drip beneficiary farmers in the state was highly inclined towards the small and large farmers. Out of the total, marginal beneficiary farmers were only 25 per cent, whereas small beneficiaries were 41 per cent and other (semi- medium, medium and large) were 34 per cent (Table 3). This is important to note that in Maharashtra state, marginal farmers were 49 per cent, small were 30 per cent and others were only 21 per cent in 2011-12. Further, there was a wide fluctuation in the beneficiaries' farmers over the years in all categories of farmers. Therefore, it is concluded that there was a highly skewed distribution of drip beneficiary farmers toward small, medium and large categories of farmers in the state.

Determinants of adoption of drip irrigation: Among the selected farmers, the majority of the drip irrigated farmers were under the category of large farmers (51%) and the non-drip farmers were small and marginal farmers (83%). Drawing upon the extant literatures (Shrestha and Gopalakrishnan, 1993; Skaggs, 2001; Namara *et al.,* 2007) pertaining to adoption of micro-irrigation technologies a host of factors which are expected to influence the adoption of drip irrigation were considered. Table 4 shows that the average size of holding was 2.61 ha, average age of the decision maker was 47.53 years, average the level of education was 7.88 years, and there are around 7 members in each family. The farmers were found to be located in the range of 11 kilometers from nearest market. Further, the average depth of bore-wells was around 130 feet, however, there was considerable variations in the depth of bore-wells as evident by relatively higher value of standard deviation i.e. 34.81. Around 59 per cent of the farmers were found to be growing the seasonal crops. As far as the access to loan is considered surprisingly, 27 per cent of the total farmers were found to be availing the loan facilities. Further, farmers were found to be reluctant to participate in the water markets, and expectedly, this is quite common in the exploited areas wherein most of the farmers do not have surplus water to sale to neighbours. The same is evident from the fact that that merely 11 percent of the farmers were reported to be buying the irrigation water.

Table 3: Farm-size-wise distribution of drip beneficiary farms (No.) in Maharashtra

Year	Marginal	Small	Others	All
2006-07	932 (22.1)	1780 (42.1)	1512 (35.8)	4224 (100.0)
2007-08	2336 (22.2)	5987 (56.9)	2200 (20.9)	10523 (100.0)
2008-09	3884 (34.2)	4275 (37.6)	3211 (28.2)	11370 (100.0)
2009-10	542 (13.9)	1474 (37.9)	1872 (48.1)	3888 (100.0)
2010-11	8741 (33.9)	13241 (51.3)	3818 (14.8)	25800 (100.0)
2011-12	9745 (28.1)	14832 (42.7)	10163 (29.3)	34740 (100.0)
2012-13	4178 (17.7)	8754 (37.0)	10725 (45.3)	23657 (100.0)
2013-14	2147 (20.0)	3278 (30.5)	5317 (49.5)	10742 (100.0)
2014-15	3296 (27.1)	4158 (34.2)	4721 (38.8)	12175 (100.0)
2015-16	3489 (16.0)	7564 (34.7)	10729 (49.3)	21782 (100.0)
2016-17	1174 (21.8)	2156 (40.1)	2044 (38.0)	5374 (100.0)
All	4464(24.6)	67499(41.1)	56312(34.3)	164275(100)

Source: State Agriculture Department, GoM (various issues)

Table 4: Description of the factors affecting adoption of drip irrigation

Variables	Mean	Standard deviation
Age of the farmer (years)	47.53	7.07
Distance from the market (Km)	11.08	3.46
Depth of ground water table (ft)	130.87	34.81
Total number of family member	7.0	2.93
Total operated area (acre)	2.67	4.77
Years of schooling (Years)	7.88	3.03
Dummy for only seasonal crops	0.59	-
Dummy for loan availed	0.27	-
Dummy for water buying	0.11	-
Dummy for membership of institution	0.28	-

The estimates of logit regression of variables like seasonal crop, the depth of ground water table, number of family members, membership of an organization and total cropped area found to be significant (Table 5). Membership of an organization reflects the positive and important role played by the intuitions in enhancing the rate of adoption of drip irrigation by the farmers. The sign for the seasonal crop was negative and significant, which is as per a *prior* hypothesis indicating that the drip is most suited for the perennial and horticultural crops than the seasonal crops. Therefore, it can be stated that the farmers who are having a sizable area under horticultural crops are more likely to adopt the drip irrigation. Similarly, it can be said that as the depth of tube-wells increase, the probability of adoption of drip irrigation system also increases. This can be attributed to the fact that with an increase in the depth of tube well, generally, not only the well yield decreases but the cost of water extraction also increases, and this encourage the farmers to adopt the water-saving drip irrigation. Further, the probability of adoption of drip irrigation was found to be increasing with an increase in the cropped area as expected. However, age and education of the respondents were not having any influence on the adoption of drip irrigation and the similar findings were also reported in Gujarat and Maharashtra (Namara *et al.,* 2007).

The estimates given in Table 5 are interpreted in terms of direction, whether a variable has positive or negative influence on the probability of adoption. The results reveal that probability of adoption of drip irrigation is reduced by 15 per cent if the farmer allocates an additional one ha of land for seasonal crop (Table 6). On the other hand, a unit change (increase) in the value of variables like depth of the ground water table, family members, total operated area and membership of organization would increase the probability of adoption of the drip irrigation in the study area by 7.2, 6.5, 6.9 and 3.5 per cent, respectively.

CONCLUSION

There was an impressive increase in the area under drip irrigation in the recent years in the country as well many states. A phenomenal adoption of drip irrigation was observed in Maharashtra state after the launch of National

Table 5: Logit estimates of factors affecting adoption of drip irrigation

Dependent variable (Drip = 1; Non-Drip = 0)	Coefficient	Standarderror	P>|z|	Odds ratio
Constant	-3.810	2.733	0.163	0.022
Age of the farmer (Years)	-0.018	0.037	0.624	0.982
Seasonal crop (if yes= 1, otherwise 0)	-1.052*	0.579	0.069	0.411
Loan (if yes= 1, otherwise 0)	0.445	0.649	0.493	1.560
Distance from market (km)	0.201	0.090	0.125	1.223
Water buying (if yes= 1, otherwise 0)	-0.817	0.758	0.281	0.442
Ground water table (ft)	0.003*	0.002	0.072	1.003
Family member (No.)	0.239*	0.122	0.065	1.252
Total operated area (ha)	0.174*	0.096	0.069	1.190
Membership (if yes=1; otherwise 0)	1.519**	0.722	0.035	4.571
Numbers of years of schooling	-0.012	0.076	0.876	0.988
χ^2	43.10***			
Number of observations	120			

***, ** and * indicates significant at 1, 5 and 10 per cent level, respectively

Table 6: Marginal effects of selected variables of logit regression

Variable	Marginal effect	Std. error	z	P>z
Age of the farmer (Years)	-0.0031	0.0065	-0.19	0.625
Seasonal crop (if yes= 1, otherwise 0)	-0.1502	0.0922	-1.63	0.103
Loan (if yes= 1, otherwise 0)	0.0742	0.1005	0.74	0.46
Distance from market (km)	0.0355	0.0167	2.12	0.034
Water buying (if yes= 1, otherwise 0)	-0.1673	0.1759	-0.95	0.341
Ground water table (ft)	0.0005	0.0003	1.79	0.074
Family member (No.)	0.0397	0.021	1.89	0.059
Total operated area (ha)	0.0307	0.0152	2.02	0.043
Membership (if yes=1; otherwise 0)	0.2232	0.0876	2.55	0.011
Education	-0.002	-0.002	-0.16	0.876

Mission on Micro Irrigation. However, it is worthwhile to mention that the adoption of drip irrigation system was not inclusive highlighting the fact that the large farmers are harnessing relative higher benefit of the scheme in Maharashtra. Study reveals that decline in water table and higher area under the horticultural crops are the key factor influencing the adoption of drip irrigation. However, the scale of adoption is far less than the desirable level of adoption. Considering the fact that farmers are viewing drip as viable mitigating strategy to sustain the crop production particularly of horticultural crops view of depleting groundwater resource in the study area. Therefore, there is a need to make efforts to achieve inclusiveness of benefits of drip irrigation, and the efforts should be directed to improve of the adoption of drip irrigation particularly for small and marginal farmers to realize its potential benefits.

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Gender Roles of Garo Women in Paddy Cultivation- A Critical Study

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ABSTRACT

Meghalaya being the only matriarchal state of the country, women enjoys more power and decision making capacity as compared to women of rest of the country. About 72 per cent of the total female workers in the state are engaged in agriculture as cultivators and labourers as against 61 per cent of male workers. In addition, about 46 per cent of the cultivators in the state are women; while the corresponding national figure is only 32 per cent. Most of the agricultural operations are performed by women folk in addition to the household chores. The major crops grown in Garo Hills are paddy, maize, cashew nut, betel nut, oranges, pineapple, black pepper and other fruits & vegetables. The study was conducted under University funded research project (IRP) during 2011. The main objective of the study was to study gender roles of the respondents engaged in paddy cultivation. A total of 120 respondents (couple) were selected from four villages (random) from the two randomly selected blocks of West Garo Hills district, Meghalaya. The main findings of the study were that application of FYM (75%), land preparation (65%), seed selection and treatment (39.17%), preparation of nursery (92%), sowing (87%), transplanting of nursery (91.67%), fertilizer application (15%), weeding (83.33%), plant protection measures (5%), harvesting (95.83%), threshing (75.83%), storage of grains (71.67%), sale of produce (38.33%) and adoption of modern technology (18.33%) were performed by farm women in contrast to their spouse. Access and control profile of the respondents showed that except for land preparation, burning of jungle and grain storage, most of the other operations –seed selection (55.3%), sowing/ nursery raising (55.26), harvesting/plucking (72.9%) and threshing (72.63%) are done exclusively or predominantly by women. The study signifies significant but unrecognised contribution of women in major crop cultivation in the selected district of Meghalaya.

Keywords: Gender roles, Paddy cultivation, Women, Meghalaya

INTRODUCTION

Women in Meghalaya are believed to be better placed and to have more autonomy than their counterparts in the rest of the country. Women are respected, honoured and placed in high position. According to the Development Assistance committee (1999) "Gender refers to the economic, social, political and cultural attributes and opportunities associated with being male and female. In most societies, men-women differ in the activities they undertake, in access and control of resources and in participation in decision – making. In most societies women as a group have less access than men to resources, opportunities and decision – making.

Gender issues have been recognized as both indicators of and foundations for effective social and economic development. There is a strong emerging consensus that to achieve sustainability, people-cantered development, progress towards equality in the roles of women and men are essential. The analysis of gender is the commonly accepted term used for studying the role of male and female in intra and inters- household dynamics within a farming system (Feldstein and Poats, 1990).

The labour force participation rate of women is 31.56 per cent as compared to men's rate of 68.44 per cent. Agriculture is the highest employer of women's labour to the extent of 84-97 per cent in India. Farm women carry 75-80 per cent work with 50-66 per cent of them contributing as agricultural labour. Women play active roles in farmstead activities but usually they work behind the scenes and most often their contribution in production goes unnoticed. Various studies conducted in different parts of the country to assess their contribution in farming have shown that they prepare land, carry and apply manure, sow seeds, transplant seedlings, pull out weeds, attend to

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hoeing, harvest crops and stack the hay. They carry thresh, clean, grind, store and cook the grain. They also graze animals, collect fodder, wash cattle, clean sheds, feed animals, milk them, process the product and often take the product for sale. Over the years, the percentage of women in agriculture, both as labours and cultivators has increased from 20 per cent to 32 per cent in the same period. Agriculture, the single largest production endeavour in India, contributing 25 per cent of GDP, is increasingly becoming a Female Activity.

Several farm activities traditionally carried out by men are also being undertaken by women as men are pulled away into higher paying employment. Thus rural India is witnessing a process which could be described as *Feminization of Agriculture*. With these points in mind the study was conducted to analyse the gender roles in paddy cultivation in Meghalaya.

MATERIALS AND METHODS

The study was carried out in West Garo Hills district of Meghalaya State. It was purposively selected because the college is situated in this district. There are six blocks in the revised map of West Garo Hills w.e.f. 2012. Out of these, two blocks i.e. Gambegre and Rongram were randomly selected. From each block two villages were selected randomly. The villages selected were Darak A. Kongre and Chekwatgre from Gambegre and Ganol Songma and Chibragre from Rongram. Since the study was carried out on "Gender Analysis", therefore equal number of male and female respondents was selected. Fifteen number of male and female each (couples) were randomly selected from each of the four selected villages. Thus the total sample size was 120 consisting of 60 male and female each engaged in agriculture. Gender roles were analysed using Harvard Analytical Framework.

Harvard Analytical Framework or Gender Roles Framework or Gender Analysis Framework: The framework consists of a matrix for collecting data at the micro (Community and household) level. It has four interrelated components:

(i) Activity profile- which answers the question, "who does what?", including gender, age, time spent and location of the activity

(ii) Access and control profile- which identifies the resources used to carry out the work identified in the activity profile, and access to and control over their use, by gender

(iii) *Analysis of influencing factors*- which charts factors that influence gender differences in the above two profiles

Data were collected from the respondents by using a structured interview schedule developed for this purpose as per Harvard Analytical Framework. The data was collected through personal face to face interview during the year 2011. The data so obtained were quantified and subjected to statistical analysis for drawing meaningful conclusions.

RESULTS AND DISCUSSION

Gender roles of rural people of West Garo Hills, Meghalaya engaged in paddy cultivation were analysed using Harvard Analytical Framework consisting of 'Activity Profile', 'Access and Control Profile' and 'Analysis of influencing factors'. The results of the study were tabulated and presented for meaningful interpretation.

Table 1: Gender roles of Garo farm women engaged in paddy cultivation

Activity	Frequency (n=60)	Percentage
Land preparation	8	13.33
Seed selection and treatment	49	81.67
Sowing and nursery raising	55	91.67
Transplanting of nursery	56	93.33
Harvesting	52	86.67
Threshing	43	71.67
Storage of grains	17	28.33

Activity Profile: The activity profile of farm women of West Garo Hills district of Meghalaya engaged in paddy cultivation has been presented in Table 1. The results of the table show that except for land preparation and storage of grains, farm women play a major role in all other activities of paddy cultivation. Majority of the respondents are engaged in seed selection and its treatment (81.67%), sowing and nursery raising (91.67%), transplanting (93.33%), harvesting (86.67%) and threshing (71.67%) which highlights their significant contribution in paddy cultivation.

Their male counterparts lend a helping hand in domestic chores and as such they get more time to contribute in agricultural operations. Moreover, land preparation (cutting of jungle) for paddy cultivation being a labour intensive activity is mostly done by males.

Further analysis of the activity profile to study gender roles with respect to their contribution in paddy cultivation is tabulated in Table 2 The results of the table shows their contribution in paddy cultivation with reference to the gender and age.

It can be concluded from this table that land preparation (44 no.) and grain storage (36 no.) is carried out mainly by male respondents particularly the young adults. The contribution of old people is none in case of male while significantly low for female. The main reasons are that they have less energy to carry out these activities and availability of other family members (children and adults) to shoulder the responsibility. The activities that are carried out from being at home are mainly carried out by old females. The contribution of children (male and female) is also low because most of them go to school for education. Only the school drop-outs are involved in these activities.

As far as the number of hours per day is concerned, it can be seen from the data of Table 2 that the hours per day spent by females in these activities are slightly greater than their male counterparts. The reason is that most of the spouse stays at home to take care of the young kids and look after other household chores while wives go out for work for long hours. However, there is no difference in the no. of days spent per season in various activities of paddy cultivation. Most of these activities are carried out within 2-3 kms from their home, which they usually cover by walk while some of the activities like seed treatment, harvesting and grain storage are carried out from the comfort of their homes.

Access and Control Profile: Access and control profile of the respondents with respect to paddy cultivation are depicted in Table 3. The data of this table reveals that access to land preparation is held exclusively by male (72.5%), while access to seed selection and treatment and sowing and nursery raising is held exclusively by female 75.83 per cent and 74.14 per cent respectively.

In case of harvesting, the access is held predominantly by female for majority of the respondents (40.0%). In case of threshing, the access is held exclusively or

Table 2: Gender Analysis of the respondents engaged in paddy cultivation-Harvard Analytical Framework (Activity Profile)

Activity	Male (n=60)			No. of hrs./ day	No. of days/ season	Distance of activity from home (km)	Female (n=60)			No. of hrs./ day	No. of days/ season	Distance of activity from home (km)
	Children	Young	Old				Children	Young	Old			
Land Preparation	16	44	0	7-8	60	2-3	2	8	1	6-7	60	2-3
Seed treatment	0	4	0	1-2	7	0 (at home)	3	49	3	1-2	7	0 (at home)
Sowing and nursery raising	8	7	0	5-6	18	2-3	11	55	1	7-8	21	2-3
Harvesting	12	9	0	4-5	12	2-3	6	52	2	6-7	15	2-3
Threshing	7	4	0	3-4	20	0 (at home)	14	43	2	5-6	30	0 (at home)
Grain storage	11	36	0	4-5	30	0 (at home)	10	17	7	6-7	30	0 (at home)

Table 3: Gender Analysis of the respondents engaged in paddy cultivation-Harvard Analytical Framework (Access and Control Profile) (n=120)

Activity	Access by Gender*					Control by Gender*				
	M	F	F/m	M/f	M/F	M	F	F/m	M/f	M/F
Land Preparation	87 (72.5)	9 (7.5)	2 (1.67)	16 (13.33)	6 (5.0)	68 (56.67)	4 (3.33)	2 (1.67)	41 (34.17)	5 (4.17
Seed treatment	16 (13.33)	91 (75.83)	9(7.5)	0 (0)	4(3.33)	4 (3.33)	72 (60.0)	35 (29.17)	6 (5.0)	3 (2.5)
Sowing and nursery raising	11 (9.17)	89 (74.17)	12 (10.0)	2 (1.67)	6 (5.0)	10 (8.33)	42 (35.0)	47 (39.17)	7 (5.83)	14 (11.67)
Harvesting	27 (22.5)	24 (20.0)	48 (40.0)	6 (5.0)	15 (12.5)	14 (11.67)	56 (46.67)	32 (26.67)	6 (5.0)	12 (10.0)
Threshing	4 (3.33)	56 (46.67)	36 (30.0)	8 (6.67)	16 (13.33)	8 (6.67)	66 (55.0)	28 (23.33)	5 (4.17)	3 (2.5)
Grain storage	26 (21.67)	14 (11.67)	12 (10.0)	61 (50.83)	7 (5.83)	33 (27.5)	12 (10.0)	16 (13.33)	49 (40.83)	10 (8.33)

*M = Exclusively male; F = Exclusively female; F/m = Predominantly female; M/f = Predominantly male and F/M = Equally female/ male
**= Figures in parenthesis indicate percentage

Table 4: Gender Analysis of the respondents engaged in paddy cultivation-Harvard Analytical Framework (Analysis of influencing factors)

Constraints	Frequency	Percentage	Opportunities	Frequency	Percentage
Women doesn't have skill to climb trees for cutting and jungle clearing	105	87.5	The cutting or burning paddy field & grain storage is mostly done by male	110	91.67
Males doesn't have skill in seed selection and its treatment	96	80.0	Except burning paddy field, all other activities are mostly controlled by female	94	78.33
Males don't involve in most of the paddy cultivation activities due to other household works	85	70.83	Threshing is done exclusively by females	88	73.33

predominantly by female i.e. 46.67 and 30.0 per cent respectively. Access to paddy grain storage is held predominantly or exclusively by male i.e. 50.83 and 21.67 per cent respectively.

An analysis of 'Control by gender profile' of the respondents reveals that land preparation is controlled either exclusively or predominantly by male i.e. 56.67 and 34.17 per cent respectively. Data of seed treatment activity reveals that it is exclusively controlled by female for majority of the respondents (60.0%). Sowing and nursery raising activity showed that it is predominantly or exclusively controlled by female for majority of the respondent i.e. 39.17 and 35.0 per cent respectively. Harvesting and threshing is exclusively controlled by female for majority of the respondents i.e. 46.67 and 55.0 per cent respectively. However, grain storage is predominantly or exclusively controlled by male for 40.83 and 27.5 per cent of the respondents respectively.

Sah *et al.* (2007) in their study found that harvesting 66 per cent and sorting and grading 52 per cent of potatoes were primarily performed by women. Land preparation was found to be carried out jointly by men and women farmers. Women had a major say in deciding land (52%) and number of nurseries (raised beds) to be utilized (49%), and amount and sources of other production inputs (60%). Potato farmers as well as farm women had equal access to the production resources and farm benefits. However, women were found to have an edge over men in controlling the resources like land and labour, and also on the farm benefits of the gender in potato cultivation in the state.

Analysis of Influencing Factors: Analysis of influencing factors that pose constraints and offer opportunities to farmers and farm women in different activities of paddy cultivation was analysed using Harvard Analytical Framework. The result of the investigation is presented in Table 4. The major constraint for women to contribute in land preparation (trees cutting and jungle cleaning) as reported by majority of the respondents (87.5%) was that women do not have the skill to climb trees for cutting and jungle clearing and have less physical potential to do it . The major constraint that hinders men to contribute in most of the paddy cultivation activities is their involvement in other household chores as reported by majority of the respondents (70.83%). Majority of the respondents (80.0%) reported that men are not skilful in seed selection and its treatment hence is a constraint for them.

The factors that offer opportunities to male for land preparation for paddy cultivation is that men are skilful in climbing trees and have more physical strength to do it as reported by majority of the respondents (91.67%). Most of the paddy cultivation activities are controlled by farm women, reported by 78.3 per cent respondents. It is an opportunity for women to take charge of most of the paddy cultivation activities and give their significant contribution in the field of agriculture. Threshing is done exclusively by women as reported by majority (73.33%) of the respondents. It connotes that there is gender division of activities in paddy cultivation.

CONCLUSION

It is concluded from the above study that there is gender division of activities in paddy cultivation among Garo people of West Garo Hills, Meghalaya. Some of the activities like land preparation and grain storage are exclusively or predominantly carried out by male whereas other activities like seed selection and treatment, sowing and nursery raising, harvesting and threshing are exclusively or predominantly done by women. Various reasons or factors influence this division of work as indicated in the above study. Some activities are designated as masculine while others as feminine and this is the chief reason for gender discrimination of activities in paddy cultivation.

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Comparative Analysis of Economic Empowerment of Rural Women Non Beneficiaries and Beneficiaries of CSR Initiatives

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ABSTRACT

Rural women are considered as the backbone of rural society. Corporate sector is trying to play a pivotal role in ensuring private investment flow through CSR (Corporate Social Responsibility) activities to rural areas that have been left out of the development process so far and also to work for sustainable development of rural women in particular by giving them entrepreneurial trainings. The present paper aims to compare and highlight the difference in terms of economic empowerment of the beneficiaries and non beneficiaries of these CSR activities. The economic empowerment in the present study was analyzed on the basis of income earned before and after becoming CSR beneficiaries and involvement in decision making in various income related matters.

Keywords: Economic empowerment, Income earned, Decision making, Corporate social responsibility

INTRODUCTION

CSR (Corporate Social Responsibility) for most of the companies have revolved around community-based development approach. Many have actively worked towards the economic and social empowerment of women. Some of them have promoted the formation of self help groups which were supported to take up income generating livelihood activities after sufficient training and capacity building. It can be observed that there is an emphasis on women and their overall well being and also a mention about gender equality and empowerment of women. It has been proved that extra income in the hands of women leads to significant and positive changes in human development since it is largely spent on children's education, health and nutrition and is a catalyst for gendering development. Many corporate houses are working towards empowering women by improving income and employment for them in rural areas. Thus, the present paper aims to compare the non beneficiaries and beneficiaries of CSR initiatives in terms of their economic empowerment.

MATERIALS AND METHODS

The present study was conducted in the Udaipur district of Rajasthan. For the purpose of the study 60 rural women beneficiaries of HZL's (Hindustan Zinc Limited) CSR initiatives and 60 non beneficiaries of villages adjoining the villages of beneficiaries were selected randomly. For the purpose of analyzing the economic empowerment, monthly income earned before and after becoming the beneficiaries of CSR was asked by the respondents. Also, items related to involvement in decision making were categorized into three categories of nil, jointly with husband/family members and independently and were assigned scores of 0, 1 and 2 respectively. Data were collected using interview schedule and frequency, percentage, mean weighted score and paired t- test were used to analyze the data.

RESULTS AND DISCUSSION

Entrepreneurial trainings which were mostly location specific and skill oriented like stitching, bag making, bamboo work, jute article making were taken up to generate income. It was observed during the collection of data that the selected company (HZL) worked for women empowerment under CSR by organizing the women into Self Help Groups. These SHGs were involved in thrift, savings and interloaning. Entrepreneurial trainings on stitching and embroidery were given to these groups from time to time, so that they can take up these activities to generate income and become economically independent.

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But, mere giving trainings would not suffice economic empowerment until and unless these are further taken up into ventures or enterprise to generate employment. Observation reveals that all the beneficiaries received training and were involved in group enterprise while none of the non beneficiaries had received any sort of training neither were they involved in any enterprise group or individually. At HZL, after completion of the training in stitching/embroidery, the trainee group was given orders to stitch kurtas, pajamas, skirts and various apparels. They were linked to Centre for the Study of Values (Cos-V), an NGO through which they sold the products and received payment on item basis.

To see the impact of CSR initiatives on the economic empowerment, monthly income before and after becoming the beneficiaries of CSR and involvement in decision making related to various economic matters of both beneficiaries and non beneficiaries was assessed.

Income earned: The income earned by the beneficiaries before staring the enterprise was also asked. It was observed (Table 1) that majority of the beneficiaries (91.66%) were earning a very meager income of less than >1000 with a few beneficiaries (8.33%) earning >1000->3000 per month. In comparison non beneficiaries were not at all earning anything with meager in the range of not more than >5000. But the scenario improved drastically after becoming the part of group enterprise as 35 per cent of the beneficiaries earned around >13001- >15000 monthly with more than one third of the beneficiaries (28.33%) earning >9001- >11000 monthly. The findings of the present study are in accordance with the findings of Kumar (2010), Ganga and Jain (2012), Bansode *et al.* (2013) and Kapila *et al.* (2017) who reported an increase in the income of beneficiaries' pre and post SHG situation.

Table 1: Distribution of the respondents on the basis of monthly earnings before and after CSR initiatives (n= 120)

Income categories (INR)	f (%)		
	Beneficiaries		Non beneficiaries
	Before involved in CSR (n_1=60)	After involved in CSR (n_1=60)	(n_2=60)
Below 1000	55(91.66)	0(0)	2(3.33)
1000-3000	5(8.33)	0(0)	3(5.0)
3001-5000	0(0)	11(18.33)	1(1.66)
5001-7001	0(0)	13(21.66)	0(0)
7001-9000	0(0)	13(21.66)	0(0)
9001-11000	0(0)	17(28.33)	0(0)
11001-13000	0(0)	4(6.66)	0(0)
130001-15000	0(0)	21(35)	0(0)

t= 22.43**; ** Significant at 1 per cent level of significance.

Paired t- test was computed to know whether there was any significant difference between before and after earnings of company's beneficiaries. Table 1 shows the significance of difference in the income of the beneficiaries of the company before and after being part of the CSR initiatives. The result reveals that there was significant difference between the incomes before and after becoming the beneficiaries of CSR. The results support the fact that the company has been able to augment the income of their beneficiaries. It was observed that HZL has linked all the beneficiaries to an assured market to yield regular income. The findings are in conformity with Baskar and Sundar (2012) who reported significant change in the income of the 49 households post membership in SHGs. Similar results were also reported by Badodiya *et al.* (2013) who reported economic development of SGSY beneficiaries.

Decision making: A *decision* can be defined as a course of action purposely chosen from a set of alternatives to achieve day to day objectives or goals. Decision making on the part of rural women is their involvement to take day to day decisions related to various economic matters. Data furnished in Table 2 highlight the items on which decision were taken. These were measured on a three point continuum as to whether the decisions were taken individually, jointly or not at all. Table highlights that the respondents lack their say in important decisions like buying and selling of land (MWS 0.13), buying and selling of house (MWS 0.13) and construction and renovation of house (MWS 0.3). The table further reveals that beneficiaries had greater say in decisions like food to consume (MWS 2), food to buy (MWS 1.72), expenditure on clothing (MWS 2), buying and selling of household assets, (MWS 1.8), and purchase of gold or jewellery (MWS 1.55). When compared to the non beneficiaries, the mean weighted scores were found to be lower than the beneficiaries for the same aspects which suggest that the non beneficiaries either were not involved in these decisions or were jointly involved with husband or other family members. The difference in the categories clearly indicates that say in decisions related to economic matters is affected by income in hand. When the women become economically independent she gains confidence to put forth her views and influence decisions.

Table 2: Involvement of the respondents in decision making (n = 120)

Items	Mean weighted scores	
	Bene-ficiaries	Non-Bene-ficiaries
Buying and selling of land	0.13	0
Buying and selling of house	0.15	0
Construction and renovation of house	0.3	0.07
Buying and selling of livestock	0.43	0.32
Buying and selling of productive assets	1.63	0.13
Buying and selling of household assets	1.8	0.33
Purchase of Gold or jewelry	1.55	0.20
Spending on marriages or special occasions	1.28	0.22
Food to buy	2	0.6
Food to consume	2	1.73
Expenditure on clothing	2	0.15
Education of children	2	0.22
Treatment of sick	0.12	0.12
Treatment of self	0.12	0.07
Planning of family budget	0.95	0.18
Spending family savings	0.95	0.20
Taking a loan	0.95	0

The findings get support from study by Das (2006) who reported improvement in women's decision making after employment. Findings are also in conformity with Sharma *et al.* (2013) who revealed important decisions related to farm and livestock were taken by male members and whereas women respondents were involved jointly in some decisions although final say was of men only.

CONCLUSION

As far as women's economic empowerment is concerned the private companies have been able to instill a change in rural women's position but still a lot needs to be done. Certainly, the primary objective of making them skilled enough to generate income cannot be attained by mere trainings without a detailed overview existing skills, raw materials, marketing and production situations. Having a regular source of income help the beneficiaries to have more involvement in decision making. Thus, it can be inferred that regularity in income or a stable source of regular income is attributed to women's economic empowerment compared to income which is seasonal or demand based.

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An Analysis of Food Accessibility and Availability of Agricultural Households in Bundelkhand Region of Uttar Pradesh

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ABSTRACT

The issue of food security is not much about availability of food grains but about the composition of the overall food basket as observed from changing consumption patterns. For a country like India, where the achievement of food security is a continuing challenge, the consequences of ignoring the problem of food and nutrition insecurity seem very dire. Food insecurity exists when all people, at all times, do not have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The present study's focus was to understand the food accessibility and availability pattern in agricultural households in Uttar Pradesh. The survey was conducted in Banda, Hamirpur and Sitapur districts in Uttar Pradesh to measure food insecurity with the Household Food Insecurity Access Scale (HFIAS). Altogether, 360 personal interviews and 6 Focus Group Discussions (FGD) were conducted The study shows that people of Hamirpur and Sitapur districts were comparatively less affected by food insecurity as compared to Banda district. It was found that the family size; monthly off-farm income and expenditure on food were the main factors which most likely affected food insecurity.

Keywords: Agricultural households, Food accessibility, Food availability, Food insecurity

INTRODUCTION

Food availability depends upon the production and distribution of food items. Food accessibility means access to food, which is determined by an individual's purchasing power, and in turn purchasing power is affected by livelihood access, access to housing and absence of caste and gender discrimination. Food security of rural families can be enhanced through production, processing and value addition of regional staple food grains like millets. A very nutritious food consumed traditionally with a blend of millets in diet declined due to the rice focused public food distribution system in India (McGill Institute for Global Food Security, 2015). One of the issues pertaining to the ongoing debate on food security is the per capita availability of food. The overall trend in per capita availability of food grains, though fluctuating has been marginally negative (with per capita availability gradually coming down). It should be noted that while availability is a concern, changing demand patterns, especially diversifying toward high-value commodities, have to be taken into account. The issue of food security is not so much about availability of food grains but the composition of the overall food basket, as observed from changing consumption patterns. As economic growth picks up, it is common to observe a change in dietary patterns, wherein people substitute cereals with high-value foods (Nandkumar *et al.,* 2010). 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 food sustainability (Leishangthem *et al.,* 2017). The study by Pal *et al.* (2017) reveals that parameters like income from animal husbandry, income from marginal works and income from labour work were positively correlated with dietary diversity; but land holding, income from agriculture, possession of household assets, average family education and maximum family education are negatively correlated with diversity. Food prices are not the main factor inhibiting food accessibility. The problem is also the lack of variety and poor quality of food that is available in the food retail environment.

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A food secure household should be defined as one, which has enough food available to ensure a minimum necessary intake by all members. This definition emphasizes three critical dimensions of food security: (i) physical supply of desired food in sufficient quantity (ii) economic access indicating close link of purchasing power to food security (iii) stability in supply which includes access to global food market. India has government programmes such as TPDS including AAY, nutrition programmes like mid-day meals, ICDS, etc. to improve food and nutrition security. NREGS and self-employment programmes can also increase access to food and nutrition. Social protection programmes in India have helped in improving incomes as well as providing protection to the population, especially to the poor, from shocks in the economy. However, there are lots of gaps and inefficiencies in the social protection programmes.

The food security analysis reveals that the state of Uttar Pradesh has considerable shortage of pulses. Food security in the Bundelkhand region of Uttar Pradesh is found to be positively correlated with food availability and food stability. Though not significant, but it also positively correlates with food accessibility (Adnan Shakeel, 2012). The objectives of the present study are to analyses the household level food accessibility and availability in agricultural households of Bundelkhand, Uttar Pradesh and also to examine the interrelationship between the indicators of food insecurity.

MATERIALS AND METHODS

The study was conducted in purposively selected state of Uttar Pradesh, India. Three districts, namely Banda, Hamirpur and Sitapur districts in Bundelkhand region of Uttar Pradesh state were selected. The multistage random sampling technique was adopted. Two blocks were selected randomly from each selected district. From each block, 60 agricultural households were randomly selected making a total of 360. To estimate the prevalence of food accessibility and availability at household level for each district, Household Food Insecurity Access Scale (HFIAS) developed by USAID's Food and Nutrition Technical Assistance (FANTA) division of FAO (Coates *et al.,* 2007) was used. The method is based on the idea that the experience of food inaccessibility and unavailability causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale. Each of the questions is asked with a recall period of four weeks (30 days). The respondent is first asked an occurrence question – that is, whether the condition mentioned in the question happened at all in the past four weeks (yes or no). If the respondent answers "yes" to an occurrence question, a frequency of occurrence question is asked to determine whether the condition happened rarely (once or twice), sometimes (three to ten times) or often (more than ten times) in the past four weeks. The responses obtained for each indicator of Household Food Insecurity Access Scale was in categorical data. For further analysis of binary depended variable probit regression could be an appropriate statistical method.

RESULTS AND DISCUSSION

The result of descriptive statistics (Table 1) indicates that the average family size of agricultural household was 4.5 and the average land holding per household was 3.6 acre. The average monthly farm income was Rs 2475/- and monthly off farm income was Rs 4168/-. Which implies that major income source was off farm activities. At the same time, it could be observed that Rs 4263/- was spent on food items (higher than monthly farm income). The analysis shows the district wise distribution of household in Bundelkhand region of Uttar Pradesh. It could also be observed that average income from off-farm activities was slightly higher in Sitapur and Hamirpur districts than Banda district. Also income spent on food items is slightly lower in Hamirpur district than Banda and Sitapur districts of Uttar Pradesh.

Table 1: Descriptive Statistics of Agricultural Households in Uttar Pradesh

	Descriptive Statistics (n=360)			
	Mean	**Std. Error**	**[95% Conf.Interval]**	
FS (Family Size)	4.51	0.09	4.34	4.69
LH (Land Holding)	3.67	0.20	3.29	4.06
MFI (Monthly Farm Income)	2475.23	229.50	2023.89	2926.57
MOI (Monthly Off Farm Income)	4168.89	168.92	3836.69	4501.09
ISF (Income Spent on Food)	4263.89	114.85	4038.03	4489.74

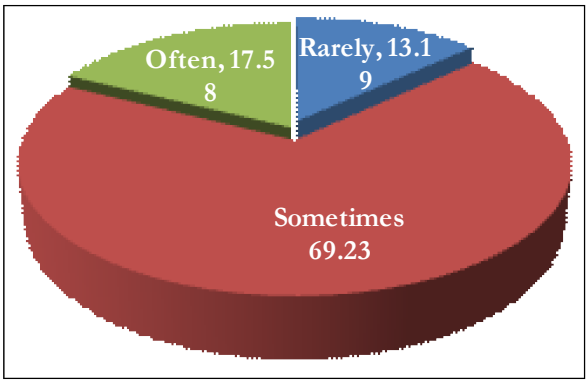
The Table 2 indicates the result of probit regression analysis to estimate the food availability and accessibility in last 30 days of agricultural households in Bundelkhand region of Uttar Pradesh. In table 2.1 and Figure 2.1, it indicates that majority (69.23%) of the households revealed that sometimes within last 30 days; they could not be able to access enough food for household consumption. Only 17.58% of households were often able to access the food for their consumption. Table 2.2 and Figure 2.2, indicates that 9.89% of the households revealed, within the last 30 days, there were sometimes when they could not eat the kinds of foods they preferred because of lack of resources. Majority (86.81%) of household members often were not able to eat the kinds of foods they preferred, because of lack of resources. Table 2.3 and Figure 2.3 indicate that 14.90% of the households sometimes eat just a few kinds of food day after day because of a lack of resources within the last 30 days. Majority (81.25%) of household members very often eat just a few kinds of food day after day because of lack of resources. From Table 2.4 and Figure 2.4, it is evident that 24.10% of the households sometimes ate foods that they did not want to eat. Majority (71.08%) of household members often ate food that they did not want to eat, instead of other foods. Table 2.5 and Figure 2.5 indicate that 23.94% of the households sometime sate a smaller meal than their need because there was not enough food. But, majority (71.81%) of household members reacted that this happened rarely. Table 2.6 and Figure 2.6 indicate that 36.81% of the households sometime sate fewer meals in a day because there was not enough food. But almost half of the total sample (49.08%) responded that this happened rarely. As evident from Table 2.7 and Figure 2.7, within the last 30 days, 27.27% of the households some time faced such situations that there was no food at all in their household because of lack of resources. But such situations were faced rarely as responded by the majority (72.73%).

The variables like family size, land holding, monthly farm income and monthly off farm income all were found significantly affecting the food accessibility and availability of the households. But variables like family size and monthly off farm income were more likely to have effect on the food accessibility and availability while other variables like land holding and monthly farm income were having comparatively less effect on food accessibility and availability. Also it could be observed from the probit regression analysis that households of districts Hamirpur and Sitapur have higher food security (availability and

Table 2: Results of Probit Regression analysis to estimate food accessibility and availability

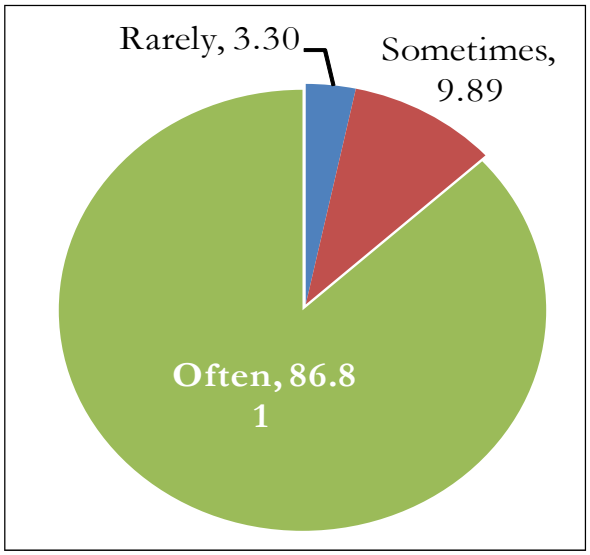
2.1 In the past 30 days, did you worry that your household would not have enough food?

Probit regression		Number of obs	360
Log likelihood = -203.06824		LR chi^2(7)	47.88
		Prob> chi^2	0.00
		Pseudo R^2	0.1055
Worry for food	**Coef.**	**Std. Err.**	**P>z**
FS	0.130111	0.051809	0.012
LH	-0.10405	0.029251	0
MFI	5.24E-05	2.85E-05	0.067
MOI	-7.6E-05	2.92E-05	0.009
ISF	3.25E-05	0.000072	0.651
district_cat			
Hamirpur	-0.17274	0.221468	0.435
Sitapur	-0.54473	0.18605	0.003
_cons	0.568661	0.268118	0.034



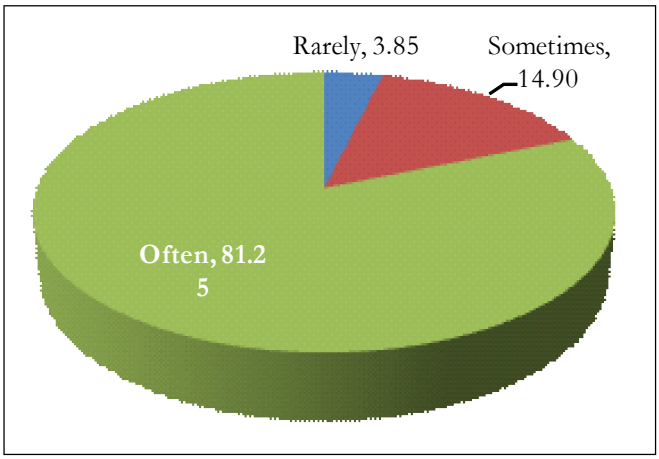
2.2 In the past 30 days, were you or any household members not able to eat the kinds of foods you preferred because of lack of resources?

Probit regression		Number of obs	360
Log likelihood = -179.1284		LR chi^2 (7)	79.86
		Prob> chi^2	0.0000
		Pseudo R^2	0.1823
Notable Toeatkind	**Coef.**	**Std. Err.**	**P>z**
FS	0.238245	0.060451	0
LH	-0.19052	0.033994	0
MFI	2.41E-05	0.000032	0.453
MOI	-6.7E-05	3.32E-05	0.044
ISF	0.000161	7.97E-05	0.043
district_cat			
Hamirpur	-0.38282	0.228734	0.094
Sitapur	-0.2833	0.197319	0.151
_cons	0.013954	0.302058	0.963



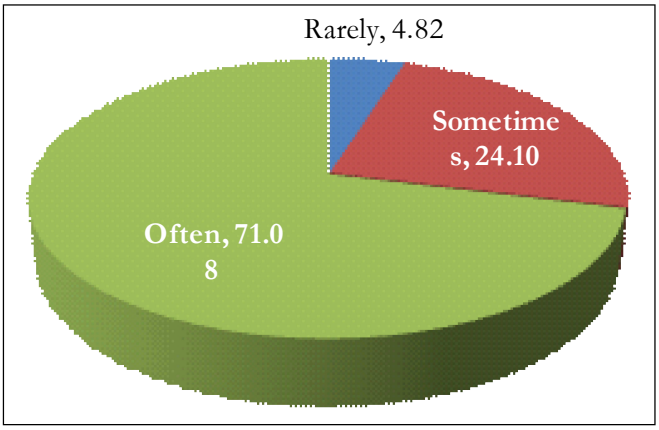
2.3. In the past 30 days, did you or any household member eat just a few kinds of food day after day because of lack of resources?

Probit regression		Number of obs	360
Log likelihood = -186.29356		LR chi^2 (7)	117.73
		Prob> chi^2	0.0000
		Pseudo R^2	0.2401
Few kinds food	**Coef.**	**Std. Err.**	**P>z**
FS	0.193884	0.058009	0.001
LH	-0.1942	0.03402	0
MFI	0.000055	2.96E-05	0.063
MOI	-8.7E-05	3.21E-05	0.007
ISF	0.000151	7.62E-05	0.048
district_cat			
Hamirpur	-1.19902	0.231453	0
Sitapur	-0.33824	0.195967	0.084
_cons	0.147206	0.285625	0.606



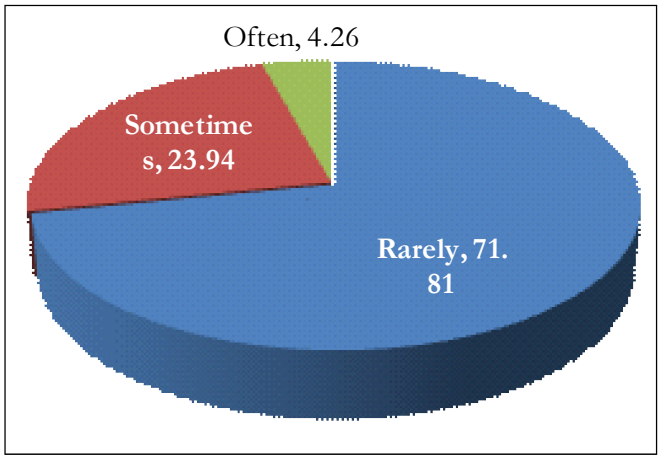
2.4. In the past 30 days, did you or any household member eat food that you did not want to eat, instead of other foods?

Probit regression		Number of obs	360
Log likelihood = -149.40708		LR chi^2 (7)	145.97
		Prob> chi^2	0
		Pseudo R^2	0.3282
Did not Want Toeat	**Coef.**	**Std. Err.**	**P>z**
FS	0.15796	0.062071	0.011
LH	-0.25711	0.038493	0
MFI	8.59E-05	0.000036	0.017
MOI	-0.00011	3.64E-05	0.002
ISF	0.000227	8.83E-05	0.01
district_cat			
Hamirpur	-1.19762	0.253792	0
Sitapur	-0.75403	0.225622	0.001
_cons	0.815654	0.326514	0.012



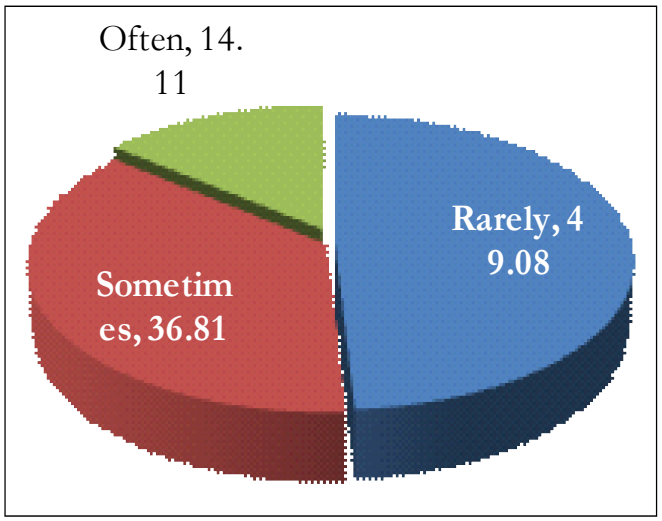
2.5. In the past 30 days, did you or any household member eat a smaller meal than you felt you needed because there was not enough food?

Probit regression		Number of obs	360
Log likelihood = -207.03219		LR chi^2(7)	84.29
		Prob> chi^2	0.000
		Pseudo R^2	0.1691
Smaller than need	**Coef.**	**Std. Err.**	**P>z**
FS	0.123106	0.051631	0.017
LH	-0.18925	0.032723	0
MFI	0.000055	2.97E-05	0.064
MOI	-5.9E-05	3.03E-05	0.052
ISF	8.86E-05	7.27E-05	0.223
district_cat			
Hamirpur	-0.79415	0.218841	0
Sitapur	-0.56962	0.183882	0.002
_cons	0.350588	0.265409	0.187



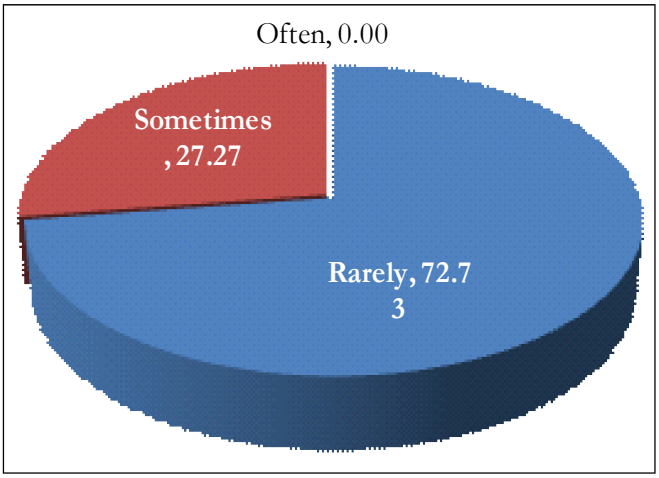
2.6. In the past 30 days, did you or any household member eat fewer meals in a day because there was not enough food?

Probit regression		Number of obs	360
Log likelihood = -159.39661		LR chi^2 (7)	177.06
		Prob> chi^2	0.000
		Pseudo R^2	0.3571
Fewermeal	**Coef.**	**Std. Err.**	**P>z**
FS	-0.11498	0.056923	0.043
LH	-0.18108	0.037788	0
MFI	6.18E-05	3.21E-05	0.054
MOI	-5.9E-05	3.19E-05	0.066
ISF	0.000266	7.71E-05	0.001
district_cat			
Hamirpur	-1.711	0.242947	0
Sitapur	-1.24895	0.196032	0
_cons	0.941572	0.28703	0.001



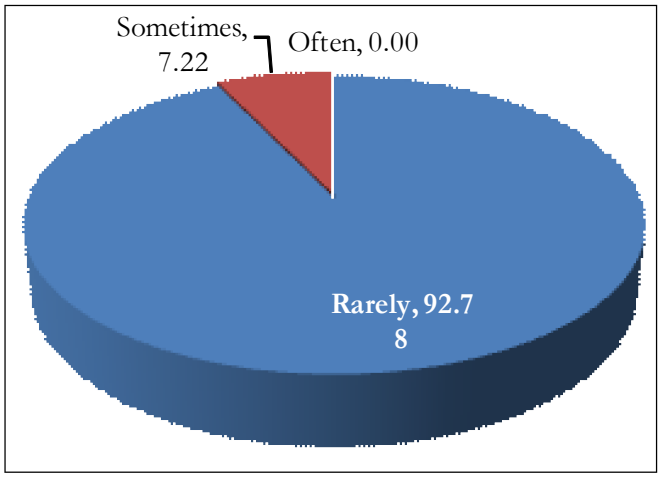
2.7. In the past 30 days, was there ever no food at all in your household because there were no resources?

Probit regression		Number of obs	240
Log likelihood = -71.778146		LR chi^2 (7)	3.5
		Prob> chi^2	0.7433
		Pseudo R^2	0.0238
No foodetal	**Coef.**	**Std. Err.**	**P>z**
FS	0.060398	0.072145	0.402
LH	-0.03921	0.056483	0.488
MFI	6.09E-05	5.52E-05	0.27
MOI	2.52E-05	5.27E-05	0.633
ISF	-0.00011	9.51E-05	0.257
district_cat			
Hamirpur	0	(empty)	
Sitapur	-0.00564	0.244545	0.982
_cons	-1.24131	0.371871	0.001



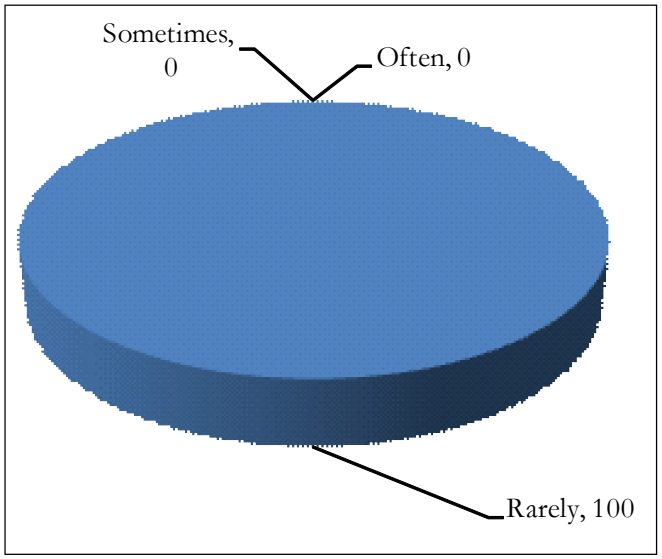
2.8. In the past 30 days, did you or any household member go to sleep at night hungry because there was not enough food?

Probit regression		Number of obs	360
Log likelihood = -174.82661		LR chi^2(7)	69.89
		Prob> chi^2	0
		Pseudo R^2	0.1666
Nighthungry	**Coef.**	**Std. Err.**	**P>z**
FS	0.10627	0.052895	0.045
LH	-0.21645	0.038834	0
MFI	0.000078	3.85E-05	0.043
MOI	3.37E-05	3.53E-05	0.34
ISF	7.35E-05	7.89E-05	0.351
district_cat			
Hamirpur	0.409526	0.230661	0.076
Sitapur	-0.19492	0.205653	0.343
_cons	-1.13767	0.277566	0



2.9. In the past 30 days, did you or any household member go a whole day without eating anything because there was not enough food?

Probit regression		Number of obs	240
Log likelihood = -22.902625		LR chi^2(7)	17.47
		Prob> chi^2	0.0077
		Pseudo R^2	0.2761
Whole day Without eating	**Coef.**	**Std. Err.**	**P>z**
FS	-0.19644	0.166074	0.237
LH	-0.39287	0.208912	0.06
MFI	-0.00023	0.000242	0.333
MOI	-3.1E-05	0.000135	0.82
ISF	0.000602	0.000293	0.04
district_cat			
Hamirpur	0	(empty)	
Sitapur	-0.30876	0.486326	0.526
_cons	-2.34718	0.672514	0



accessibility) than households of Banda district. It might be due to less distance from nearby cities like Kanpur and Lucknow, where they could get more opportunities to engage themselves in nonfarm activities. The analysis of data clearly indicates that the monthly off farm income has significant role and more likely to affect the food security status. It may be justified that farm income is not monthly based as it is a seasonal phenomenon. So it is less likely to have effect on household's food insecurity estimation.

CONCLUSION

The study shows average land holding per household was 3.6 acre and their average monthly farm income was Rs 2475/-. And their monthly average income from nonfarm activities (Rs 4168/-) are just higher than monthly farm income. It was estimated that Rs 4263/- was spent on food items which is higher than monthly farm income. The results of study indicate that monthly farm income is not sufficient for their livelihood same time it was shown that monthly off farm income play significant role to overcome food insecurity. At districts wise analysis shows that Hamirpur and Sitapur districts were comparatively less affected by food insecurity than Banda district. The reason could be availability of more avenues for income generating nonfarm activities in district itself. It was also found that the family size, monthly off-farm income and income spent on food were the main factors which most likely affected food accessibility and availability.

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Comparative Response of Sulphur and Phosphorus Fertilizer on Productivity and Profitability of Mustard in Limited Irrigation Condition of Bihar Eastern Plain Zone

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ABSTRACT

On-farm trials were conducted during the winter (*rabi*) season of 2013–14 and 2014–15 on a sulphur (S) and phosphorus (P) deficient soil in limited irrigation under late sown condition at farmer's field of adopted villages of KVK Bhagalpur to validate, refine and popularize the technology developed at Bihar Agricultural University, Sabour, Bhagalpur (Bihar) for enhancing the productivity and profitability of mustard (*Brassica Juncea* L.). Results revealed that the application of recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O), and phosphorus supply through di-ammonium phosphate along with 20 kg/ha elemental sulphur (T_3) and recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O), and phosphorus supply through single super phosphate (T_4) significantly increased the plant height, dry matter/plant, branches/plant (primary and secondary), siliquae/plant, length of siliqua, number of seeds/siliqua, 1,000-grain weight, seed yield, stover yield, oil content and NPS uptake over farmer's practice and recommended dose of fertilizer (phosphorus supply through di-ammonium phosphate). Application of recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus through single super phosphate produced 30.7 and 18.6% higher seed yield as compared to farmer's practice and recommended dose of fertilizer phosphorus through di-ammonium phosphate, respectively. Application of recommended dose of fertilizer (phosphorus supply through single super phosphate) was most economical. These SSP applications on mustard crop recorded Rs. 18,599/ha net returns along with 0.85% benefit: cost ratio.

Keywords: Economics, Mustard, Oil content, Phosphorus, Single supper Phosphate, Sulphur and Yield

INTRODUCTION

Mustard (*Brassica juncea* L.) is one of the most important winter season oil seed crop next to groundnut in the Indian oilseed economy. It is generally grown on marginal lands with poor fertility under rainfed conditions, contributing 28.4 per cent of the total oil production in India. The position of Bhagalpur with respect to average yield, 1174 kg/ha, is not satisfactory because it is much below the Patna district average yield of 1984 kg/ha (Directorate of Economics and Statistics Bihar, 2014-15). In India, nearly 85–90 per cent of the total annual rainfall is received during the rainy season (June–September), and Indian mustard is grown during winter season primarily in the marginal lands with limited irrigation or with residual soil moisture. As water and nutrients are the major inputs, efforts should be focussed to generate information on the effects of nutrients application and amounts of irrigation water on the growth and yield of this crop. Rapeseed and mustard are one of the most important edible oils of northern and eastern parts of India. The challenge of increasing crop yield per hectare to satisfy the needs of an ever increasing human population cannot be ignored. The supply of oil and protein is becoming scarce especially in developing countries. The oilseed is essential part of human diet. Besides it produces basic raw materials for agro-based industries and has large acreage covering 20.7 million ha under various oilseeds in different agro-climatic zones of India.

Phosphorus (P) is an important nutrient for oilseed production. It does not present abundantly in soil as

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nitrogen and potassium. Total concentration of P in surface soil varies from 0.02 to 0.10 per cent. The quantity of total P in soils has little or no relationship to the availability of P to plants. In Phosphorus deficient plant, the growth was retarded and shoots and root dry matter ratio usually decreases. Phosphorus deficit soils not only give low yields but also produced poor quality of products. Phosphorus is a structural component of nucleic acids, coenzymes, phospho proteins and phospholipids which improves seed size, proper seed filling and increases oil content. It involves in plant metabolism which plays an important role in cellular energy transfer, respiration, photosynthesis. Phosphorus deficiency reduces the leaf expansion, leaf area and number of leaves of crop plants. The chlorophyll content is increased under phosphorus deficiency, and the leaves have a dark green colour as cell and expansion of leaves are more reduced than chloroplast and chlorophyll formation. However, the photosynthetic efficiency per unit of chlorophyll is much lower in Phosphorus deficient plant, (Das, 2004).

Sulphur is also an important nutrient for oil seed crop production which helps in the formation of chlorophyll and synthesis of oils. Sulphur improves the quality of food crops, particularly of oilseeds. Sulphur is also very important for oilseeds as the volatile di-and poly-sulphide compounds help to increase the pungency of the vegetable oils. It plays an important role in the formation of S-containing amino acids like cystine, cysteine, methionine, which act as building blocks in the synthesis of proteins. Sulphur also plays a key role in the activation of enzymes, nucleic acids and forms a part of biotin and thiamine. Amongst many agronomic factors responsible for low yields, imbalanced and injudicious use of fertilisers also limits crop production (Sattar *et al.,* 2011). Continuous use of major plant nutrients such as urea, diammonium phosphate and muriate of potash has resulted in the depletion of soils of their secondary and micronutrient reserves. Introduction of high yielding varieties and subsequent use of high analysis S-free fertilizers under intensive cropping systems have resulted in increased sulphur deficiency.

Sulphur fertilizers are most commonly available as either soluble sulphate or elemental forms. Elemental sulphur is totally unavailable to plants. Elemental sulphur must be oxidized by soil microbes to SO_4-S before it becomes available to crops. Thus, it takes considerably more time for elemental forms to become available to the plant, compared to soluble sulphate forms of fertilizer. Application of adequate amounts of N, P and K failed to give optimum yields until the deficiency of sulphur was corrected. The sulphur fertility status of soils in oilseed growing area is poor and wide spread sulphur deficiency has been observed in crops and soils in 120 district of India irrespective of soil texture and cropping pattern (Tandon 1991).

Keeping above fact in mind, the present study was undertaken to know the comparative response of sulphur and phosphorus on productivity and profitability of mustard.

MATERIALS AND METHODS

On-farm trials were conducted during the winter (*rabi*) season of 2013–14 and 2014–15 on a sulphur and phosphorus deficient soil under limited irrigation facility after long duration rice crop at farmer's field of adopted villages of KVK Bhagalpur (Bihar). Farmers in the region did not cultivate high water requirement crops like wheat due to limited irrigation. On the basis of initially Participatory Rural Appraisal (PRA), five villages were subjectively selected namely Bandhaw, Mohanpur, Barahari, Kharawa and Pakra to validate, refine and popularize the technology developed at Bihar Agricultural University Sabour, Bhagalpur (Bihar) for enhancing the productivity and profitability of mustard (*Brassica Juncea* L.) variety Rajendra Sufalam. Participatory Rural Appraisal (PRA) was done to identify causes of low yield of mustard and high cost of production. Soil of the experimental field had low sulphur and phosphorus under limited irrigation in late sown condition, which poses a serious constraint in adopted villages. These locations were situated at 64 m above mean sea-level in the heart of the vast Indo-gangetic plains of North India. The climate of this place is tropical to subtropical of slightly semi-arid in nature and is characterized by dry summer, moderate rainfall and very cold winter. December and January are usually the coldest months where the mean temperature normally falls as low as 8.2°C. Whereas, April and May was the hottest months, having the maximum average temperature of 29.6°C. The average annual rainfall is 1407 mm but crop received only 46.3 and 37.0 mm during entire growth period. All the farmers selected for On- Farm Trials were small farmers.

Composite soil samples of all five selected sites were analyzed. The soil of the experimental sites was sandy loam to loamy in texture, with average pH 7.5, organic carbon 0.48%, available N 201.9 kg/ha, P_2O_5 19.8 kg/ha, K_2O

173 kg/ha and available sulphur 10.1 ppm. The experiment comprised 4 treatments viz. T_1- farmer's practice (40:20 Kg/ha N and P_2O_5) phosphorus through di-ammonium phosphate, T_2- recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus through di-ammonium phosphate, T_3- recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus through di-ammonium phosphate along with 20 kg/ha elemental sulphur and T_4- recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus through single super phosphate. Treatments were arranged in randomized block design (RBD) with five replications in which one farmer was treated as one replication. The area of each experimental field was 0.2 ha. Mustard was sown after the harvesting of long duration rice crop under limited irrigation in late sown condition (*i.e.* third week of November during both the years) with the spacing of 30×10 cm at the depth of 2-3 cm with the seed rate of 5 kg/ha variety Rajendra Sufalam (duration 105-115 days). Rajendra Sufalam is recommended for late sowing i.e.15th November to 25 December and their yield potential is 1250 kg/ha. As per treatments, half dose of nitrogen and full dose of phosphorus, potassium and elemental sulphur were applied as basal dressing at the time of sowing and remaining half dose of nitrogen was top dressed after first irrigation. Fertilizers were applied uniformly through urea, di-ammonium phosphate (DAP), single super phosphate (SSP) and muriate of potash (MOP). Crop was raised by following recommended scientific cultural practices during both the years of study. Oil content was estimated by the following of standard method (AOAC 1960). In this method seed samples were kept in the oven at 65°C for removal of moisture. After removal of moisture the seeds were crushed in a pestle-mortar for extraction of oil.

$$\text{Oil content (\%)} = \frac{\text{Wt. of oil flask + ether extract - Wt. of flask oil}}{\text{Substances taken}} \times 100$$

Economics was computed using prevailing costs of inputs and labour and returns were computed by seed price as 3000/q and stover price as 145/q. Benefit: cost ratio (B:C ratio) was expressed as ratio of net returns to cost of cultivation. After harvest of the crop, treatment wise grain and straw samples were collected for N, P and sulphur nutrient analysis and for nutrient uptake. Nitrogen was determined by micro Kjeldahl method, P was estimated in aliquots calorimetrically using vanadomolybdate yellow color method, K was determined with flame photometer and sulphur content in the digest of plant extract was determined using turbidimetric method of Chesnin and Yien (1951). Total NPS uptake (seed + stover) in mustard was determined by multiplying the N, P and S concentration with corresponding seed and stover yields, respectively and expressed in kg/ha. The data were subjected to statistical analysis as prescribed by Gomez and Gomez (1984) and significant effects were presented and discussed in this paper. Since data obtained over the years done at same experimental site followed the homogeneity test.

RESULTS AND DISCUSSION

Growth attributes: The growth attributes measured in term of plant height, Main shoot length (cm), dry matter/plant, branches/plant (primary and secondary) at harvest stage was positively affected with the application of sulphur and phosphatic fertilizer under limited irrigation after long duration rice crop in late sown condition (Table 1). Application of recommended dose of fertilizer *i.e.* 80:40:40 kg/ha N, P_2O_5 and K_2O (phosphorus through di-ammonium phosphate along with 20 kg/ha elemental sulphur) and recommended dose of fertilizer (phosphorus through single super phosphate) have shown significant improvement in growth attributes as compared to farmer's practice and application of recommended dose of fertilizer (phosphorus supply through di-ammonium phosphate *i.e.* omission of sulphur from recommended dose of fertilizer during both the years. Application of recommended dose of fertilizer (phosphorus through single super phosphate) under limited irrigation in late sown condition recorded 14.1, 19.9, 42.9 and 25.9 per cent higher plant height, dry matter per plant, primary branches/plant and secondary branches/plant over farmer's practice, respectively. Seed yield was found to be positively correlated with dry matter/plant (R^2=0.956) at harvest stage (mean of two years). This might be due to more synthesis of amino acids, increase in chlorophyll content in growing region and improving the photosynthetic activity with the application of sulphur, ultimately enhancing cell division and thereby increased the crop growth rate. Similar finding was also reported by Murmu *et al.* (2015) and Ray *et al.* (2014). Increased supply of P and S which helped the crop to increase photosynthesis and hasten different physiological activities and metabolic processes related to its growth. These results are in close conforming to those of Mallick and Raj (2015).

Table 1: Effect of sulphur and phosphorus on growth and yield attributes of mustard (mean data of 2 years)

Treatment	Growth attributes at harvest					Yield attributes			
	Plant height (cm)	Main shoot length (cm)	Dry matter /plant (g)	Primary branches/ plant	Secondary branches/ plant	No. of siliquae/ plant	Length of siliqua (cm)	Seeds/ siliqua	1000-seed wt. (g)
T_1-Farmers Practice (40:20 kg N, P_2O_5/ha)	182.3	112.8	41.1	3.2	4.0	93.0	4.2	9.6	5.0
T_2-RDF (phosphorus through DAP)	201.7	123.8	45.2	4.2	3.9	129.4	5.3	10.1	5.3
T_3-RDF (phosphorus through DAP + 20 kg/ha sulphur)	213.5	136.3	50.6	5.1	5.8	151.1	6.3	11.5	5.7
T_4-RDF (phosphorus through SSP)	212.2	140.5	51.3	5.6	5.4	148.2	6.1	11.8	6.0
SEm±	5.32	4.22	1.41	0.21	0.17	3.3	0.29	0.30	0.14
CD (P=0.05)	15.4	12.2	3.8	0.6	0.5	9.4	0.9	1.1	0.4

Note: Recommended dose of fertilizer (RDF) - 80:40:40 kg/ha N, P_2O_5 and K_2O

Yield and yield attributes: The yield attributing characters viz. number of siliquae/plant, length of siliqua, number of seeds/siliqua and 1,000-seeds weight also influenced with the application of phosphorus and sulphur under limited irrigation in late sown condition. Maximum yield attributes of mustard was also recorded with the application of recommended dose of fertilizer *i.e.* 80:40:40 kg/ha N, P_2O_5 and K_2O (phosphorus through single super phosphate) as compared to farmer's practice (FP) and omission of sulphur from recommended dose of fertilizer *i.e.* recommended dose of fertilizer (phosphorus through di-ammonium phosphate) which was statistically non significant with recommended dose of fertilizer (phosphorus through di-ammonium phosphate along with 20 kg/ha elemental sulphur) application. Seed yield was found to be positively significant correlated with yield attributes, namely siliquae/plant (R^2 = 0.872), siliqua length (R^2 = 0.873), seeds/siliqua (R^2 = 0.939) and 1,000-seeds weight (R^2 = 0.862) [(mean of two years)]. This higher translocation was possible perhaps due to the better sink capacity as indicated by the higher number of capsules and seeds per plant. The better sink capacity might be attributed to the better dry matter production owing to better photosynthetic capacity of the plant during the reproductive phase of the crop. Similar results were also observed in sesame by Murmu *et al.* (2015) and Chaurasiya and Sharma 2014 in mustard.

The beneficial effect of phosphorus on yield attributing characters could be ascribed to the fact that enhanced activity of growth and more flowering and pod setting as phosphorus stimulates the flowering and seed formation (Solanki *et al.,* 2015) and also producing bold sized seeds with more accumulation of photosynthates.

Seed and stover yields of mustard were also significantly influenced by phosphorus and sulphur application (Table 2). Among all the treatments, phosphorus through single supper phosphate of recommended dose of fertilizer *i.e.* 80:40:40 kg/ha N, P_2O_5 and K_2O (T_4) gave significantly higher seed (12.13 q/ha) and stover yield (31.0 q/ha) over farmer's practice (FP) and omission of sulphur from recommended dose of fertilizer (recommended dose of fertilizer phosphorus through di-ammonium phosphate). Application of recommended dose of fertilizer phosphorus through single super phosphate produced 30.7% and 18.6% higher seed yield as compared to farmer's practice and recommended dose of fertilizer phosphorus through di-ammonium phosphate,

Table 2: Effect of sulphur and phosphorus on yield, oil content, nutrient uptake and economics of mustard (mean data of 2 years)

Treatment	Seed yield (q/ha)	Stover yield (q/ha)	HI (%)	Oil content (%)	Total nutrient uptake (kg/ha)			Cost of cultivation (Rs./ha)	Gross return (Rs/ha)	Net return (Rs./ha)	B:C ratio
					N	P	S				
T_1-Farmers Practice (40:20 kg N,P_2O_5/ha)	8.41	22.8	27.18	35.95	38.9	9.7	6.9	19,256	28,296	9,040	0.48
T_2-RDF (phosphorus through DAP)	9.87	25.8	28.09	35.95	44.1	11.5	8.4	21,991	33,318	11,328	0.52
T_3-RDF (phosphorus through DAP + 20 kg/ha sulphur)	11.1	30.8	28.72	39.8	56.9	13.8	10.8	22,916	39,516	16,601	0.73
T_4-RDF (phosphorus through SSP)	12.13	31.0	29.38	39.7	60.4	14.6	11.2	22,156	40,754	18,599	0.85
SEm±	0.39	1.17		0.55	1.73	0.27	0.42				
CD (P=0.05)	1.10	3.4		1.6	5.1	0.8	1.2				

Note: Recommended dose of fertilizer (RDF) - 80:40:40 kg/ha N, P_2O_5 and K_2O

respectively. Production of Seed and stover yields with the application of recommended dose of fertilizer phosphorus through single super phosphate was at par with the application of recommended dose of fertilizer phosphorus through di-ammonium phosphate along with 20 kg/ha elemental sulphur (T_3). This might be attributed to significantly larger and higher siliquae/plant having higher and heavier seeds. Similar results were also reported by Sheoran *et al.* (2013) in sunflower Murmu *et al.* (2015) in sesame and Mamgai *et al.* (2018). Application of phosphorus through single super phosphate contributed about 30 kg sulphur/ha is responsible for higher yield. In deficient soil, the effect of sulphur is prominent on growth parameters, yield attributing characters and total biomass of crop. It might be due to sulphur plays an important role in the formation of S-containing amino acids like cystine, cysteine, methionine, which act as building blocks in the synthesis of proteins, which also plays a key role in the activation of enzymes, nucleic acids and forms a part of biotin and thiamine. Hakan Ozer (2003) also reported early and timely sowings of rapeseed (*Brassica napus L.)* gave higher yields than late sowings. Singh *et al.* (2003) also reported mustard crop was most sensitive to the moisture stress from the vegetative to early-flowering stage and moisture stress in all growth stages reduced the significantly grain yield. Mandal *et al.* (2006) reported 48.8% higher Indian mustard seed yield with the application of 60 mm pre-sowing + 60 mm post-sowing irrigation at rosette + 60 mm at flowering stage along with 100% NPK as compared to 60 mm pre-sowing and no post-sowing irrigation along with 100% NPK

Oil Content and Nutrient uptake: The oil content of mustard varied from 35.95 to 39.80 % with the application of sulphur/without sulphur. Maximum oil content was obtained with the application of recommended dose of fertilizer phosphorus *i.e.* 80:40:40 kg/ha N, P_2O_5 and K_2O supply through di-ammonium phosphate along with 20 kg/ha elemental sulphur and recommended dose of fertilizer phosphorus supply through single super phosphate. Minimum oil content was recorded in farmers practice and recommended dose of fertilizer phosphorus supply through di-ammonium phosphate. Application of recommended dose of fertilizer phosphorus supply through di-ammonium phosphate along with 20 kg/ha elemental sulphur and recommended dose of fertilizer phosphorus supply through single super phosphate gave 3.9% higher oil content as compare to both farmers practice and recommended dose of fertilizer phosphorus

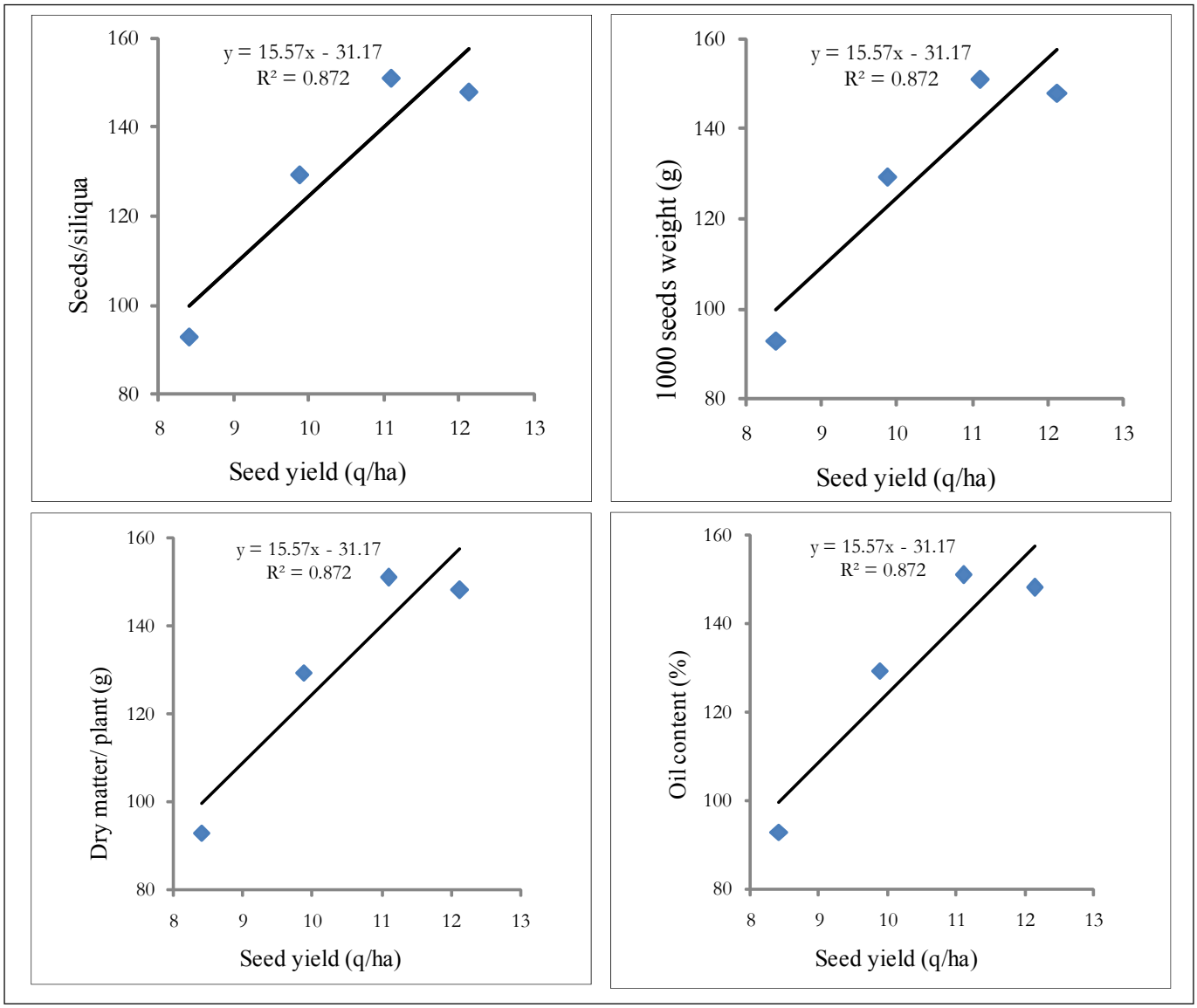

Figure 1: Relationship between growth, yield attributes and seed yield of mustard

supply through di-ammonium phosphate. Seed yield of mustard was positively and significantly correlated with oil content ($R^2 = 0.784$). Oil content increased significantly with the application of sulphur it may be attributed to increase in glycosides. Kumar *et al.* (2006) and Murmu *et al.* (2015) in sesame reported similar results.

Application of recommended dose of fertilizer phosphorus *i.e.* 80:40:40 kg/ha N, P_2O_5 and K_2O supply through single super phosphate resulted more total uptake of N, P and S (Table 2). Nutrient uptake by mustard is mainly a function of yield and nutrient concentration in seed and stover. This may be attributed to increased seed and stover yield of crop and their respective nutrient contents owing to increased availability of nutrients to the crop as a result of improved soil fertility. The concentration of sulphur in seed and stover is also increased due to sulphur fertilization because it improved nutritional environment in rhizosphere and consequently plant system. The results are in conformity with the finding of Sheoran *et al.* (2013) in sunflower and Mallick and Raj (2015) in rapeseed (*Brassica Campestris* L. var. yellow sarson).

Economics: The variations in the cost of cultivation under different treatments were recorded due to variable doses and cost of di-ammonium phosphate, single supper phosphate and elemental sulphur. The cost of cultivation was recorded to be highest (Rs. 22,916/ha) with the application of recommended dose of fertilizer phosphorus supply through di-ammonium phosphate along with 20 kg/ha elemental sulphur while, net return (Rs. 18,599/ha) and benefit cost ratio (0.85) were highest in recommended

dose of fertilizer phosphorus supply through single super phosphate. The minimum cost of cultivation, net return and benefit cost ratio was observed with farmers practice (Table 2). Application of recommended dose of fertilizer phosphorus supply through single super phosphate gave Rs. 1,998/ha higher net return over recommended dose of fertilizer phosphorus supply through di-ammonium phosphate along with 20 kg/ha elemental sulphur. Sheoran *et al.* (2013) also reported similar results from sunflower crop at Ludhiana.

CONCLUSION

Based on two years study, it may be concluded that application of recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus supply through single super phosphate resulted in higher growth, yield, oil content and net returns of mustard compared to farmer's practice, recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus supply through DAP and recommended dose of fertilizer (80:40:40 kg/ha N, P_2O_5 and K_2O) phosphorus supply through DAP + 20 kg/ha sulphur.

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Analysis of the Constraints from Farmer's Perspective in Agricultural Knowledge Creation, Information Management and Technology Delivery Systems (AgriKITS) in Bundelkhand Region of U.P.

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ABSTRACT

The study was undertaken to identify the major constraints in the processes of knowledge creation, information management and technology delivery functions which are provided by AgriKITS including research institutes, agricultural universities, KVKs, some NGOS and progressive farmers in the Bundelkhand region of U.P. An extensive list of probable constraints were prepared through the analysis of secondary data and with the help of experts. To study the severity of the constraints, the data were collected from 120 farmer respondents through personal interviews and group discussions. The quantification of data was done by ranking the constraints based on the responses obtained from the respondents and calculating the Rank Based Quotient (RBQ). Findings of the study indicated that Complex technologies, Lack of knowledge and awareness on improved technology, Unavailability of quality inputs, Climatic risk and uncertainty were emerged as important constraints perceived by the farmers.

Keywords*:* constraint analysis, Rank based quotient, Complex technologies, Unavailability of quality inputs

INTRODUCTION

Knowledge creation, information management and technology delivery system are the important aspects of all agricultural information system. Many studies from a different portion of the world revealed that one-fourth of the yield gap for many crops is due to knowledge deficits. As indicated in the linear thinking model in the knowledge creation it is assumed that research institutes as the creators of the knowledge and technology, extension as the diffusers of advice and farmers as the adopters of new practices (Peter Ballantyne, 2009). Hence the institutions which are performing the functions of knowledge creation and technology delivery are extremely important in defining and developing the capacity farmers in adoption of improved techniques. In India one of the most developing nation, not only the public sector funded by government, which is still the main agricultural information provider of the country, but also private sector and civil society, such as NGOs and non-profit organizations have a growing interest to involve in agricultural technology innovation and knowledge sharing system.

Now a day's, agriculture is becoming totally knowledge-intensive enterprise and productivity in agriculture relies upon the way of using optimum combination of inputs, land management methods and its know-how. Though the agriculture is termed as knowledge intensive, to a maximum number of small holders in India are remaining detached with the knowledge sector and majority of the existing knowledge, skills and information about production techniques and technologies remains inaccessible to them (Suresh and Babu, 2015). In order to increase the agricultural productivity, information access is the main key factor (Sharma *et al.,* 2012). NITI Ayog report says that high yield gap in the Bundelkhand region poses a challenge that can be encountered by creation and dissemination of suitable modern agricultural technologies as this region has soundly fair agro-potential to enhance farm income if necessary conditions are provided through the adoption of suitable technologies holdup and strong technology delivery mechanism (NITI Ayog, 2015). In Bundelkhand number of institutions are serving this purpose by involving themselves in the

knowledge creation and delivery function. But still the agriculture is not at a status of prosperity in this region. This points, there is lacunae in the mode of operendi of these knowledge systems (Agri KITS) in all the dimensions like creation and acquisition of knowledge, management and handling the information and the dissemination and delivery of the technology or information which are the ultimate output of the knowledge. On this background, the present study was an attempt to find out various constraints perceived by the farmers with respect to different Agri KITS and analyse the severity of them.

MATERIALS AND METHODS

The present study was purposively conducted in the Jhansi and Banda districts of Bundelkhand region due to its proximity with different research institutes and agricultural universities. From each districts three villages were randomly selected. From each village 20 respondents were selected, thus the total sample was 120. In order to identify the constraints faced by the farmers, a list of constraints was prepared through meticulous review of literature, consultation with experts and extension workers. The constraints were categorised into different categories like technical constraints, socio-economic constraints, organizational constraints and other constraints. The farmers in the study were asked to rate the constraints according to the perceived relevance under their circumstances. The listed constraints were then quantified through Rank Based Quotient technique (RBQ) (Sabaranathan, 1988), which is as follows:

$$RBQ = \frac{\Sigma f1\ (n + 1 - i)}{N \times n} \times 100$$

f_i = Frequency of farmers for the i^{th} rank of the problem

n = Total number of ranks

i = Rank given by the respondents

N = Total number of respondents contacted

RESULTS AND DISCUSSION

Constrain analysis was carried out as per the above mentioned procedure and constraints perceived by the farmers' in different categories i.e. technological, socio-economical, organizational, technological and other constraints are discussed below.

Technical constraints: It is clear from the Table 1, that among technical constraints, complex technologies (RBQ score 102.46) were ranked as most severe. Since complex technologies require strong know-how knowledge, complex procedure associated with those technologies makes farmers difficult to understand and adopt if the time suitable and correct knowledge is not provided to them. So farmers ranked these were the most severe technical constraint. The second most severe constraint in this category was costly inputs/technologies (RBQ score 71.75), because the majority of the farmers were small and marginal farmers having poor affordability to costlier technologies. The least severe was unavailability of trained staff (RBQ score 51.07) to explain the different procedures associated with these technological adoption among the farmers.

Table 1: Severity analysis of perceived technical constraint

Particulars	RBQ score	Rank
Non availability of trained staff	51.07	4
Incompatible technologies	58.90	3
Costly inputs/technologies	71.75	2
Complex technologies	102.46	1

Burman *et al.* (2013) in their study found that the awareness of respondents about improved technologies was very poor due to less access to the quality information even if the farmers were willing to pay for quality information, which could lead to substantial economic return. Another study by Shukla *et al.* (2009) found out that major problems affecting the impact of knowledge could be limited access to information and insufficient visibility due to use of tolled access information dissemination modes.

Socio-economic constraints: Among the socio-economic constraints, lack of knowledge and awareness on improved technology (RBQ score 97.13) was found severe. Farmers were basically unaware about the improved practices which were created and tested in the laboratory conditions and experimental stations. The technologies and improved practices produced by organizations were restricted to nearby villages or adopted villages, which shows poor dissemination of the agricultural technologies. This was followed by lack of change agent or extension personnel to communicate the recent development in the technological aspects with the farmers. The least severe constraint was lower social participation (RBQ score 27.88) of the farmers. Farmers perceived these are least important because the respondent farmers were

Table 2: Severity analysis of perceived Socio- Economic constraints

Particulars	RBQ score	Rank
Small and dispersed land holding	55.77	3
Lower social participation	27.88	6
Lack of knowledge and awareness on improved technology	97.13	1
Lack of change agents	75.2	2
Lack of risk bearing capacity	50.13	4
Poor economic condition of family	37.6	5

actively participating in social activities and social groups like co-operatives, NGOs.

Organisational constraints: Among different organisational constraints listed and identified, unavailability of the quality inputs (RBQ score109.04) ranked as most severe, because farmers argued that Agri KITS organisations were not supplying good quality of seeds and other inputs at the right time to the poor and needy farmers and farmers were compelled to depend on the informal source like input dealers who provide low quality inputs at higher prices. The second most severe constraint was lack of timely advice and guidance (RBQ score 103.08). Farmers were in need of information like weather and pest attack forecast information and timely guidance to avoid such problems. It has been observed that farmers were mainly relying on neighbour farmers for any information on this regard. It intern pointed to the inefficiency institutions to fulfil the felt needs of the farmers or their inability to perceive it properly.

Yadav *et al.* (2015) found that knowledge management is no longer a technical challenge but is rather constrained by social and organizational barriers and need rigorous institutional and policy changes to address these barriers.

Table 3: Severity analysis of perceived Organizational constraints

Particulars	RBQ score	Rank
Low credibility of extension personnel	53.26	6
Biased attitude of extension personnel	53.26	6
Lack of linkage with service provider	93.06	4
Lack of effective supervision and monitoring	102.77	3
Unavailability of quality inputs	109.04	1
Lack of timely advice and guidance	103.08	2
Lack of motivation and feedback	54.83	5
Less exposure visits	43.24	7

Other constraints: Some of the other constraints perceived by the farmers were also found be affect agricultural knowledge creation, information management and technology delivery system severely. In other constraints political hindrances (RBQ score 55.46) were ranked as most severe because poor farmers were not getting any facilities and recognition due to the unavoidable political interference. It was followed by climatic risk and uncertainty (RBQ score 5 1.7), due to prolonged drought and harsh climate of this region farmers could not comprehend and adopt the different technologies which are out of the regular used one. The seasonal attack of diseases and insufficient coverage of success stories were not perceived as very serious (RBQ score 22.87) constrains associated with the Agri KITS prevailing in the area.

Table 4: Severity analysis of other perceived constraints

Particulars	RBQ score	Rank
Political hindrance	55.46	1
Seasonal attack of diseases	22.87	4
Climatic risk and uncertainty	51.7	2
Insufficient coverage of success stories	35.72	3

CONCLUSION

Many farmers are reluctant to adopt the advance technologies and management practices due to the lack of knowledge about the concerned area. Even though the farming community is surrounded by many players arguing the status of information providers and technology disseminators, in reality farmers have less access to those information providing systems. Perceived reasons for the non-availability and inaccessibility of those knowledge, information and technology were delineated in this study. Simple description of the reasons will not make any change in the information poor status of the farmers. In order to overcome these situation strategic consideration are very important like, (i) technology generation should be based on the felt need of stakeholders and should be in a form of easily understandable. It should be well adapted to the socio-economic settings. In order to solve the affordability issue of costlier inputs and technologies like machineries, the innovative collective actions like customer hiring centres can be promoted. (ii) The farmer to change agent ratio has to be increased to meet the information needs of large number of farmers. Effective training has to be provided to the extension persons to deliver the information or else ICT can be deployed in this manner to bridge this wide gap. Horizontal farmer to farmer extension can be

encouraged by focusing the progressive farmer as the change agent. (ii) Necessary quality inputs like seeds, fertilizers should be provided through credible government outlets at lesser price in order to avoid the dominance of private input companies. The government has to keep close eye on the input dealers through monitoring and supervision. The information regarding the activities like seed disbursement, provision of inputs on subsidy has to be uploaded on online to avoid any political injustice and to maintain transparency.

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Assessing Socio-economic and Modernization Status of King Chilli (*Capsicum spp.*) Growers: Evidence from Nagaland, North East India

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ABSTRACT

Indian agriculture is required to re-engineer with issues of climate change and to assure higher income from agriculture for farmers. Modernization of agriculture is not only conglomeration of knowledge, attitude and adoption of improved technologies for higher productivity, income and food security but also includes environmental and higher income security (i.e., doubling farmers' income by 2022). So, scientific cultivation of spices, including king chilli (*Capsicum spp.*) with scramble of environment and higher income security is not an exception. This paper is an attempt to examine the existing socio-economic and modernization status of king chilli growers in the Mon district, Nagaland, India; it will pave the way to accelerate the further modernization. Various socio-economic variables were included to examine the socio-economic status of king chilli growes. Knowledge, attitude on improved technologies and status of adoption of improved technologies in king chilli cultivation by respondents were measured. Modernization index was calculated and respondents were categorized. Study showed that 'income from king chilli' contributed around 77.42 per cent of annual income from agriculture and around 70 per cent of total annual income. Majorities (63%) were under medium and remaining (37%) were in low modernization index category. Further, variables, namely, 'experience in King Chilli cultivation', 'total size of land holding', 'size of operational land holding', 'land under king chilli cultivation', 'type of house', 'material possession', 'annual income', 'income from agricultural sector' and 'income from king chilli cultivation' were positively and significantly correlated for characterizing the modernization of king chilli cultivation.

Keywords: King chilli, Socio-economic status, Modernization, Modernization index and Correlation

INTRODUCTION

Modernization in existing agricultural scenario is a diverse and complex process. Modernization yield not only on higher production and better quality, it can simultaneously breed on ecological and environmental issues (Patra *et al.,* 2004). Patra *et al.* (2004) further emphasized that in modernizing-agriculture; knowledge, attitude and adoption are the critical inputs in characterizing the entire process. Knowledge component denotes the cognitive/knowing the existence of innovation by individual while attitude help to unleash the internalized motives and drives, and adoption is a combined effect of knowledge and attitude with other requirements.

In the present context, climate change and its impacts are forcing the agriculture sector to new normal (Jasna *et al.,* 2017). Indian agriculture is required to re-engineer with issues of climate change and to assure higher income of farmers from agriculture. Therefore, modernization of agriculture is not only conglomeration of knowledge, attitude and adoption of improved technologies for higher productivity, income and food security but also includes environmental security and higher income security (i.e., doubling farmers' income by 2022) (Chand, 2017), and cultivation of spices including king chilli (*Capsicum spp.*) with scramble of environment and higher income security is an obvious scenario.

King chilli or Naga king chilli (*Capsicum spp.*) is one of the ancient and eminent spice crops of India and especially in the North Eastern Region (NER) of the country. It is an important and well known crop used as a vegetable, spice, culinary supplement or as a condiment. The economic part is fruit that is pungent and aromatic and is used for culinary purposes. It is globally famous as hottest chilli of the world (www.guinnessworldrecords.com/world-records/hottest-chili). It is a perennial, dicotyled-

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onous plant of *solanaceae* family. It is a perennial crop but can produce fruit up to 3rd year. There are about five cultivated species of chilli under the genus capsicum viz. *Capsicum annuum* L., *Capsicum baccatum* L., *Capsicum chinense* Jacquin., *Capsicum frutescens* L. and *Capsicum pubescens* Ruiz and Pavon. Among the cultivated species *C. annum* is most widely spread and have worldwide commercial distribution (https://en.wikipedia.org/wiki/Bhut_jolokia). In NER of India, the most popular spice is the Naga king chilli. King chilli or Naga king chilli is an inter-specific hybrid of *C. chinense* and *C. frutescens*. It grows in Assam, Nagaland, Manipur, Arunachal Pradesh, Mizoram and parts of neighboring countries, namely, Bangladesh and Myanmar. The Naga king chilli is a traditional food item of the people of Nagaland and believed to be the original home (centre of origin) of this chilli pepper (https://en.wikipedia.org/wiki/Bhut_jolokia).

In recent years, king chilli is gaining importance in the scientific community as it was recognized as world's hottest chilli variety (measuring 8, 55, 000 Scoville Heat Unit, SHU) beating the Mexican Red Savana Habanaros at 5, 77, 000 SHU and officially declared on 9th September 2006 by Guinness world record ltd. (https://en.wikipedia.org/wiki/Bhut_jolokia and www.guinnessworldrecords.com/world-records/hottest-chili). The state Government also got the patent rights of Naga king chilli and got Geographical Indication from Government of India under.

Registration and Protection Act 1999 (www.nagalandpost.com and www.nelive.in). Therefore, king chilli is a traditional and potential crop in the NER and particularly in Nagaland. Traditionally, in Nagaland, king chillies are grown in burned bamboo soils while *jhumming* (Local name of sifting cultivation) and also in homestead/kitchen garden.

Nagaland consists of 11 Districts and king chilli is found to be grown in almost all the Districts. However, there are some Districts where it is growing in large scale and in commercial way. Among the 11 Districts of Nagaland, Mon is one of the Districts where king chilli is grown abundantly. Farmers of the District are growing king chilli as one of the component of mixed cropping under *jhum* cultivation, whereas some farmers are growing it commercially as mono-crop. It is also grown in small homestead garden. Apart from king chilli, rice is one of the major crop, followed by maize, yam, pulses, varieties of vegetables and other crops.

Among all the potentials, high value and high profit making crop, king chilli is abundantly growing and supporting the economy and livelihood of farmers in the State. In spite of huge contribution to rural and State economy, potentiality is relatively underestimated; up-gradation and improvement of the existing pattern of king chilli cultivation is neglected. Though, this State is regarded as centre of origin of Naga king chilli (www.nagalandpost.com and www.nelive.in), its large scale and commercial cultivation with modern technologies is relatively less popularized. Various reasons may be there for this condition, that is influencing the farming and farmer's condition. Therefore, identification of influential factors, extent and degree of influence of factors in Naga king chilli cultivation are needed to be studied and recognized.

Considering all the issues and taking into account, this study was conducted for mapping of socio-economic characteristics of the study community, status of modernization of king chilli cultivation as well as a relationship study between socio-economic characteristics and modernization index. Study was carried out with following objectives- i) to explore the socio-economic characteristics of study community, ii) to assess and map the level of modernization of king chilli cultivation, and iii) to study the relationship between various socio-economic factors and modernization of king chilli cultivation.

MATERIALS AND METHODS

Present study was conducted in Mon District of Nagaland. King chilli is an abundantly growing important crop of the district, and its cultivation plays a vital role in the economic condition and livelihood of farmers of the district. Therefore, Mon district was purposively selected to carry out the research work. District comprises of eight Blocks and out of which two blocks were selected for the study. Further, one village was purposively selected (availability of growers/respondents with required experience were taken into account for selection of village) from each block and 50 king chilli growers were purposively selected from each village and a total of 100 respondents were included in this study. An interview schedule was constructed for data collection by individual interview method. To know the socio-economic status of king chilli growers, various socio-economic factors were taken into consideration and were analyzed to furnish the valuable results. Response against each socio-economic variable was converted into suitable numerical value/score

and interpreted accordingly. Further, the value/score of socio-economic variables were used as independent variables in correlation analysis with dependent variable.

In this study dependent variable was 'Modernization Index' of individual king chilli grower to determine the modernization status of king chilli farmers. Modernization index was obtained by adding the value of ratio of awareness level, attitude level and ratio of adoption level and divided by 3 and multiplied by 100. The formula employed for calculation of modernization index is:

$$\text{Modernization index} = \frac{\text{Ratio of awareness + ratio of attitude + ratio of adoption}}{3} \times 100$$

In order to find out the ratio of awareness, 11 questions from 8 selected practices/fields related to planting material, variety, method of planting, manures and fertilizer, plant protection measures viz., weed management, insect control and disease control and harvest time have been asked to the respondents. For each question, a score of '1' was assigned in case of 'aware' and '0' for 'not aware'. This way maximum achievable score was 11 and minimum being 0. Further, the total score achieved by the respondents was divided by total achievable score i.e. 11 to get the 'ratio of awareness' value. Similar methods were adopted to find out the 'ratio of attitude' and 'ratio of adoption.'

Further, with the help of Score of modernization index, farmers were distributed into three categories, viz., Farmers with high modernization index, Farmers with medium modernization index and Farmers with low modernization index by using the following formula; Low= < (Mean – SD), Medium= between mean ± SD and High= > (Mean + SD), respectively.

The null hypothesis of the study ($H_0 1$) was 'there was no association between the socio-economic characteristics of king chilli growers and present status of the king chilli cultivation' (i.e., 'Modernization Index').

RESULTS AND DISCUSSION

The following socio-economic variables viz. Age, Education, Experience in king chilli cultivation, Size of land holding, Size of operational land holdings, land under king chilli cultivation, Annual income, Income from Agricultural sector and Income from king chilli, were included and studied to measure the socio-economic characteristics of study community.

Table 1 shows the distribution of study community according to their socio-economic features. Most of the respondents (59%) belonged to middle age group and the remaining 37 per cent and 4 per cent were belonged to the old age group and young age group respectively. The average age of the respondents was 48 years and it ranged from 35 to 60 years. On the other hand 52 per cent of the respondents were having 4 to 6 years of experience in king chilli cultivation and 29 per cent were having 7 to 10 years of experience. Another, 11 per cent of the respondents had only upto 3 years of experience and 8 per cent had above 11 years of experience in king chilli cultivation.

Educational status of the respondents was in pitiable state, around 40 per cent of the respondents were illiterates, another, 39 per cent had received education only upto class IV, followed by 20 per cent of respondents who received middle school education and only 1 per cent of the respondents received education upto matriculation. It was also observed that older respondents were having lower educational qualification and young respondents were relatively more qualified. Table 1 also contains information about distribution of the respondents according to their primary occupation. Around 94 per cent of the respondents' primary occupation was farming. Remaining 3 per cent each of the respondents were continuing with business and government job, respectively but they were continuing agriculture and king chilli cultivation as subsidiary occupation.

Majority of the respondents (56%) had '*kutcha* house' and this type of house was characterized by bamboo made walls and pillars and roof made from palm leaf. On the other hand 43 per cent of the respondents had '*pucca* house'. This type of house characterized by cemented walls and Corrugated Galvanized Iron (CGI) sheet made roof. The Table 1 also shows that only 1 per cent of the respondents had Reinforced Concrete Cement (RCC) type of house. In respect of material possession, around 95 per cent of respondents had possessed gun whereas, 78 per cent had cell phones and 45 per cent of them had possessed television in their house. On the other hand only 9 per cent of the respondents had radio and negligible portion (i.e. 1%) of the respondents had two wheelers/ motor cycle and in respect of 'accessibility of village', both the villages were far from the expected level.

On the other hand need for strengthening extension system for prompt technology transfer has well recognized

Table 1: Socio- economic characteristics of the king chilli growers (N=100)

Variable	Category	Frequency	Percentage
Age	≤35 years (young age)	4	4
	36-50 years (middle age)	59	59
	≥51 years (old age)	37	37
Experience in king chilli cultivation	Upto 3 years	11	11
	4 to 6 years	52	52
	7 to 10 years	29	29
	Above 11	8	8
Educational Qualification	Illiterate	40	40
	Upto class V	39	39
	Upto class VIII	20	20
	Upto class X	1	1
Occupation (primary)	Farming	94	94
	Business	3	3
	Government Employee	3	3
Type of House	Kutcha house	56	56
	Pucca house	43	43
	RCC	1	1
Material Possession	Gun	95	95
	Phone	78	78
	Television	45	45*
	Radio	9	9*
	Two wheeler	1	1
Extension Contact (NGO and KVK workers)	Sometimes	57	57
Accessibility of village	Moderate	1	50
	Poor	1	50

*sources of information had not accessed for agricultural information

(Sahoo *et al.,* 2017) and findings of present study supporting the agreement. In the study area only 57 per cent of the respondents had accessed extension service from functionaries of NGO and KVK.

Modernization of agricultural sector is directly associated with productivity of crops and diversity in crop production. Agricultural productivity is directly linked with the accessibility of improved agricultural information (Sharma *et al.,* 2012) and extension delivery mechanism. But Indian rural farmers have very limited access to improved agricultural information (Jain, 2011). The study area is not an exception; none of the respondents have accessed state extension services, radio and TV for agricultural information. Therefore, reorientation of institutional and policy mechanism of state agricultural policy and agricultural extension delivery mechanism is urgently needed (Patra, 2018).

Table 2 contains the information related to the distribution of the respondents according to their size of land holding under different land use classes. It was found that 42 per cent each of the respondents had small and semi-medium land holding respectively. Study also shows that 10 per cent of respondents had marginal land holding and 6 per cent of respondents had medium land holding. On the other hand large and landless farmers were not present in the study area. It can be concluded that 48 per cent of the respondents had land holding of 5.01 acres or more.

According to the operational land holding pattern of the respondents, 63 per cent of the respondents had small operational land holding. On the other hand, 24 per cent of the respondents had marginal operational land holding, followed by semi-medium category (13%). Study further shows that large and landless farmers (according to their

Table 2: Distribution of respondents according to land holding under different sub-classes (N=100)

Category	Size of land holding		Operational land holding		Land under king chilli	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Landless (<0.025 Acre)	0	0	0	0	0	0
Marginal (0.025-2.5 Acre)	10	10	24	24	37	37
Small (2.51-5 Acre)	42	42	63	63	63	63
Semi medium (5.01-10 Acre)	42	42	13	13	0	0
Medium (10-25 Acre)	6	6	0	0	0	0
Large (>25 Acre)	0	0	0	0	0	0

operational land holding size) were not present in the study area. From the table it can be concluded that 76 per cent of the respondents had possessed 5 acres or more land for agriculture and allied activities.

Similarly, in respect of land under king chilli cultivation, 37 per cent of respondents had marginal (0.025-2.5 Acre) area of land under king chilli cultivation and remaining 63 per cent had Small (2.51-5 Acre) area of land under king chilli cultivation. Land under king chilli ranged from 1-5 acre, where average size of holding under king chilli was 2.80 acre. It can be concluded that 63 per cent of the respondents had possessed 2.51 to 5 acres of land under king chilli cultivation.

Table 3 contains the information about the distribution of the respondents according to cropping pattern. Around 55 per cent of the respondents had followed mixed and mono cropping concurrently and 42 per cent of respondents had followed mixed cropping and remaining 3 per cent of respondents had purely followed mono-cropping. Nearly, 60 per cent of mixed cropping growers were in marginal farmers' category and remaining 40 per cent of mixed cropping farmers were from small category. Out of the total respondents followed 'both' practices, 82 per cent were under small category and remaining 18 per cent were under marginal category (Table 3). Income is one of the important parameter to express the socio-economic and livelihood status of the study community. Table 4 shows the distribution of study community according to their annual income, income from agriculture and income from king chilli cultivation, respectively. Majority of the king chilli growers (71%) were in medium annual income group i.e. from Rs. 21,278 to 60,702. Another 15 per cent of the respondents were in high annual income group i.e. more than Rs. 60,702 and remaining 14 per cent had low annual income i.e. less than Rs. 21,277. The annual income of the respondents was ranged from Rs. 8,500 to Rs. 1,30,000 and with average annual income of Rs. 40,990.

In respect of annual income from agricultural sector, around 66 per cent of respondents were having medium (Rs. 20,301-53,335) level of annual income from agricultural sectors. On the other hand, 17 per cent each of the respondents were having low level of annual income and high level of annual income from agricultural sectors. The annual income of the respondents from agricultural sector was ranged from Rs. 1,200 to Rs. 1,20,000. The average annual income from agricultural sector was Rs. 36, 818. From the study it can be concluded that around 83 per cent of the farmers are earning moderately from agricultural sectors.

On the other hand majority of the respondents (76%) were in medium (Rs 13,834-43,266) level of income from king chilli cultivation, whereas, 16 per cent of the respondents had high level of income from king chilli

Table 3: Categorization of respondents according to their land under king chilli cultivation and cropping pattern (N = 100)

Category	Mixed cropping (N=42)		Mono cropping (N=3)		Both (N=55)		Total (N=100)	
	F*	%*	F	%	F	%	F	%
Landless (<0.025 Acre)	0	0	0	0	0	0	0	0
Marginal (0.025-2.5 Acre)	25	59.53	2	66.66	10	18	37	37
Small (2.51-5 Acre)	17	40.47	1	33.33	45	82	63	63
Total	42	100	3	100	55	100	100	100

*F=frequency and %= percentage

Table 4: Distribution of respondents according to income N=100

Category	Frequency	Percentage	Mean	Sd
1. Annual Income				
Low (< Rs. 21,277)	14	14	40,989	19,712
Medium (Rs. 21,277-60,702)	71	71		
High (> Rs. 60,702)	15	15		
2. Income from agriculture				
Low (< Rs. 20,301)	17	17	36,818	16,517
Medium (Rs. 20,301-53,335)	66	66		
High (> Rs. 53,335)	17	17		
3. Income from king chilli cultivation				
Low (< Rs. 13,834)	8	8	28,550	14,716
Medium (Rs 13,834-43,266)	76	76		
High (> Rs. 43,266)	16	16		

cultivation. Around 8 per cent of the respondents were having low level of income from king chilli cultivation. The annual income of the respondents from king chilli cultivation was ranged from Rs.1,000 to Rs. 90,000 with mean annual income from king chilli was Rs. 28,550. It is also emerged that income from king chilli contributed around 77.42 per cent of annual income from agriculture and around 70 per cent of annual income.

Status of modernization of king chilli cultivation and relationship between various factors and modernization: In this study, an attempt was made to categorize the farmers according to their modernization index (the mean score of modernization index was 43.67) and to find out the relationship between various independent variables and dependent variable.

Table 5: Distribution of respondents according to their modernization index (N=100)

Category	Score range	Population
Low	< (Mean – SD)	37
Medium	Mean ± SD	63
High	>Mean + SD	00

Table 5 shows the distribution of respondents according to their modernization index. Majority (63 per cent) of the study community were under medium modernization index category. Remaining 37 per cent of the respondents were belonged to low modernization index category. There was no respondent under high modernization index category. In the correlation study, 136 correlations emerged out and of which 27 were negatively correlated and 109 were positively correlated, where 60 were found to be significant. Out of these, 6 were positively significant at 5% and 54 were significant at 1% level. In this paper only correlations with independent variables versus dependent variable were taken into consideration (Table 6) and correlations among the independent variables were neglected. Further hypothesis testing was carried out based on the significant relationship between independent versus dependent variables.

The findings presented in Table 6 revealed the relationship between the independent variables and the modernization index. It was found that the variables, namely, 'experience in king chilli cultivation', 'total size of

Table 6: Relationship between various factors and modernization index of king chilli cultivation

Variables	Value of 'r'	Hypothesis testing ($H_0$1)
Age	0.101^{NS}	Accepted
Experience in king chilli cultivation	0.318**	Rejected
Accessibility of the villages	-0.032^{NS}	Accepted
Educational status of the respondents	0.167^{NS}	Accepted
Occupation of the respondents	0.066^{NS}	Accepted
Total size of land holding	0.513**	Rejected
Size of operational land holding	0.476**	Rejected
Land under king chilli cultivation	0.375**	Rejected
Type of house	0.392**	Rejected
Material possession	0.426**	Rejected
Annual income	0.500**	Rejected
Income from agricultural sector	0.585**	Rejected
Income from king chilli cultivation	0.602**	Rejected
Source of information	-0.077^{NS}	Accepted
Extension contact	-0.067^{NS}	Accepted

**Significant at 1% level; NS – not significant

land holding', 'size of operational land holding', 'land under king chilli cultivation', 'type of house', 'material possession', 'annual income', 'income from agricultural sector' and 'income from king chilli cultivation' had positively and significantly correlated for characterizing the modernization level of king chilli cultivation. The correlation value between 'age,' 'educational status' of the respondents, and 'occupation' of the respondents were positively correlated for modernization level of king chilli cultivation. The correlation values of 'accessibility of the village', 'source of information' and 'extension contact' were -0.032, -0.077 and -0.067 and negatively correlated with modernization level of king chilli cultivation. Owing to poor 'accessibility of villages', non availability of 'sources of information' and inadequate 'extension contact' the relationship study with modernization index had produced negative correlation.

CONCLUSION

It can be concluded from the study that the educational status of the respondents was in pitiable state; around 40 per cent each of the respondents were 'illiterates' and 'educated upto class IV', respectively. Around 37 per cent respondents had marginal (0.025-2.5 Acre) area of land under king chilli cultivation and remaining 63 per cent had Small (2.51-5 Acre) area of land under king chilli cultivation. Land under king chilli was ranged from 1-5 acres; with average size of holding under king chilli was 2.80 acres. The mean annual income from king chilli was Rs. 28,550. Income from king chilli had contributed around 77.42 per cent of annual agricultural income, and around 70 per cent of total annual income. Around, 63 per cent of the study community was under medium modernization index and remaining 37 per cent was under low modernization index category. None of the respondents was under high modernization index category and index ranged from 41.80 to 77.86. Variables, namely, experience in king chilli cultivation, total size of land holding, size of operational land holding, land under king chilli cultivation, type of house, material possession, annual income, income from agricultural sector and income from king chilli cultivation were positively and significantly correlated for characterizing the modernization level of king chilli cultivation. Immediate intervention is needed to up-scale the education, knowledge and attitude of farmers on improved management practices of king chilli and status of adoption of improved technologies in king chilli cultivation for modernization of king chilli cultivation and to achieve food, environment and higher income security.

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Impact of Front Line Demonstration on Okra in Kathua District of Jammu and Kashmir

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ABSTRACT

Realizing the importance of frontline demonstrations the form of demonstration of the production and protection technology at the farmer field under the complete supervision of scientists in different agro climatic regions and farming situations Krishi Vigyan Kendra Kathua, Jammu & Kashmir conducted FLDs on Okra at farmer's field and accordingly impact was recorded in Kathua district. The study revealed that majority of the beneficiaries (90%) had adopted high yielding variety resistant to yellow vein mosaic virus. The important package of practices where more increase in adoption was found were use of recommended fertilizer dose (57%), seed treatment (50%), use of high yielding improved variety (47%), line sowing on ridges and furrow, plant protection measures to control insects-pests and diseases (40%), weed management (35%), use of proper seed rate and spacing (30%). The mean knowledge and adoption scores of beneficiaries were higher comparatively to non-beneficiaries. It was also observed that majority of beneficiaries had medium to higher knowledge and adoption of production technology promoted through front line demonstration. This might be due to the concentrated educational efforts made by KVK scientists in implementation of front line demonstrations. There was significant difference observed in yield and B:C ratio of okra before the FLD and after FLD programme. The data also signified strong satisfaction of farmer about the services rendered by scientists through front line demonstration ultimately lead to increase in knowledge and adoption level of beneficiaries and higher yields and economic net returns.

Keywords: Front line demonstration, Impact, Adoption, Benefit: cost ratio, Okra

INTRODUCTION

Indian agriculture has always acted as a catalyst for stronger and sustained economic growth of the country. India is the second largest producer of the vegetables. In India area under vegetable is 9.21 million ha with the production of 162 million tones resulting in productivity of about 17.6 MT/ha. Mostly the vegetables are grown under irrigated condition in normal condition and in un-irrigated conditions during rainy season with low productivity. Many high yielding varieties have been released for cultivation but their adoption by the farmer is less. In Kathua district, majority of the area is under cereals, however the efforts are being made by the KVK to motivate the farmers to grow vegetables through training programmes, awareness camps, and field days. In Kathua district of Jammu and Kashmir area under vegetable cultivation is 4705 ha with the production of 941000 metric tons with a very low productivity of about 200 kg/ha which may be attributed to non adoption of improved varieties and their package of practices.

The okra is one of the most important crops available throughout the year at steady and stable market price and early crop always fetch higher price as compared to other commonly available vegetable. Although vegetable growers of Kathua district cultivate the okra along with other vegetable crops. Still it crop gives good returns to the farmers and has emerged as important vegetable crop due to the available irrigation in irrigated region and during monsoon in rainfed region. Also technology development with regard to improved varieties and other inputs have played important role in raising productivity.

Frontline demonstration a concept evolved by ICAR to demonstrate the latest crop production technologies and its management practices in the farmer's field under different agro-climatic regions and farming situations under close supervision of the scientist work on the principles of Believing through seeing and learning by doing and helps in technology integration. Realizing the importance of frontline demonstrations in transfer of okra production technologies, Krishi Vigyan Kendera, Kathua conducted

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front line demonstration for three years in different locations of Kathua district with the objective of convincing farmers and extension functionaries together about the okra crop production technologies for wider technology application. In order to further strengthen the programme the FLDs need validation for various performance parameters in respect to yield and economics. The present investigation was planned and conducted to evaluate the front line demonstration in term of extent of knowledge of farmer and adoption of recommended okra production technology, assess the impact in terms of yield and economics along with the satisfaction of beneficiaries regarding services rendered.

MATERIALS AND METHODS

The present study was conducted in Kathua district of Jammu and Kashmir during 2014-2016, total 150 farmers were included in front line demonstrations on Okra production technology. For this purpose four tehsils were selected purposively in which okra FLD'S had been given by KVK Kathua during *kharif* season. For the selection of respondents, a list of farmers was prepared who laid out the FLDs. Randomly, ten farmers from each tehsil were selected making a total sample size of forty. Basic data of the beneficiaries was collected from KVK. The data were collected by personal interview technique with the help of interview schedule developed for the study. The interview schedule developed through discussion with experts, scientists and extension officers working in the district. Under these FLDs, forty farmers and an area of 4.0 ha was covered.

Knowledge was operationally defined as the technical knowhow, possessed by the individual okra cultivator about okra production technology. A structured schedule was developed for measuring the knowledge of the respondents/beneficiaries about various aspects of okra cultivation as envisaged in the front line demonstrations. Adoption was operationalised present as practicing the recommended package of practices of okra cultivation by the farmer. The selected practices were administrated through structured interview schedule to the farmers for measuring the extent of adoption. For assessing the impact of front line demonstration recorded data on front line demonstrations available with KVK were collected and computed. The impact of front line demonstration in the present investigation was studied on the percentage of increase in yield in comparison to local practices, net and gross returns obtained and benefit cost ratio in comparison to local practice.

Satisfaction of beneficiaries was taken as to react positively or negatively towards the services rendered during front line demonstrations through various dimensions like technology demonstrated , training of participants, timeliness of services, provision of inputs, field visits, diagnosis and advisory services to field problems, organization of extension activities, performance of variety demonstrated and overall impact of front line demonstration. The selected respondents were interviewed personally with the help of structured interview schedule on different dimension. Client satisfaction index of each respondent was calculated as developed by Kumaran and Vijayraghavan (2005). All the

Table 1: Demonstrated package of practices and farmer practice for okra cultivation

Particular	Demonstrated practices	Farmer practices
Improved variety resistant to yellow Mosiac virus	Varsha Uphar	Local variety
Sowing time	June-2nd fortnight	July
Seed treatment	Seed treated with Bavistin	Not followed
Seed rate and spacing	15 kg/ha at 45x30 cm	20-22 kg broadcast
Recommended fertilizer dose	25 tonnes FYM, 60 kg N+30 kg P_2O_5+30 kg K_2O. 1/3rd N+Full dose of P_2O_5 & K_2O at the time of sowing and remaining 2/3rd equally distributed at 30 and 60 DAS	Only FYM and small amount of DAP.
Plant protection measures to control Insects-pest and disease	Need based application stem and fruit brorer-Cypermethrin 0.2ml/lt of water (spraying) Aphid- Diamethoate 1ml/lt	Not followed
Irrigation	Once in a week	Once / twice in week
Weed management	Pre –emergence herbicide basalin	Hand weeding 3- 4
Harvesting at proper stage	Demonstrated use of cutter for picking of fruits at proper stage	Used local knife and at improper stage

data were analyzed with appropriate statistical procedures. The information on demonstrated package of practice and farmer practice followed are mentioned in Table 1.

RESULTS AND DISCUSSION

Extent of farmer's knowledge on okra production technology: The information regarding knowledge level of respondents about okra production technology has been presented in Table 2 and reflects that majority of beneficiaries (57%) possessed medium knowledge followed by high knowledge (25%) and low knowledge (17%) categories of respondents about improved package of practices of okra production technology. With regard to non beneficiaries, majority of the respondents possessed medium to low knowledge (each 40%) regarding okra production technology. However the mean score of beneficiaries were comparatively higher that of mean knowledge scores of non beneficiaries. This showed positive impact of front line demonstration on knowledge of farmers which resulted in higher adoption of improved okra production technology. This might be due to concentrated efforts made by KVK scientists in implementation of front line demonstration.

Table 2: Extent of farmer's knowledge on okra production technology

Knowledge of Farmer	Beneficiaries (n=40)		Non beneficiaries (n=10)	
	Frequency	Percent	Frequency	Percent
Low (<28)	7	17	04	40
Medium (29-33)	23	57	04	40
High (>)	10	25	02	20

Adoption of recommended package of practices: Adoption of the improved package of practice was the ultimate outcome to be judged in terms of the impact of frontline demonstration. The data presented in the Table 3 reveals that majority (90%) of the respondents had adopted improved okra variety followed by application of recommended fertilizer dose (82%), seed treatment (80%), line sowing on ridges and furrows (77%), plant protection measures to control pests and diseases (72%), use of proper seed rate and spacing (72%) and timely irrigation (70%). Increase in adoption in the important package of practices where use of recommended fertilizer dose (57%), seed treatment (50%), use of high yielding variety (47.5%) plant protection measures to control insects pests and diseases (40%), line sowing on ridges sand furrows (40%), weed management (35%), use of proper seed rate and spacing (30%), sowing time of okra (30%), where as the increase in adoption was less in case of harvesting at proper stage of maturity (22%) and timely irrigation (25%). The more adoption rate by beneficiaries was due to more exposure of improved package practices of okra acquired through direct laying and organization of demonstrations, participation in skill training programme and close contact with programme officials in learning and applying the skilled techniques of okra cultivation. This might be due to concentrated educational efforts made by KVK scientists through implementation of front line demonstration. These findings were in close conformity with the results reported by Thaker and Patel (2006); Singh *et al.* (2014).

The data in the Table 4 reveals that the yield of okra increased per hectare by 51.3 per cent in front line

Table 3: Extent of adoption of recommended package of practices of okra crop before and after FLD

Package of practice	Adoption (Before FLD)		Adoption (After FLD)		Increase in Adoption	
	No.	Percent	No.	Percent	No.	Percent
Use of high yielding improved variety	17	42	36	90	19	47.5
Sowing time of okra	15	37	27	67	12	30
Seed treatment	12	30	32	80	20	50
Use of proper seed rate and spacing	16	53	29	72	13	30
Line sowing on ridges and furrows	22	55	31	77	9	40
Recommended fertilizer dose	10	25	33	82	23	57
Plant protection measure to control insects pests and diseases	13	32	29	72	16	40
Timely irrigation	19	47	28	70	10	25
Weed management	11	44	25	62	14	35
Harvesting at proper stage	15	37	24	60	9	22

Table 4: Yield of okra before FLD and after FLD

Average yield of Okra crop (q/ha)		Percent increase
Before FLD	After FLD	in yield
75.6	114.9	51.3

demonstration plots. The significant yield difference may be attributed to the improved variety along with technology demonstrated through FLD and its adoption by the front line demonstration beneficiaries. The successful outcome of the demonstrations have shown efficacy of intervention framed and demonstrated through FLD'S .The results are similar to the findings of Jha *et al.* (2011); Manjarekar *et al.* (2015).

Economic Impact: The economic impact of the demonstrated okra technology was worked out by calculating total cost, gross return, net return and B:C ratio (BCR) of before FLD plot and after FLD plot. Total cost was calculated by total sum of expenditure of land preparation, seed, manure and fertilizers, plant protection measures, irrigation and labour component.

Table 5: Profitability of okra before and after FLD

Item	Before FLD	After FLD
Cost of cultivation (Rs/ha)	60625	68480
yield of okra	75.6	114.9
Gross Return	151200	240240
Net return	90575	167320
B:C ratio	1.4	2.6

The data in the Table 5 reveals that before FLD the yield of the okra was 75.6 q/ha while after FLD the yield was 114.9 q/ha. The B:C ratio for okra before FLD was 1.49 (calculated @ Rs 2000/- per quintals), which increased to 2.6 after FLD. However, increase in B:C after FLD plot was due to adoption of 50 to 87.5 per cent adoption of different package of practices. Similar results were reported by Sharma and Sharma (2004); Patel and Patel (2014).

Satisfaction of beneficiaries regarding services rendered through Front line demonstration: The concept of satisfaction of beneficiaries was measured as to react positively or negatively towards the services rendered through frontline demonstrations.

A close observation of figures presented in the table 6 depicts that majority (57%) of the respondents expressed medium to high (25%) level of satisfaction for the extension services rendered and performance of the technology demonstrated. Relatively very less respondents (17%) expressed lower level of satisfaction. The results signified the positive response of beneficiaries towards the services rendered through FLDs. It also depicts the stronger conviction and active involvement of beneficiaries in laying the demonstration which would lead to increase in knowledge level and higher adoption. This showed the optimism and relevance of organization of front line demonstration.

Table 6: Extent of satisfaction of beneficiaries about services rendered through organization of FLDs

Satisfaction of	Beneficiaries (n=40)	
beneficiaries	Frequency	Percent
Low (<85)	07	17
Medium (85-95)	23	57
High (>96)	10	25

CONCLUSION

On the set of technologies of okra crop before frontline demonstration, the adoption was very less but after the FLD programme most of the farmers became aware about recommended production technologies of okra crop. The important package where more increase in adoption was found included use of recommended fertilizer dose, timely irrigation, use of high yielding improved variety, use of proper seed rate and spacing after FLD as compared to before FLD. Increase in B:C ratio after FLD plot was due to adoption of 50.00 to 87.5 per cent adoption of different package of practices after FLD which show positive impact of FLD on adoption of demonstrated technology. The strong satisfaction of farmer about the services rendered by scientists through front line demonstrations promoted the physical and mental active involvement of the beneficiaries which ultimately led to increase in knowledge and adoption level of beneficiaries.

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Perception of Faculties on Teaching and Learning Indicators for Monitoring and Evaluation of Agricultural Education System of India

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ABSTRACT

Every year thousands of students pass out from agricultural higher education system of India. Maintaining the quality of agricultural education is paramount important for greater interest of India. For maintaining the quality of agricultural higher education in India under global perspective a set of indictors should be developed, as indicator conveys a general impression with more or less precision. Under this backdrop, this research work was undertaken with the objectives to identify and validate the Indicators for Monitoring and Evaluation (M&E) of Agricultural Education System (AES) of India in teaching-learning. Altogether 26 indicators for M&E in AES in India were validated in the areas of Human Resource and Finance, students' outstanding academic performance, job opportunities for pass out students, change in curriculum, degree completion by students, staff to student ratio and girls students' ratio. These indicators will help universities, government or other independent agencies for maintaining quality of agricultural higher education in India under global scenario.

Keywords: Students, Agricultural university, Quality, Higher education

INTRODUCTION

Agricultural higher education is imparted in India through ICAR-Agricultural Universities (AUs) system comprising of State Agricultural Universities (64), Deemed to be universities (5), Central Agricultural University (3) and Central Universities (4) with Agriculture Faculty. Private agricultural universities and colleges are also running academic programme in Agricultural higher education. Every year thousands of students passed out. Maintaining the quality of agricultural education is paramount important. However, higher agricultural education system of India is facing the problems of dilution in the quality of agricultural education; inadequate infrastructure, financial support, cenralized planning of agricultural education system and curricula is not addressing the local needs to the extent required (NAAS 2005). So, there should be some indicators, those can be used for monitoring and evaluation of the agricultural higher education system of India. As, indicator is something that conveys a general impression with more or less precision - something that gives a broad indication of the state of the situation investigated (Johnstone, 1981). The rationale behind indicators in higher education is to ensure the education provided to students equips them for employment and provides the nation with a highly skilled workforce that supports economic growth (Trowler *et al.*, 2005). Institutional and national quality models and performance indicators are considered vital components in raising the standard of higher education (Marginson and Van der Wende, 2007) and developing effective mechanism for communication of farm information and dissemination of technology to the farmers (Roy Burman *et al.*, 2013), overall communication, organizational culture and team work of agricultural universities (Yunus and Desai, 2017). Under this backdrop, this research work was undertaken with the objectives to identify and validate the Indicators for monitoring and evaluation of Agricultural Education System of India.

MATERIALS AND METHODS

There are number of organisations, institutions, agencies those independently assess the academic institutions through the process of ranking (world and regional) *viz.* Academic

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Ranking of World Universities (ARWU), Times Higher Education (THE), U-Multi rank, Higher Education Evaluation and Accreditation Council of Taiwan, (HEEACT), U.S. News Best Global Universities Rankings, Australian Universities Ranking; National Institute Ranking Framework in India; ICAR Agricultural University Ranking *etc.* For present study, indicators of aforesaid agencies were reviewed and an exhaustive list of indicators was made. Finally, through expert judgement the scale was developed. Five point Likert Scale was used for recording the response/perception of the respondents. For the study, data was collected from 250 faculties of twenty two agricultural universities across India. Among these respondents 126, 33 and 91 were Assistant Professor, Associate Professor and University Professor respectively. The period of data collection was January to February, 2017.

Formula for selection of Indicators

1) Mean value for Assistant Professor response is symbolised as M_1
2) Mean value for Associate Professor response is symbolised as M_2
3) Mean value for Professor response is symbolised as M_3
4) Mean value for altogether response is symbolised as M_4

Criteria for selection of a specific indicator:

$M_1 = M_2 = M_3 = M_4 = 2$ or more .....(Criteria 1)

$M_1 = M_2 = M_3 = 2$ or more .....(Criteria 2)

$M_1 = M_2 = M_4 = 2$ or more..... (Criteria 3)

$M_2 = M_3 = M_4 = 2$ or more .....(Criteria 4)

If any of the listed 42 indicators (Table 5) satisfied any one of the aforesaid criteria, it was selected for the monitoring and evaluation of agricultural Education System of India in the study.

RESULTS AND DISCUSSION

It is noted that out of 250 teachers/scientists respondents, 50.40% respondents were Assistant Professor; and 13.20% and 36.40% respondents were Associate Professor and Professor, respectively (Table 1). It was also noted that altogether (Assistant Professor, Associate Professor and Professor), the respondents' mean experience is 17.372 years with SD 10.110 (Table 2).

Table 1: Distribution of respondents (teachers/scientists) as per their designation (n=250)

Designation	*f*	Per cent
Assistant Professor	126	50.40
Associate Professor	33	13.20
Professor	91	36.40
Total	250	100.00

Table 2: Distribution of the respondents according to their teaching and research experience (n=250)

Categories	Mean	SD
Assistant Professor	10.992	7.866
Associate Professor	18.121	7.139
Professor	26.34	6.412
Altogether (Asst. Prof + Assoc. Prof. + Prof.)	17.372	10.11

Table 3: Reliability statistics of the Scale

Categories	Cronbach's alpha
Assistant Professor	0.960
Associate Professor	0.958
Professor	0.967
Altogether	0.961

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. The alpha coefficient for the 42 indicators (Table 5) is 0.960 (Assistant Professor), 0.958 (Associate Professor), 0.967 (Professor) and 0.961 (Altogether), respectively and suggesting that the items have relatively high internal consistency (A reliability coefficient of 0.70 or higher is considered "acceptable" in most social science research situations). Taking the experiences of the respondents as dependent variable and remaining 42 indicators as independent variables, regression analysis was conducted and it was noted that R^2 was 0.595 which implied that all those indicators explained 59.50% variation in the model (Table 4).

Table 4: Model Summary

Model Summary			
R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
0.771	0.595#	0.067	9.62112

#While in natural science research it is not uncommon to get R^2 values as high as 0.99, a much lower value (0.10-0.20) of R^2 is acceptable in social science research (Gaur and Gaur, 2006).

Table 5: Indicators for monitoring and evaluation of agricultural Education System of India (n=250)

S.No.	Indicators (1)	Respondents categories with their Mean & SD								
		Asst. Professor (A) (n_1=126)		Assoc. Professor (B) (n_2=33)		Professor (C) (n_3=91)		Altogether (A+B+C) (n_4=250)		Remark on validation of Indicator
		Mean (M_1) (2)	SD (3)	Mean (M_2) (4)	SD (5)	Mean (M_3) (6)	SD (7)	Mean (M_4) (8)	SD (9)	(Selected/ Rejected) (10)
1	Selection of students in ARS during last 5 years.	**2.225**	0.824	**2.515**	0.565	**2.427**	0.637	**2.337**	0.736	Selected
2	JRF/SRF/Upper 5% Rank in GATE during last year.	**2.325**	0.646	**2.363**	0.652	**2.505**	0.621	**2.396**	0.641	Selected
3	Number of students receiving awards at national and international levels.	**2.032**	0.822	**2.090**	0.842	**2.255**	0.786	**2.121**	0.815	Selected
4	Alumni of the institution winning national and international Prize.	1.926	0.860	**2.093**	0.689	**2.044**	0.801	**2.091**	0.818	Selected
5	Ratio of Ph.D.s awarded to total students admitted.	1.967	0.913	**2.000**	0.901	1.955	0.903	1.967	0.904	Rejected
6	Number of students received ICAR Jawahar Lal Nehru Award for Ph. D.	1.804	0.980	1.625	0.975	1.835	0.969	1.792	0.974	Rejected
7	Percentage of doctoral graduates with research stipend who presented their thesis in a maximum of three years.	1.886	0.907	1.878	0.819	**2.175**	0.692	1.991	0.831	Rejected
8	Number of University students getting admission in M.Sc. and Ph.D. through ICAR entrance examination & in Deemed Universities of ICAR during last year.	**2.285**	0.702	**2.272**	0.626	**2.263**	0.712	**2.276**	0.694	Selected
9	Ratio of the number of entries into a first degree programme to the number of students obtaining a first degree.	**2.064**	0.793	**2.156**	0.574	**2.133**	0.767	**2.101**	0.757	Selected
10	Re-entries into higher education and success rate (PG & Ph.D.).	**2.087**	0.759	**2.218**	0.659	**2.065**	0.827	**2.096**	0.771	Selected
11	Percentage of graduates following the bachelor's-master's doctorate qualifications structure.	**2.016**	0.712	**2.062**	0.715	1.976	0.685	**2.008**	0.701	Selected
12	Number of graduated/PG student admitted to foreign university to total no. of student.	1.587	1.006	1.848	1.003	1.659	0.945	1.648	0.983	Rejected
13	Number of students admitted from overseas during last 5 year	1.523	1.025	**2.000**	0.983	1.648	0.899	1.630	0.983	Rejected
14	Adoption of ICAR 5th Dean committee syllabus.	**2.379**	0.727	**2.406**	0.665	**2.307**	0.725	**2.356**	0.717	Selected
15	Doctorate-to-bachelor's ratio.	1.768	0.824	**2.121**	0.819	1.715	0.843	1.796	0.837	Rejected
16	Percentage of girls students to total student.	**2.104**	0.842	**2.218**	0.750	1.844	0.898	**2.024**	0.897	Selected
17	Number of physically challenged students get admission to total student.	1.456	0.911	1.636	0.742	1.355	0.825	1.443	0.861	Rejected
18	International-to-domestic-student ratio.	1.476	0.969	1.545	0.904	1.500	0.962	1.494	0.955	Rejected
19	Percentage of students from other states.	1.984	0.903	**2.060**	0.863	**2.054**	0.834	**2.020**	0.871	Selected
20	Doctorates awarded-to-academic staff ratio.	1.968	0.832	**2.181**	0.768	**2.011**	0.910	**2.012**	0.852	Selected
21	% of passed out students employed.	**2.424**	0.743	**2.727**	0.516	**2.483**	0.603	**2.485**	0.672	Selected

Table 5 contd.....

S.No.	Indicators (1)	Respondents categories with their Mean & SD								
		Asst. Professor (A) (n_1=126)		Assoc. Professor (B) (n_2=33)		Professor (C) (n_3=91)		Altogether (A+B+C) (n_4=250)		Remark on validation of Indicator
		Mean (M_1) (2)	SD (3)	Mean (M_2) (4)	SD (5)	Mean (M_3) (6)	SD (7)	Mean (M_4) (8)	SD (9)	(Selected/ Rejected) (10)
22	Salaries and wages of graduates from higher education.	**2.064**	0.759	**2.030**	0.683	**2.088**	0.697	**2.068**	0.725	Selected
23	Number of student becomes Entrepreneur to number of students passed.	1.976	0.827	1.968	0.999	1.901	0.857	1.947	0.859	Rejected
24	Graduation rate.	**2.240**	0.755	**2.187**	0.931	**2.300**	0.741	**2.255**	0.772	Selected
25	Relative rate of graduate employment.	**2.179**	0.719	**2.451**	0.623	**2.292**	0.606	**2.253**	0.672	Selected
26	Time to degree.	**2.403**	0.815	**2.300**	0.876	**2.370**	0.788	**2.378**	0.811	Selected
27	Fellowship or Associateship of National Science Academies recognized by ICAR/ICMR/DST/CSIR.	**2.222**	0.778	**2.156**	0.677	**2.318**	0.787	**2.249**	0.768	Selected
28	Number of doctorate degree staff to total no. of staff.	**2.301**	0.782	**2.545**	0.616	**2.329**	0.768	**2.344**	0.759	Selected
29	Staff-to-student ratio	**2.206**	0.762	**2.303**	0.809	**2.373**	0.693	**2.280**	0.745	Selected
30	International-to-domestic staff (academic & research) ratio.	1.432	0.986	1.687	0.997	1.522	0.926	1.498	0.966	Rejected
31	% of faculty from the state other than the state in which university situated.	1.928	0.868	1.937	0.840	1.945	0.834	1.935	0.849	Rejected
32	Staff of the institution winning national and international Prize.	1.935	0.762	1.906	0.856	**2.011**	0.737	1.959	0.764	Rejected
33	% of faculty positions filled in teaching, research and extension.	**2.190**	0.816	**2.406**	0.756	**2.472**	0.672	**2.321**	0.768	Selected
34	Number of Academic Staff with 6 months or more of Post doctoral/ Visiting scientist experiences abroad.	1.800	0.889	1.875	0.975	1.846	0.905	1.826	0.903	Rejected
35	Total number of staff accepted as members in the national international professional bodies/associations.	1.920	0.848	**2.281**	0.771	1.967	0.737	1.983	0.804	Rejected
36	Number of new executive programmes conduct by universities.	1.976	0.794	1.939	0.658	1.956	0.828	1.964	0.788	Rejected
37	Number of new professional development programmes/short courses conduct by universities.	**2.047**	0.778	**2.272**	0.719	**2.175**	0.739	**2.124**	0.758	Selected
38	Proportion of programmes reviewed in the last 5 years.	1.826	0.744	1.968	0.739	1.978	0.745	1.898	0.744	Rejected
39	Proportion of programmes that are responsive to the national priorities.	**2.016**	0.796	**2.212**	0.649	**2.186**	0.773	**2.104**	0.772	Selected
40	Inward/outward mobility of teachers.	**2.174**	0.727	**2.242**	0.662	**2.134**	0.800	**2.169**	0.744	Selected
41	Ratio of fund received for teaching & learning and its utilization.	**2.325**	0.746	**2.333**	0.692	**2.300**	0.756	**2.317**	0.740	Selected
42	Average expenditure per student.	**2.064**	0.729	**2.343**	0.700	**2.168**	0.678	**2.138**	0.710	Selected

On the basis of aforesaid formula as stated in methodology (i.e. $M_1 = M_2 = M_3 = M_4 = 2$ or more; $M_1 = M_2 = M_3 = 2$ or more; $M_1 = M_2 = M_4 = 2$ or more and $M_2 = M_3 = M_4 = 2$ or more) twenty six indicators were validated as mentioned in column number 10 of table 5 as per the response received from the faculties. In brief the indicators were selection of students in ARS from the institution; rank in JRF, SRF and GATE; alumni received the national and international prize, ratio of number of students received first degree, re-entry in higher education, adoption of ICAR syllabus, percentage of girls students, percentage of students from other states, doctorates awarded-to-academic staff ratio, students employed and their salaries, graduation ratio, time to degree, Associateship of National Science Academies recognized by ICAR/ ICMR/DST/CSIR; doctorate degree staff to total number of staff and others as stated in above Table 5.

To bring out an easily comprehensible simple structure of Indicators for Monitoring and Evaluation of Agricultural Education System of India, Factor Analysis of the 26 variables, (those were 'selected') was done with the responses obtained from the total number of 250 respondents. For extraction of factors, the Principal Component Analysis method was followed with Varimax rotation. In the present study, the Eigenvalues which were greater than 1 were retained. The perusal of table 6 is given below-

In respect of the independent variables, the following Eigenvalues were greater than 1.

5.616, 2.502, 1.974,1.468,1.348,1.190,1.084

The total variance per cent explained by the Eigenvalues were as below.

20.801, 9.266, 7.309, 5.436, 4.992, 4.406, 4.016

The cumulative percentage of the Eigenvalues were

20.801, 30.067, 37.376, 42.813, 47.805, 52.212, 56.227

Factor 1: Indicators for M&E of Human Resource and Finance in AES: Factor 1 accounted for 20.80 per cent of the total data variability. Seven indicators for Monitoring and Evaluation (M&E) of Agricultural Education System (AES) of India with high factor loadings and high communality were taken for interpretation this factor. These indicators were staff-to-student ratio (X_{20}), per cent of faculty positions filled in teaching, research and extension (X_{21}), number of new professional development programmes/short courses conduct by universities (X_{22}), proportion of programmes that are responsive to the national priorities (X_{23}), inward/outward mobility of teachers (X_{24}), ratio of fund received for teaching & learning and its utilization (X_{25}) and average expenditure per student (X_{26}). The factor loadings of these seven factors were all positive and factor loadings were X_{20} (0.601), X_{21} (0.571), X_{22} (0.697), X_{23} (0.526), X_{24} (0.653), X_{25} (0.787) and X_{26} (0.680) respectively. For the common understanding of these indicators, these indicators are broadly named as *Indicators for M&E of Human Resource and Finance in AES*.

Factor 2: Indicators for M&E of students' outstanding academic performance in AES: Factor 2 accounted for 9.27 per cent of the total data variability. Six indicators for M&E of AES of India with high factor loadings and high communality were taken for interpretation this factor. These indicators were selection in ARS during last 5 years (X_1), JRF/SRF/Upper 5% Rank in GATE during last year (X_2), number of students receiving awards at national and international levels (X_3), alumni of the institution winning national and international prize (X_4), number of University students getting admission in M.Sc. and Ph.D. through ICAR entrance examination and in Deemed Universities of ICAR during last year (X_5) and fellowship or associate ship of National Science Academies recognized by ICAR/ICMR/DST/CSIR (X_{18}). The factor loadings of these six factors were all positive and factor loadings were X_1 (0.740), X_2 (0.605), X_3 (0.617), X_4 (0.681), X_5 (0.574) and X_{18} (0.611) respectively. For the common understanding of these indicators, these indicators are broadly categories as *Indicators for M&E of students' outstanding academic performance in AES*.

Factor 3: Indicators for M&E of job opportunities for passed out students in AES: Factor 3 accounted for 7.30 per cent of the total data variability. Three indicators for M&E of AES of India with high factor loadings and high communality were taken for interpretation this factor. These indicators were per cent of passed out students employed (X_{13}), salaries and wages of graduates from higher education (X_{14}) and relative rate of graduate employment (X_{16}). The factor loadings of these three factors were all positive and factor loadings were X_{13} (0.716), X_{14} (0.636) and X_{16} (0.651) respectively. For the common understanding of these indicators, these indicators are broadly named as *Indicators for M&E of job opportunities for passed out students in AES*.

Table 6: Rotated Component Matrix of Indicators

S.No.	Indicators	Factors							Commu-nalities
		1	2	3	4	5	6	7	
1	Selection in ARS during last 5 years (X_1).	0.100	**0.740**	-0.029	-0.099	0.007	-0.025	0.040	0.571
2	JRF/SRF/Upper 5% Rank in GATE during last year (X_2).	-0.003	**0.605**	0.082	0.069	-0.141	0.301	0.018	0.489
3	Number of students receiving awards at national and international levels (X_3).	0.257	**0.617**	0.121	0.078	0.123	-0.052	0.293	0.572
4	Alumni of the institution winning national and international Prize (X_4).	0.120	**0.681**	0.050	0.029	0.161	-0.065	0.094	0.521
5	Number of University students getting admission in M.Sc. and Ph.D. through ICAR entrance examination and in Deemed Universities of ICAR during last year (X_5).	0.057	**0.574**	0.021	-0.155	-0.126	0.348	-0.054	0.498
6	Ratio of the number of entries into a first degree programme to the number of students obtaining a first degree (X_6).	0.025	-0.110	-0.028	0.281	**0.678**	0.100	0.093	0.572
7	Re-entries into higher education and success rate (PG & Ph.D.) (X_7).	0.033	0.217	0.118	-0.046	**0.742**	0.001	0.179	0.648
8	Percentage of graduates following the bachelor's-master's doctorate qualifications structure (X_8).	0.005	-0.010	0.427	0.159	**0.518**	0.320	-0.214	0.624
9	Adoption of ICAR 5th Dean committee syllabus (X_9).	0.049	0.033	-0.134	**0.737**	0.007	0.011	0.207	0.607
10	Percentage of girls students to total student (X_{10}).	0.198	0.123	0.239	0.014	0.312	0.114	**0.560**	0.535
11	Percentage of students from other states (X_{11})	0.325	0.201	0.107	0.092	0.012	**0.587**	0.118	0.524
12	Doctorates awarded-to-academic staff ratio (X_{12}).	0.169	0.096	0.028	0.008	0.234	**0.638**	0.101	0.511
13	% of passed out students employed (X_{13}).	0.161	0.010	**0.716**	0.106	-0.077	0.143	0.167	0.605
14	Salaries and wages of graduates from higher education (X_{14}).	-0.030	0.281	**0.636**	0.044	0.149	0.134	0.062	0.530
15	Graduation rate (X_{15}).	0.020	-0.033	0.035	**0.794**	0.093	0.018	-0.021	0.643
16	Relative rate of graduate employment (X_{16}).	0.188	0.048	**0.651**	-0.145	0.110	-0.179	0.134	0.545
17	Time to degree (X_{17}).	-0.096	-0.132	0.359	**0.564**	0.222	0.048	-0.130	0.542
18	Fellowship or Associate ship of National Science Academies recognized by ICAR/ ICMR/DST/CSIR (X_{18}).	0.351	**0.611**	0.213	-.0079	0.112	0.053	-0.072	0.569
19	Number of doctorate degree staff to total no. of staff (X_{19}).	0.006	-0.130	0.049	0.043	-0.007	**0.529**	0.590	0.649
20	Staff-to-student ratio (X_{20}).	**0.601**	0.108	0.092	-0.039	0.065	0.029	0.414	0.559
21	Percent of faculty positions filled in teaching, research and extension (X_{21}).	**0.571**	0.150	0.327	-0.028	-0.052	-0.066	0.239	0.520
22	Number of new professional development programmes/short courses conduct by universities (X_{22}).	**0.697**	0.270	-0.050	0.040	0.234	0.013	-0.047	0.620
23	Proportion of programmes that are responsive to the national priorities (X_{23}).	**0.526**	0.199	-0.073	-0.092	0.036	0.266	0.222	0.452
24	Inward/outward mobility of teachers (X_{24}).	**0.653**	0.019	-0.024	-0.075	0.047	0.318	-0.168	0.565
25	Ratio of fund received for teaching & learning and its utilization (X_{25}).	**0.787**	0.122	0.141	0.100	-0.069	-0.031	-0.089	0.678
26	Average expenditure per student (X_{26}).	**0.680**	0.006	0.098	0.040	-0.054	0.166	0.120	0.519

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax

Factor 4: Indicators for M&E of change in curriculum in AES: Factor 4 accounted for 5.43 per cent of the total data variability. Three indicators for M&E of AES of India with high factor loadings and high communality were taken for interpretation this factor. These indicators were adoption of ICAR 5th Dean committee syllabus (X_9), graduation rate (X_{15}) and time to degree (X_{17}). The factor loadings of these three factors were all positive and factor loadings were X_9 (0.737), X_{15} (0.794) and X_{17} (0.564) respectively. For the common understanding of these indicators, these indicators are broadly categories as *Indicators for M&E of change in curriculum.*

Factor 5: Indicators for M&E of degree completion by students in AES: Factor 5 accounted for 4.99 per cent of the total data variability. Three indicators for M&E of AES of India with high factor loadings and high communality were taken for interpretation this factor. These indicators were ratio of the number of entries into a first degree programme to the number of students obtaining a first degree (X_6), re-entries into higher education and success rate (X_7) and percentage of graduates following the bachelor's-master's doctorate qualifications structure (X_8). The factor loadings of these three factors were all positive and factor loadings were X_6 (0.678), X_7 (0.742) and X_8 (0.518) respectively. For the common understanding of these indicators, these indicators are broadly categories as *Indicators for M&E of degree completion by students in AES*.

Factor 6: Indicators for M&E of staff to student ratio in AES: Factor 6 accounted for 4.40 per cent of the total data variability. Three indicators for M&E of AES of India with high factor loadings and high communality were taken for interpretation this factor. These indicators were percentage of students from other states (X_{11}), doctorates awarded-to-academic staff ratio (X_{12}) and number of doctorate degree staff to total number of staff (X_{19}). The factor loadings of these three factors were all positive and factor loadings were X_{11} (0.587), X_{12} (0.638) and X_{19} (0.529) respectively. For the common understanding of these indicators, these indicators are broadly categories as *Indicators for M&E of staff to student ratio in AES*.

Factor 7: Indicator for Girls students' ratio to total students in AES: Factor 7 accounted for 4.01 per cent of the total data variability. The indicator is percentage of girls' student to total student (X_{10}) with factor loading 0.560. This is named as Indicator for Girls students' ratio in AES.

CONCLUSION

For maintaining the quality of agricultural higher education in India, it is imperative to maintain quality of teaching-learning in agricultural universities and institutions. The quality of agricultural higher education should be considered under global perspective. Through this study number of Teaching Learning indicators for Monitoring and Evaluation of Agricultural Education System of India is identified and validated on the basis of perception of faculties of agricultural universities. These indicators will help universities, government or other independent agencies for maintaining quality of agricultural higher education in India under global scenario through continuous monitoring and evaluation.

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Constraints Faced by Training Institutes in Enhancing Core Competencies of Extension Personnel in Kerala: An Analytical Study

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ABSTRACT

Training is progressively being recognized as a chief device to build up competencies and to advance performance in diverse fields. It is one of the chief activities of the agricultural extension system that consumes large proportion of the resources (time, budget, etc.). Hence, the present study was undertaken to assess the constraints of training programmes as perceived by the trainees representing from three training institutions: Community Agro-biodiversity Center-CAbC (working under an NGO), State Agricultural Management and Extension Training Institute -SAMETI (working under State Department) and Central Training Institute- CTI (under State Agricultural University) Which conducted four different training programmes related to core competency development during 2017-18. Fifteen trainees for each training programmes were selected randomly with a sample size of sixty from each institute making one hundred eighty trainees as total sample size. Freidman test was used to determine the severity of the constraints by using mean rank. Social constraints, economic constraints and personal constraints were the most severe constraints as perceived by the trainees of CAbC, CTI and SAMETI, respectively.

Keywords: Training, Core competencies, Constraints, Effectiveness, Friedman test

INTRODUCTION

The changing demography of farming communities, advancing technologies, increase in competition for resources and expansion of globalization concepts through the boundaries of different nation warrant a shift in the extension paradigm to a demand-driven, participatory and pluralistic form. These shift expected to be in extension paradigm requires human resources competent in activities, process and technical skills in the agricultural education, extension and field level activities to help the farming communities to develop themselves. As training is increasingly being recognized as a major tool in developing competencies and to improve performance in various fields, trainers at micro and macro level have been investing time and effort in exploring ways and means to improve its delivery.

Training is considered as the process of acquiring specific skills to perform a job better. It helps people to become qualified and proficient in doing some jobs as compared with the earlier situation (Dahama, 1979). Kirkpatrick (1993) suggested that much thought and emphasis needs to be given in designing trainings to make sure that the programmes are effective and relevant. Efficient extension personnel should remain updated with emerging technologies, be able to handle challenges, tap opportunities and demonstrate competency in their services. They need to possess a set of core competencies i.e., collective organizational skills upon which the organization bases its primary operation or services.

Athey and Orth (1999) defined core competencies as collection of observable dimensions like individual skills, knowledge, attitudes, behaviours, and collective processes and capabilities, necessary for individual, organizational and program to success. An Extension worker's performance is a function of his/her knowledge plus skills and attitudes. Hence, extension professionals should not be judged solely on how knowledgeable they are in their technical subject area of expertise, but it should be on the basis of how skilful and able they are in delivering services to their clients. It should also be noted that core competency needs are contextual and extension workers' contexts affect their competency needs and competency levels. Training plays a significant role in enhancing core competencies of

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extension personnel. Training is one of the chief activities of the agricultural extension system that consumes large share of the resources. Davis *et al.* (2014) ascertained that most of the trainings were not properly conducted, monitored and evaluated. Hence, a systematic analysis of the training efforts, training effectiveness and job performance in terms of enhanced technical and process skills needs to be done through a research investigation. In this context, the present investigation has been done to address the following objective of assessing the constraints of training programmes as perceived by the trainees.

MATERIALS AND METHODS

The study was conducted purposively in the state of Kerala. Extension worker to farmer ratio in Kerala is 1:300 (Sulaiman, 2012) indicated that Kerala is comparatively superior in position in comparison with other states. Three training institutions: Community Agrobiodiversity Center (working under an NGO), SAMETI (working under State Department) and CTI (under State Agricultural University) were chosen for the study. The sample consisted of trainees from the three different training institutes. Four different training programmes related to core competency development being organized during 2017-18 were selected purposively from each of the three training institutes. For each training programme, sample of 15 trainees were selected, totalling about 60 trainees for four training programmes from each training institute. Thus, the total sample size for the study was 180.

Constraint is any factor that prevents or limits an individual or group from adopting an intervention or restrains them from tapping the intended virtues of an intervention. Constraints can be personal or external to an individual or a social system. An attempt was made to analyse the personal, organisational, social and economic constraints that hinder both the rate and success of effective implementation of the training program. Constraints perceived by the trainees in the effective implementation of the program were identified by administering a semi-structured interview schedule and questionnaire. Constraints were ranked based on mean rank obtained for each constraints using Friedman test.

Friedman test was used to determine severity of the constraints by using mean rank. In this study, the test statistics used in case of Friedman test is chi-square test.

Data were collected by personal interview of the trainees, questionnaire and focused group discussions. Collected data were coded and tabulated for statistical analysis. Both primary and secondary data were utilized for the study.

RESULTS AND DISCUSSION

In the present investigation, an attempt has been made to study the constraints of training programmes as perceived by trainees of the three institutes. Constraints were categorised into personal, organisational, social and economic constraints. Various constraints in different categories of constraints based on the response of trainees were compared using Friedman test. The data has been presented under the following four heads.

Personal constraints as perceived by the trainees: Personal constraints were the psychological difficulties faced by respondent as a trainee. Five different constraints were listed *viz* lack of confidence, fear of handling ICTs, lack of experience, financial problems, and lack of motivation. Responses were collected on the bases of their severity. Results are presented in Table 1.

It is evident from Table 1 that the fear of handling ICTs was the most severe constraint as perceived by the trainees of CTI, CAbC and SAMETI, so it was ranked first with highest mean rank. It indicates that the training in handling of ICTs is the need of the hour.

The details of Friedman test for personal constraints are given in Table 2. The test statistics values were obtained

Table 1: Personal constraints as perceived by the trainees

Personal Constraints	CAbC		CTI		SAMETI	
	Mean Rank	Rank	Mean Rank	Rank	Mean Rank	Rank
Lack of Confidence	2.99	3	3.21	2	2.65	3
Fear of handling ICT	4.02	1	3.98	1	4.47	1
Age factor	3.08	2	2.62	4	4.25	2
Financial problems	2.08	5	2.90	3	2.58	4
Lack of motivation	2.83	4	2.29	5	1.06	5

Table 2: Friedman test for personal constraints as perceived by the trainees

	CAbC	CTI	SAMETI
N	60	60	60
Chi-Square	57.23	68.72	211.38
df	4	4	4
Asymp. Sig.	.001	.001	.001

for the three institutes and its level of significance was 0.001, which indicated that the differences were highly significant.

Organisational constraints as perceived by the trainees: Eight different organisational constraints *viz* poor quality of reading materials, poor management, lack of proper training hall, poor library facility , poor usage of audio visual aids, improper lodging and boarding facilities, lack of field visits and demonstrations and poor work organisation facilities were taken for analysis. Responses were collected on the basis of their severity. The results are presented in Table 3.

It is drawn from the Table 3 that the facilities in work organisations was the most severe constraint as perceived by the trainees of CTI and SAMETI, so it was ranked first with the highest mean ranks in the two institutes. It indicates that the trainees should be able to transfer the skills in their work organizations. Lodging and boarding facility was the major constraint as perceived by the trainees of CAbC. This indicates that proper boarding and lodging facilities should be arranged for the trainees as they are coming from distant places.

The details of Friedman test for organisational constraints are given in Table 4. The test statistics values were obtained for the three institutes and its level of

Table 4: Friedman test for organisational constraints as perceived by the trainees

	CAbC	CTI	SAMETI
N	60	60	60
Chi-Square	195.06	105.21	317.10
df	7	7	7
Asymp. Sig.	.001	.001	.001

significance was 0.001, which indicated that the differences were highly significant.

Economic constraints as perceived by the trainees: Economic constraints were the financial difficulties faced by respondent as a trainee. Three different constraints were listed *viz* lack of fund, insufficient training budget and TA was not paid. Responses were collected on the bases of their severity. Results are presented in Table 5.

Among the enlisted constraints relating to economic constraints in Table 5, lack of fund was the most severe constraint as perceived by the trainees of CTI and CAbC, so it was ranked first with highest mean ranks. Whereas "TA was not paid" was the most severe constraint as perceived by the trainees of SAMETI. The details of Friedman test for economic constraints are given in Table 6. The test statistics values were obtained for the three institutes and its level of significance was 0.001 which indicated that the differences were highly significant.

Social constraints as perceived by the trainees: Social constraints were the social difficulties faced by the respondent as a trainee. Four different constraints were listed *viz* lack of faith in training programme, belief in traditional system, difficulty in adjusting with heterogeneous groups, and family problems. Responses were collected on the bases of their severity. Results are presented in Table 7.

Table 3: Organisational constraints as perceived by the trainees

Organisational Constraints	CAbC		CTI		SAMETI	
	Mean Rank	Rank	Mean Rank	Rank	Mean Rank	Rank
Poor quality of reading materials	5.36	2	4.12	5	5.40	5
Poor management	3.02	8	3.98	7	2.21	8
Lack of proper training hall	3.68	7	4.25	4	5.48	4
Poor library facility	4.18	3	3.85	8	2.48	6
Improper lodging and boarding facility	7.82	1	4.53	3	2.28	7
Poor usage of Audio visual aids	3.71	6	5.12	2	6.14	2
Lack of field visits and demonstrations	4.10	5	4.11	6	5.61	3
Poor facilities in work organisations	4.14	4	6.03	1	6.28	1

Table 5: Economic constraints as perceived by the trainees

Economic Constraints	CAbC		CTI		SAMETI	
	Mean Rank	Rank	Mean Rank	Rank	Mean Rank	Rank
Lack of fund	2.26	2	1.96	2	3.00	1
Insufficient training budget	2.69	1	1.29	3	1.48	2
TA was not paid	1.05	3	2.75	1	1.50	3

Table 6: Friedman test for economic constraints as perceived by the trainees

	CAbC	CTI	SAMETI
N	60	60	60
Chi-Square	96.958	76.368	120.000
df	2	2	2
Asymp. Sig.	.000	.000	.000

Among the enlisted constraints relating to social constraints in Table 7, difficulty in adjusting with heterogeneous groups was the most severe constraint as perceived by the trainers of CTI, CAbC and SAMETI so it was ranked first with highest mean ranks.

The details of Friedman test for social constraints are given in Table 8. The test statistics values were obtained for the three institutes and its level of significance was 0.001 which indicated that the differences were highly significant.

Constraints as perceived by the trainees: Constraints were the various difficulties faced by respondent as a trainee. Four different constraints were listed *viz* personal constraints, organisational constraints, economic constraints, social constraints. Responses were collected on the bases of their severity. Results are presented in Table 9.

Among the enlisted constraints in Table 9, social constraint with mean value of 3.10 was the most severe constraint as perceived by the trainees of CAbC. Economic constraint with mean value of 3.45 was the major constraint for CTI and personal constraint with a mean value of 3.74 was the major constraint for SAMETI, so it was ranked first with the highest mean rank. The details of Friedman test for constraints are given in Table 10. The test statistics values were obtained for the three institutes and its level of significance was 0.001 which indicated that the differences were highly significant. Many impediments and hindrances were encountered by trainees while

Table 8: Friedman test for social constraints as perceived by the trainees

	CAbC	CTI	SAMETI
N	60	60	60
Chi-Square	126.53	135.64	160.42
df	3	3	3
Asymp. Sig.	.001	.001	.001

Table 7: Social constraints faced by the trainees

Social Constraints	CAbC		CTI		SAMETI	
	Mean Rank	Rank	Mean Rank	Rank	Mean Rank	Rank
Lack of faith in training programme	1.52	4	1.43	4	1.26	4
Belief in traditional system	1.71	3	1.93	3	1.99	3
Difficulty in adjusting with heterogeneous groups	3.51	1	3.73	1	3.92	1
Family problems	3.26	2	2.90	2	2.82	2

Table 9: Constraints as perceived by the trainees

Constraints	CAbC		CTI		SAMETI	
	Mean Rank	Rank	Mean Rank	Rank	Mean Rank	Rank
Personal constraints	2.67	**2**	2.65	**3**	3.74	**1**
Organisational constraints	2.18	**3**	1.02	**4**	2.02	**3**
Economic constraints	2.05	**4**	3.45	**1**	1.00	**4**
Social constraints	3.10	**1**	2.88	**2**	3.24	**2**

Table 10: Constraints as perceived by the trainees of the three institutes

	CAbC	CTI	SAMETI
N	60	60	60
Chi-Square	25.63	119.67	164.99
df	3	3	3
Asymp. Sig.	.001	.001	.001

implementing the training program. Hence, it is essential to identify and manage these constraints so as to keep them below the threshold level. Findings were well in similarity of the findings of Sharma (2004), Mahendra and Khan (2007) and Patil (2009).

CONCLUSION

Training of extension personnel is an essential part of agricultural development. Trained personnel are a way and end towards social change. It is the need of the hour to identify and manage the constraints for effective implementation of training programmes. Social, economic and personal constraints were the most severe constraints as perceived by the trainees of CAbC, CTI and SAMETI, respectively. The main purpose of the training programme should be to motivate the trainees to learn something to improve the job performance. Training should be need based and trainees input are vital for making the next session and to make the overall training program more effective.

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Reasons for Discontinuation of Polyhouse Cultivation by Farmers in Haryana

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ABSTRACT

Despite, India being the second largest producer of vegetables in the world its demand of vegetables is rapidly increasing because of burgeoning population along with rising health and nutrition consciousness among people. The factors such as adverse climatic conditions, high potential of vegetables, fruits and flowers, agro inputs availability, small and fragmented land holdings and increased demand of quality vegetables necessitate the adoption of protected cultivation. Despite sincere efforts by government, farmers are discontinuing the practice which is reflected by findings that approximately 75.00 percent of continuing poly house farmers were found vulnerable to discontinuity. Major reasons for discontinuation were socio-economic factors such as inability to maintain the structure due to high maintenance cost of cladding material, dependency on external support schemes for investments, marginal money returns being capital intensive endeavour, and lack of remunerative price policy for vegetables by the government followed by technical factors viz. lack of expertise of field functionaries of public extension system in horticulture, lack of thorough knowledge of horticulture, plant physiology, growing media, plant pathology and entomology as well as the engineering capability of farmers to provide an environment best suited for plant growth and lack of thorough knowledge of greenhouse designs especially gutter height requirement for various crops & environment control systems followed by lack of vegetables processing knowledge & value addition process knowledge and poor quality cladding material among input related factors.

Keywords: Poly house, Discontinuation and multiple cropping

INTRODUCTION

Though India is the second largest producer of vegetables in the world, its requirements of vegetables are rapidly increasing because of burgeoning population. India has a wide spectrum of diverse agro climatic conditions but vegetable cultivation practices in our country have been generally restricted to regional and seasonal needs with the technology and practices predominantly of traditional nature, which results into low yields and inconsistent quality and quantity produce supply of the markets. The factors such as adverse climatic conditions, high potential of vegetables, fruits and flowers, agro inputs availability, small and fragmented land holdings and increased demand of quality vegetables necessitate the adoption of protected cultivation. Protected conditions for vegetables, fruits and flowers are created by using different type of structures as per season and location specific like low cost protected structures viz. Plastic low tunnels, walk-in tunnels, low cost green houses are suitable for off-season vegetables and nursery raising in major vegetable growing areas. Insect proof net houses are highly suitable for diseases free seedlings among them most common and widely used are poly house. It is designed to modify the climatic conditions like temperature, humidity, wind velocity etc. along with high soil, water, fertilizer and other inputs use efficiency for growing horticultural crops.

The protected vegetables cultivation has high productive potential to meet the demand along with conserving resources like water, fertilizer & land. Being eco-friendly it must not be only popularised but out of its sheer necessity. Sincere efforts are made by the government to promote protected cultivation to ensure sustainable food and nutritional security to every Indian citizen and enhancement of income of the farming community (Mishra *et al.,* 2010). Haryana government also supported and promoted the polyhouse cultivation in state to exploit high production as well marketing potential of national capital region. However, upgrading and expansion of

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protected cultivation is not to satisfactory level. But there are several constraints and problems which restrict protected cultivation of vegetables (Sirohi *et al.,* 2002). Unlike open field cultivation, protected cultivation need intensive care as well initial capital investment to initiate production. It has been observed that farmers tend to discontinue the practice after 3-4 years of cultivation even after high sum of capital investment. Discontinuation can be a major hindrance to sustainability of such highly productive and resource efficient technology. Therefore, the study was undertaken to find out reasons for discontinuation of polyhouse cultivation.

MATERIAL AND METHODS

To collect the primary data on "Reasons for discontinuation of polyhouse cultivation by farmers in Haryana", the respondents were selected with the multistage sampling. Zone-6 Trans-Gangetic Plains of the country (comprising the states Punjab, Haryana, Union territories of Chandigarh, Delhi) was purposely selected having largest vegetables and fruits market in Delhi and from selected zone, Haryana state was selected purposively falling in NCR of capital New Delhi and having direct access of investigators. Further two districts namely, Karnal and Panipat were selected purposively being in proximity of National Capital Region of Delhi as well as Centre of Excellence for vegetables itself in Karnal District. The poly house farmers were selected randomly from the list supplied by the respective District Horticulture Office viz. Nagla Megha, Sohana, Manchuri, Badagaon, Phusgargh, Mohiuddinpur, Jundala, Kunjpura, Nali, Manchuri, Jaisinghpura, Peont, Pakka khera, Shekhpura, Chirao, and Karnal from Karnal district and Nara, Joshi, Kavi, Dharamgargh, Khandra, Rasalpur, Bapoli, Shivah, Assan Khurd, and Panipat from Panipat district. A total of 60 polyhouse farmers were interviewed personally, out of which 30 were discontinued and 30 continuing poly house cultivation for 3 years and above. The data were collected with the help of well-structured pre-tested interview schedule. The data were analyzed and tabulated after applying the statistical techniques like frequency, percentage, mean and standard deviation.

RESULTS AND DISCUSSION

The farmers of both the districts were growing the major vegetable crops such as cucumber (*Cucumis sativus*), tomato (*Solanum lycopersicum*), capsicum (*Capsicum annum*), chillies (*Capsicum frutescens*) and brinjal (*Solanum melongena*) and gerbera (*Gerbera jamesoni*), lilium (*Lilium longiflorum*), and rose (*Rosa*) flowers. The majority of farmers used to grow cucumber, capsicum and tomato as their main crops and among them cucumber was the most preferred crop. While Lillium, Gerbera and Rose were the major flower crops and rose was found most profitable by the respondent poly house farmers. The data pertaining to attributes of continuing polyhouse farmers presented in Table 1 depicts that majority of polyhouse farmers belonged to middle age group, 56.67 per cent had 4-5 years experience in poly house cultivation while less than 25.00 per cent had more than 5 years experience raises the question of sustainability of technology. Approximately 2/3rd had graduation as their educational qualification followed by post graduation 23.33 per cent which is a good sign that qualified persons were practising the high tech farming.

Pertaining to family type and size, data shows that majority belonged to joint families with medium size family of 5-6 members. Regarding land holding, 56.70 percent belonged to medium farmers category followed by large farmers 30.00 per cent only whereas, large majority of farmers had agriculture as their occupation and hardly 1/4th had agriculture plus business as their occupation. Tube well was major source of irrigation, 50.00 per cent of respondents had full farm mechanization in form of tractors with other farm implements like planters and diggers etc. Cent percent farmers got their soil and water tested before installation of structures while, 93.33 per cent got short duration training on protected cultivation.

Majority of respondents belonged to high innovativeness category followed by medium innovativeness (46.67%) category and none was in low innovativeness category. Similarly 90.00 percent of respondents had moderate to high economic motivation along with scientific orientation which is essential for such agri-preneurship. Pertaining to information source utilization, majority of polyhouse farmers (60.00%) belonged to medium category followed by 36.00 percent to high information source utilization category using modern ICTs like internet & social media like WhatsApp.

The data presented in Table 2 show that among environmental factors, weather conditions like high temperature & humidity favourable for high incidence of minute insects especially white fly & mites was found major reason for discontinuation by 83.33 per cent of respondents followed by frequent occurrence of natural hazards like wind storms, hailstorms (80.00%) and

Table 1: Socio-personal attributes profile of continuing poly house farmers (n=30)

S.No.	Variable	Category	Frequency	Percentage
1	Age	Young (up to 37 years)	09	30.00
		Middle (38-55 years)	16	53.33
		Old (above 55 years)	05	16.67
2	Experience	3 years	06	20.00
		4-5 years	17	56.67
		> 5 years	07	23.33
3	Education	Up to primary	02	6.67
		Up to higher secondary	02	6.67
		Graduation	19	63.33
		Post graduation	07	23.33
4	Family type	Nuclear	10	33.33
		Joint	20	66.67
5	Family size	Small family (Up to 4 members)	02	6.67
		Medium family (5 to 6 members)	15	50.00
		Large family (More than 6 members)	13	43.33
6	Land holding	Small farmers (2.5 to 5 acres)	04	13.30
		Medium farmers (6 -10 acres)	17	56.70
		Large farmers (> 10 acres)	09	30.00
7	Occupation	Agriculture alone	21	70.00
		Agriculture + allied occupation	01	3.33
		Agriculture + business	07	23.34
		Agriculture + government service	01	3.33
8	Source of irrigation	Tube well	17	56.67
		Both tube well & canal	13	43.33
9	Farm mechanization	No tractor	14	46.67
		Tractor/ mini tractor	01	3.33
		Tractor with other implements like planters & diggers etc.	15	50.00
10	Soil & water testing	Get done	30.00	100.00
11	Trainings on protected cultivation	Received	28	93.33
		Not received	02	6.67
12	Innovativeness	Low	-	0.00
		Medium	14	46.67
		High	16	53.33
13	Economic motivation	Low (up to 27)	03	10.00
		Medium (28-31)	13	43.33
		High (32-35)	14	46.67
14	Scientific orientation	Low (up to 33)	01	3.33
		Medium (34-36)	18	60.00
		High (37-40)	11	36.67
15	Information source utilization	Low (up to 14)	01	3.33
		Medium (15-18)	18	60.00
		High (20-26)	11	36.67

Table 2: Reasons for discontinuation of polyhouse cultivation by farmers (n=60)

Factors	Frequency	Percentage
Environmental factors		**76.11**
Frequent occurrence of natural hazards like wind storms, hailstorms	48	80.00
Weather conditions like high temperature & humidity favourable for high incidence of minute insects especially white fly & mites	50	83.33
Soils favourable for nematode infestation	39	65.00
Inputs related factors		**72.22**
High cost of hybrid seeds	44	73.33
Lack of credible input dealers in seeds and agrochemicals with a wide selection of high-quality of seeds, fertilizers and pesticides	30	50.00
Poor quality cladding material	56	93.33
Technical factors		**82.91**
Lack of thorough knowledge of horticulture, plant physiology, growing media, plant pathology and entomology as well as the engineering capability farmers to provide an environment best suited for plant growth.	58	96.67
Lack of credible seed dealers who can provide knowledge and instruction on cultivation, pest control, and marketing	38	63.33
Lack of expertise of field functionaries of public extension system in horticulture, plant physiology, growing media, plant pathology and entomology as well as the engineering capability to provide an environment best suited for plant growth especially in polyhouses.	58	96.67
Lack of thorough knowledge of greenhouse designs especially gutter height requirement for various crops & environment control systems	58	96.67
Lack of guidance on customization of foggers for humidity as per requirement of crop grown	44	73.33
Lack of computer skills for operating the fertigation system	30	50.00
Lack of vegetables processing knowledge	57	95.00
Lack of knowledge of value addition processes of produce	55	91.67
Marketing factors		**71.66**
Lack of marketing intelligence for both national and international markets	48	80.00
Inability to produce high-quality products on schedule, preferably in festive season and other customary ceremonies	38	63.33
Lack of transport facilities especially of refrigerated van	20	33.33
Small scale production by farmers	44	73.33
Location of poly house is far away from customers' direct access especially medium to high income residents	32	53.33
Lack of cooperative organization of polyhouse growers	42	70.00
Lack of remunerative price policy for vegetables by the government	60	100.00
Distress sales due to immediate need for money to meet out expenses	50	83.33
Lack of cold storage facilities in villages	48	80.00
Lack of vegetable processing units in villages	48	80.00
Socio-economic factors		**86.39**
Lack of family support being labour intensive & care intensive as well	31	51.67
Marginal money returns being capital intensive endeavour	60	100.00
Dependency on external support schemes for investments	60	100.00
Part time engagement of farmers	48	80.00
Run of polyhouses by absentee farmers	52	86.67
Inability to maintain the structure due to high maintenance cost of cladding material	60	100.00

polyhouse soils favourable for nematode infestation by 65.00 per cent farmers. Findings are in congruence with past study of Ghanghas *et al.* (2015). Pertaining to inputs related factors, 93.33 per cent of respondents reported poor quality cladding material as major reason for discontinuation followed by high cost of hybrid seeds (73.33%) while, half of the respondents found lack of availability of credible input dealers in seeds and agrochemicals with a wide selection of high-quality of seeds, fertilizers and pesticides. High cost of hybrid seeds, frequent occurrence of wind storms, hailstorms, lack of knowledge of value addition along quality of cladding material had been matter of concern of past studies by Singh and Sirohi (2004), Nair and Barche (2014) and Ghanghas *et al.* 2015.

Among technical factors for discontinuation, lack of thorough knowledge of horticulture, plant physiology, growing media, plant pathology and entomology as well as the engineering capability of farmers to provide an environment best suited for plant growth, lack of expertise of field functionaries of public extension system in horticulture, plant physiology, growing media, plant pathology and entomology as well as the engineering capability to provide an environment best suited for plant growth especially in polyhouses and lack of thorough knowledge of greenhouse designs especially gutter height requirement for various crops & environment control systems were found major reasons by 96.67 per cent of respondents followed by lack of vegetables processing knowledge (95.00%) and value addition process knowledge (91.67%). At the same time about $3/4^{th}$ respondents perceived lack of guidance on customization of foggers for humidity as per requirement of crop grown followed by lack of credible seed dealers who can provide knowledge and instruction on cultivation, pest control, and marketing (63.33%) and lack of computer skills for operating the fertigation system (50.00%). Findings are supported by past study of Ghanghas *et al.* (2018).

Regarding marketing factors, cent percent farmers reported lack of remunerative price policy for vegetables by the government as major discontinuation reason followed by distress sale (83.33%), lack of marketing intelligence, cold storage and vegetable processing units in villages (80.00%) followed by small scale production by farmers were other reasons for discontinuation. Similarly, cent percent poly house farmers opined inability to maintain the structure due to high maintenance cost of cladding material, dependency on external support schemes for investments and marginal money returns being capital intensive endeavour as major reasons for discontinuation followed by run of polyhouses by absentee farmers (86.67%) and part time engagement (80.00%) and lack of family support for labour and care by 51.67 per cent polyhouse farmers. Similar findings have been reported by Wijerantha *et al.* (2014).

Table 3: Overall distribution of poly house farmers on the basis discontinuation factors score (n=30)

Category	Score	Frequency	Percentage
Low	Up to 22	8	26.67
Medium	23-25	7	23.33
High	26.31	15	50.00

Mean score=25.13; Standard deviation=3.01

The overall distribution of continuing farmers on the basis of discontinuation factor score clearly indicate that half of the respondents belonged to high discontinuation category followed by medium category (23.33%) and low category only about 27.00 percent clearly indicated that about $3/4^{th}$ of respondents are vulnerable to discontinuation of the technology. So there is an urgent need to validate and standardize the technology as per state weather and climatic conditions for its sustainability along with addressing the reasons accounting for discontinuation.

CONCLUSION

The findings of the study explicit that approximately 75.00 percent of continuing poly house farmers were found vulnerable to discontinuity. The major reasons for discontinuation were socio-economic factors like inability to maintain the structure due to high maintenance cost of cladding material, dependency on external support schemes for investments, marginal money returns being capital intensive endeavour, and lack of remunerative price policy for vegetables by the government (100%) followed by technical factors viz. lack of expertise of field functionaries of public extension system in horticulture, lack of thorough knowledge of horticulture, plant physiology, growing media, plant pathology and entomology as well as the engineering capability of farmers to provide an environment best suited for plant growth and lack of thorough knowledge of greenhouse designs especially gutter height requirement for various crops & environment control systems (96.67%) followed by lack of vegetables

processing knowledge (95.00%) and value addition process knowledge (91.67%) and 93.33 per cent of respondents reported poor quality cladding material as major input related reason for discontinuation. It can be concluded that sanitation, ventilation, continued proper technical guidance, maintenance support and quality structures by standardized agency/ institution is of utmost importance for sustainability of technology at field in the region.

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Production and Economics of Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.) cv. Indra F_1 cultivation in Agra District

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ABSTRACT

Vegetable are a basic component of food security and necessary to meet the increasing food demand of increasing population. Present study was designed to explore the increasing demand of capsicum (*Capsicum annuum* L. var. *grossum* Sendt.) and its low productivity in Agra district. Hence, to study the production and economics of capsicum in open field condition a front line demonstrations were conducted by Krishi Vigyan Kendra, Bichpuri, Raja Balwant Singh College, Agra on improved variety of capsicum cv. Indra F_1 hybrid in two adopted villages - Nagla Khardia and Dawali of block Akola, Agra for two consecutive years 2008-09 and 2009-10 during winter seasons. The recommended dose of fertilizers (RDF) at the rate of 75 kg N, 75 kg P, 50 kg K, 30 kg $ZnSO_4$ and 16 kg Boron with 250 quintal FYM ha^{-1} were used in demonstration. Capsicum cv. Indra F_1 proved its dominance over other local cultivars regarding yield (437, 415 Q ha^{-1}) than that of check (340, 310 Q ha^{-1}) with an increase in yield by 28.52% and 33.87% under demonstration. Maximum net return was also recorded comparatively higher (Rs. 5,55,500/-, Rs. 5,22,500/- ha^{-1}) then local check (Rs. 5,10,000/-, 4,65,000 ha^{-1}) with BCR (6.55 during 2009 and 6.22 during 2010) over local check (4.25 during 2009 and 3.87 during 2010).

Keywords: Demonstration, Improved practices, Economics, Productivity

INTRODUCTION

Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.) also known as Bell peppers, sweet pepper, green pepper or Shimla mirch is a member of family Solanaceae. Bell peppers have a glossy exterior of different, vivid colours including green, red, yellow, orange, purple and brown to black. Green peppers provide proteins, minerals, vitamin A and C while dry are known as a source of vitamin A and D (Patel, 2014). It is consumed as a spice, vegetable, pickle, condiment and sauce. Internationally, chillies are consumed as a spice and used as an ingredient in medicines and beverages (Velayutham and Damodaran, 2015).

In India, capsicum was introduced by the Britishers in the 19th century in Shimla hills. Globally, it is cultivated over an area of 19.89 million ha with a production of 33.52 million tones. Among various chilli grown countries, India (13 million tones or 38.78%) is the largest chilli producing country and it was followed by China (3 million or 8.65%) (Patel, 2014).

Cultivation of sweet pepper in India is confined to urban centers but now large scale or commercial productions have been undertaken under irrigation in the rural areas in open field conditions. But its productivity is very low. There are several factors that influence the growth and yield of pepper, some of which include temperature, relative humidity, day length, photoperiod etc. Along with other factors which affect the per unit area production like nutrition, cultivar, growing system and soil fertility, plant density has its significance (Agarwal *et al.,* 2007).

In India it is extensively cultivated in Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Himachal Pradesh, and hilly and plain areas of Uttar Pradesh. However, India contributes one fourth of world production of capsicum with an average annual production of 182.50 thousand metric tons from an area of 32.15 thousand hectares (Anonymous, 2016). It is likely to increase in the future because of having great market demand by urban consumers with good demand for export too. The export market needs fruits with longer shelf life, medium size,

tetra lobed fruits with an attractive dark colour, mild pungency and good taste. But, the supply is inadequate due to low productivity of the crop. Therefore, the study has been taken to reassess the total production cost, total revenue, benefit-cost ratio and net income in open field capsicum production.

MATERIALS AND METHODS

The front line demonstrations was conducted during the winter cropping season of 2008-09 and 2009-10 under open field condition on farmer field at adopted villages Nagla Khardia and Dawali of Akola block, Agra as per FLD guidelines established by ICAR. The village lies on $27^{o}25^{I}$ N, $77^{o}9^{I}$ E and at altitude of 163.4 meter mean sea level. As per results of soil test, the soil was sandy loam in texture, slightly alkaline in reaction (pH 7.8), low in organic carbon (3.5 g kg^{-1}), available nitrogen (157 kg ha^{-1}), phosphorus (9.8 kg ha^{-1}) and potassium (110 kg ha^{-1}). The area received an average annual rainfall of 650 mm. The mean annual minimum and maximum temperatures were 8.25 and 23.4°C respectively.

The capsicum cv. Indra F_1 hybrid seedlings were raised at nursery beds. After 35 days, at 5-6 true leaf stage; these seedlings were transplanted in field on 1 meter wide beds, transplants were dipped into *Trichoderma viride* CFU – 2 X 10^9 per gm^2 gm 1 ts^{-1} solutions to facilitate root formation and early establishment at maintaining planting distance of 60×45 cm. Once seedlings were established, thereafter for raising healthy crop, all the necessary recommended cultural and plant protection operations were followed. Data of other villagers were also recorded for local check.

Before transplanting, the experimental field was well prepared by mixing recommended dose of fertilizers (RDF) 75 kg N, 75 kg P, 50 kg K, 30 kg $ZnSO_4$ and 16 kg Boron (soil testing based) with 250 quintal FYM ha^{-1}. Full dose of Potassium, phosphorus and $1/3^{rd}$ dose of Nitrogen is mixed in rows just before transplanting and the rest of the nitrogen dose is given in two equal splits i.e. one after one month of transplanting and second after two months of transplanting. All required agronomic practices were followed during the cropping period.

The knowledge of farmers of both villages was estimated by taking random sample of 6 farmers. The difference between the demonstration and farmers practice are mentioned in Table 1. The use of quality seed of improved varieties, raised bed transplanting, timely weeding and as well as balance fertilizers were followed during the experiment.

The farmers were provided well in advance technical knowledge about sustainable cultivation of capsicum under guidance of KVK scientists by making regular visits to demonstration plots and these visits were also utilized for collection of feedback of the farmers, field day and group meeting were also organized at the demonstration site to disseminate the message at large. The yield and economics data were collected from control and demonstration plots.

After taking into consideration of variables, fixed input and their corresponding rates, the cost was worked out for an area of ha^{-1}. To get gross return ha^{-1}, the fruit yield (tones ha^{-1}) obtained in both year was multiplied with

Table 1: Comparison between Package and practices under demonstration and existing farmers' practices

Particulars	Package and practices under demonstration	Farmers' practices
Farming situation	Irrigated	Irrigated
Variety	cv. Indra F_1 hybrid	Local variety
Seed rate	250-300 gms	400-500 gms
Time of nursery sowing	15-20 July	20 June
Soil treatment	*Trichoderma viride* CFU – 2 X 10^9 per gm powder @ 3.5 kg ha^{-1}	No soil treatment
Time of transplanting	15 August	30 July
Fertilizer dose	75 kg N, 75 kg P, 50 kg K, 30 kg $ZnSO_4$ and 16 kg Boron and 250 Q FYM ha^{-1}	50 kg N, 50kg P, 40 kg K
Seedling	Before transplanting seedling roots are dipped in *Trichoderma viride* CFU – 2 X 10^9 per gm powder @ 2 gm lts^{-1}	No seedling treatment
Weed management	Pre emergence spray of Pendimethalin 35% EC herbicide @ 3.33 lts ha^{-1} followed by one hand weeding at 40-45 days of transplanting	Hand weeding at 40-45 days
Plant protection	Use of need based pesticides	Use of large quantity of pesticides

prevailing local mandi rates. Net return was calculated by subtraction of cost of cultivation from the gross return. The benefit-cost ratio was computed with division of gross return by cost of cultivation.

RESULTS AND DISCUSSION

Data furnished in Table 1 shows that farming situation was same under demonstration as well as under farmers practice, that is the land was irrigated. For the FLD in capsicum Indra F_1 hybrid was used due to its better yield and quality. The variety was compared with locally used varieties by the farmers. Table 1 clearly shows that the seed rate of the introduced variety Indra F_1 hybrid was almost half of the local variety used by the farmers. Moreover seed treatment, weed management and need based plant protection was done to ensure optimal production potential.

Yield Parameters: It is evident from Table 2 that the average yield of capsicum cv. Indra F_1 under demonstration was substantially higher (437, 415 Q ha^{-1}) than that of check (340, 310 Q ha^{-1}) respectively. There was a percent increase of 28.52 per cent and 33.87 per cent respectively for the consecutive years 2008-09 and 2009-10 over local check. Khan *et al.* (2017) also reported similar findings.

Economics of fruit production of Capsicum: The comparative economic of demonstration was made on ha^{-1} basis, taking consideration of prevalent wages and rates of critical inputs in the area. The economic indicator 'gross return' was calculated taking care of average selling price of produce whereas the 'net profit' was worked out from gross return and total cost of cultivation.

The data presented in Table 3 clearly revealed that keeping the gross cost same (100000 Rs./ha) in the demonstrations the gross cost of check was higher for both the years. The high gross cost compared to demonstration is attributed to higher use of fertilizers and chemicals by the practicing farmers due to lack of knowledge and ignorance regarding appropriate package of practices. The net return were substantially higher (Rs. 5,55,500/-, 5,22,500/-) than that of local check (Rs. 5,10,000/-, 4,65,000 ha^{-1}) in both years respectively. Economics analysis of the field performance revealed the high BCR of demonstration (6.55 during 2009 and 6.22 during 2010) plot than control plots (4.25 during 2009 and 3.87 during 2010).

Thus open field capsicum production is a profitable activity and it was in line with the results of Sanusi & Ayinde

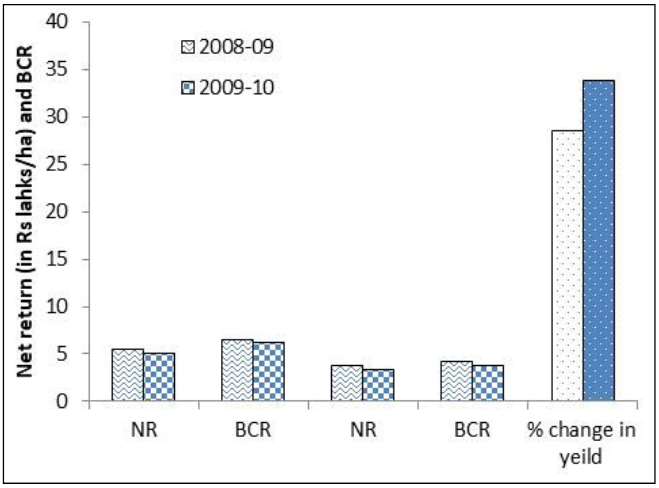

Figure 1: Economics of FLD over farmers practice and change in crop productivity during 2008-09 and 2009-10

Table 2: Yield of capsicum crop during cropping seasons of 2008-09 and 2009-10

Year	Name of the technology	No. of farmer	Area (ha)	Yield (q ha^{-1})				% change in yield
				Demo			Check	
				High	Low	Average		
2008-09	Capsicum cv. Indra F_1 hybrid	6	1.00	450	425	437	340	28.52
2009-10	Capsicum cv. Indra F_1 hybrid	6	1.00	430	400	415	310	33.87

Table 3: Economics of capsicum crop during cropping seasons of 2008-09 and 2009-10

Year	Economics of demonstration (Rs./ha)				Economics of check (Rs./ha)			
	Gross Cost	Gross Return	Net Return	BCR(R/C)	Gross Cost	Gross Return	Net Return	BCR(R/C)
2008-09	100000	6,55,500	5,55,500	6.55	1,20,000	5,10,000	3,90,000	4.25
2009-10	100000	6,22,500	5,22,500	6.22	1,20,000	4,65,000	3,45,000	3.87

Mandi price of capsicum @ Rs 15/- kg.

(2013), Singh *et al.* (2014), Daundkar & Bairagi (2015) and Rana *et al.* (2017).

Other Extension Activities: Extension activities were carried out to demonstrate and train farmers in carrying out appropriate technological practices and also closely monitor the production and productivity of the crop so grown. The Table 4 shows the number of extension activities organised during the cropping season.

Table 4: Extension Activities organized during cropping seasons of 2008-09 and 2009-10

Activity	Number of activities	Number of participants
Farmers Training	6	80
Scientist visits	8	70
Field days	2	150
Farmers counselling	22	22

Perusal of the Table 4 shows that a total of 6 training courses for 80 farmers were organized over the period of two years 8 scientist's visits were also made at demonstration site in which 70 farmers were benefited. Two field days were also organized for 150 farmers in both villages. Seedlings produced by KVK were distributed among 6 more farmers other than the demonstration. Fifteen farmers visited KVK with their problems related to capsicum cultivation were also registered.

CONCLUSION

The higher net income was due to technological intervention provided during the demonstration over the period of two years. From two year front line demonstration results, it could be inferred that, improved technologies (cv. Indra F_1 hybrid) enhanced the yield of capsicum and found economically remunerative with high B:C ratio. Good quality planting material supplied by KVK and regular advisory support helped in exploiting potential of improved variety in the study area. Thus it may be concluded that suitable extension intervention may be designated to get benefit from improved technologies.

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Evaluation of Recommended Maize Production Technology in *Kandi* Areas under Farmer FIRST Programme

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ABSTRACT

The potential of kandi areas can be fully exploited through proper implementation of recommended scientific practices. As a part of the continuous effort to address the issues of farmers in kandi areas, a project under Farmer FIRST programme of Indian Council of Agricultural Research (ICAR) has been implemented in the year 2016-17 in Samba district of Jammu region of J&K State. The recommended maize production technologies were demonstrated under the project during *kharif* season of 2017 and the crop data was collected to find out the impact of technologies under demonstrations. The difference between the yield under demonstration plots and local check was found to be statistically significant with average maize yield of 46.43/ha ± 3.81 under demonstrations and 31.60/ha ± 5.92 under local plots. The variation in maize productivity under demonstration plots was also less as compared to the productivity under local plots with an additional net return of Rs. 19222.87 per hectare. The results of the demonstrations confirmed that the adoption of recommended maize production technologies can ensure enhanced and sustainable maize production, even in the kandi areas of Jammu region, as well.

Keywords: Farmer FIRST programme, Production efficiency, B.C ratio, Maize

INTRODUCTION

The probability of getting sustainable returns from agriculture under kandi (rainfed) ecosystem is extremely difficult due to non-availability of assured irrigation. The '*kandi*' as is usually known refers to the unirrigated area. This belt is largely devoid of any assured source of irrigation and farming community has largely to depend upon timely availability of rainfall. The kandi areas have unique agro-ecological features and thus have specific effects on prevailing cropping system and water and nutrient use efficiency in agriculture (Rawat, 2013; Bala, 2014). Maize is the principal cereal crop in the rainfed areas and its productivity is crucial for nutritional and livelihood security of families. Several researchers have analysed production potential of maize based cropping system (Sharma, 2000; Issaka, 2016), including intercropping under rainfed conditions (Lingaraju, 2008). Water scarcity limits the productivity of maize in rainfed areas and the application of adequate irrigation scheduling can reduce the yield losses significantly (Nazeer, 2009). Liu (2012) assessed the average maize yield 18.3 q/ha less under rainfed situations than the average potential yield with irrigation. The sensitivity of maize crop to water scarcity also depends upon the sensitivity of particular genotypes Andrioli (2009). Besides, water scarcity, climate change vulnerability further enhances the threats to agricultural production under rainfed ecology (Conde, 1997). Cohen (2014) related maize yield variation and probability of its yield failure in kandi areas to distinctive pattern based on planting date and rainfall occurrence. The prevalence of weeds is another limiting factor, responsible for reducing maize yield in kandi areas, ranging from 28-100% (Sharma *et al.,* 2010). Das *et al.* (2016) advocated mulching with fresh *Eupatorium* (after earthing up) and soybean green manuring + one Hand Weeding for the effective management of weeds in maize under rainfed organic farming system. Keeping the complexities associated with rainfed agriculture, there is a need for greater investment in R & D, as the arable land under irrigation throughout the world is very limited (Devendra, 2016). However, the demonstration of proven recommended scientific technologies for kandi areas can enhance their adoption

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on farmers' fields for enhanced productivity and economic returns.

The Farmer First Programme of ICAR aims at increasing productivity to enhance farmer's income through demonstration and popularization of proven scientific agricultural practices for kandi areas in district Samba of Jammu region of J&K state. Front Line Demonstration is an important extension activity conducted under the close supervision of scientists for demonstration of proven scientific technologies on farmers' fields. The demonstrations of scientific technologies in different crops had yielded better results as compared to the existing practices (Sharma and Parkash, 2015; Singh *et al.,* 2016; Singh *et al.,* 2016 and Rana *et al.,* 2017). The present paper is an attempt to find out the economics of recommended maize production technologies demonstrated under FLDs in kandi areas of Jammu region of J&K state.

MATERIALS AND METHODS

The present investigation was conducted in the subtropical '*Kandi'* belt of Jammu region, where the recommended scientific maize production technologies were demonstrated under the Farmer 'FIRST' Programme of SKUAST-Jammu, covering twelve villages, namely Sarna, Raith, Badla Deonian, Badla Brahmna, Kayani, Patyari, Nangal, Satah, Sarain, Toond, Dheora and Balore of three Panchayat of block Nud in Samba District of the state of Jammu and Kashmir. Each demonstration was comprising of 0.4 hectare area and the farmers were provided with free critical inputs to be applied as per the scientific package of practices recommended by the research wing of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, J&K (Anonymous, 2007). The data on yield of maize, cost of production and monetary returns were gathered from sites of demonstrated plots and from the traditional plots with the objective to identify the yield gaps as well as to work out the difference in input cost and monetary returns under front line demonstrations and farmers' (traditional) practices in kandi areas. The production efficiency of maize crop under demonstrated plots was also assessed using following formula:

$$\text{Production efficiency} = \frac{\text{Yield of a particular crop on the given farm}}{\text{Average yield of that crop in the locality}} \times 100$$

Besides, the technology gap, extension gap and technology index were calculated as given by Samui *et al.* (2000) as:

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – yield from traditional plots

$$\text{Technology index} = \frac{\text{Potential yield – demonstration yield}}{\text{Potential yield}} \times 100$$

Testing of Hypothesis (Comparison of productivity levels): In order to assess the validity of improved efficiency of demonstrated plots compared to the local ones, 'independent two sample t-test' was applied under the following hypotheses:

H_0: $\mu_1 - \mu_2 = 0$ *(i.e. the difference between the two population means is equal to 0)*

H_1: $\mu_1 - \mu_2 \neq 0$ *(i.e. the difference between the two population means is not 0)*

RESULTS AND DISCUSSION

Description of maize production technologies: The details of demonstrations conducted under the Farmer FIRST Programme of SKUAST-Jammu are given in Table 1, wherein some of the major differences between the practices adopted under Front Line Demonstrations and traditional farms were presented. The demonstrations were comprised of recommended technologies including hybrid maize variety and the recommended package of practices. Traditionally, the farmers were using farm saved local or mixed seed (mixture of seed of different varieties). The farmers were employing broadcast method of sowing which resulted in high seed rate per hectare. There was a good amount of farm yard manure available on farm but urea was the only chemical fertilizer used by the farmers (Table 2). In demonstration plots, farmers were provided with hybrid maize seed i.e. Kanchan-612 recommended for the intermediate zone of Poonch district. Kanchan-612 is a white colored variety with a maturity period of 90-120 days and is resistant against lodging. The seed was sown in lines and optimum seed rate of 1 kg per hectare was used. All the demonstrations were laid under scientists' supervision and line sowing on sloppy lands was done by using Kera method (technique of dropping seed in line ploughed by the bullocks) (Figure 2). Chemical fertilizers (N:P:K) were applied in the ratio of 60:40:20. Nitrogen was applied in three equal split doses (one-third as basal dose during sowing, another one-third when the plant reached knee-height and the last one-third at cob formation stage) whereas phosphorus and potash was applied in full during sowing as basal dose as recommended by the package of practices.

Table 1: Details of maize production technologies demonstrated

Crop	Particulars	Traditional Practices	Front Line Demonstrations	Area (ha)	No. of farms
Maize	Variety	Mixed/local	Hybrid (Double Dekalb)	151.20	756
	Sowing	Broadcasting	Line sowing		
	Nutrient Management (N:P:K)	70:00:00	60:40:20		

Production efficiency of maize: The production efficiency of maize crop under demonstrated plots was assessed under different farm size groups. The marginal, small and medium demonstrated farms witnessed the production efficiency of 134.8 per cent, 130 per cent and 128.8 per cent, respectively with average productivity of 40.9 q/ha, 41.2 q/ha and 40.6 q/ha (Figure 1). The production efficiency of maize crop showed a decreasing trend with increase in total size of land holdings acquire by the respondents. The yield also showed an indirect relationship with size of holdings, as the productivity of maize increased with decrease in size of land holding. This also means that the part of land holdings on which demonstrations were conducted had shown greater efficiency compared to the non-demonstrated plots on similar pieces of land.

Physical performance of scientific maize production technologies: The recommended scientific practices under front line demonstrations brought increased yield over respective traditional plots (Table 2). The average yield of maize under demonstrated plots was 46.43 q/ha compared to 31.60 q/ha under traditional practice. The percentage increase in the yield over respective traditional plots was 46.93. The yield improvement in maize can be accrued to the combined effect of hybrid variety and the nutritional management. The descriptive statistics of the maize yield under both the demonstrated and local plots has been presented in Table 2 and the Box & Whisker Plot plots are depicted in Figure 2.

The farmers in rainfed areas are more prone to risks of weather due to which there exists a wide variation in productivity (Rivas *et al.*, 2011). Further, climate change is also increasing the vulnerability of rainfed maize crops (Conde *et al.,* 1997). Keeping this fact in view, the variation under demonstration and local plots was assessed. The variation in maize productivity under demonstration plots was found to be very less (3.81) compared to productivity under local plots (5.92). The same fact is apparent in Box & Whisker Plot depicted in Figure 2. This reveals the fact that if homogeneity in use of technology is achieved in the area, the variation in production and productivity of maize can be reduced.

Technology and extension gaps: The yield of maize under front line demonstrations was compared to its

Figure 1: Production efficiency of maize under demonstrated plots

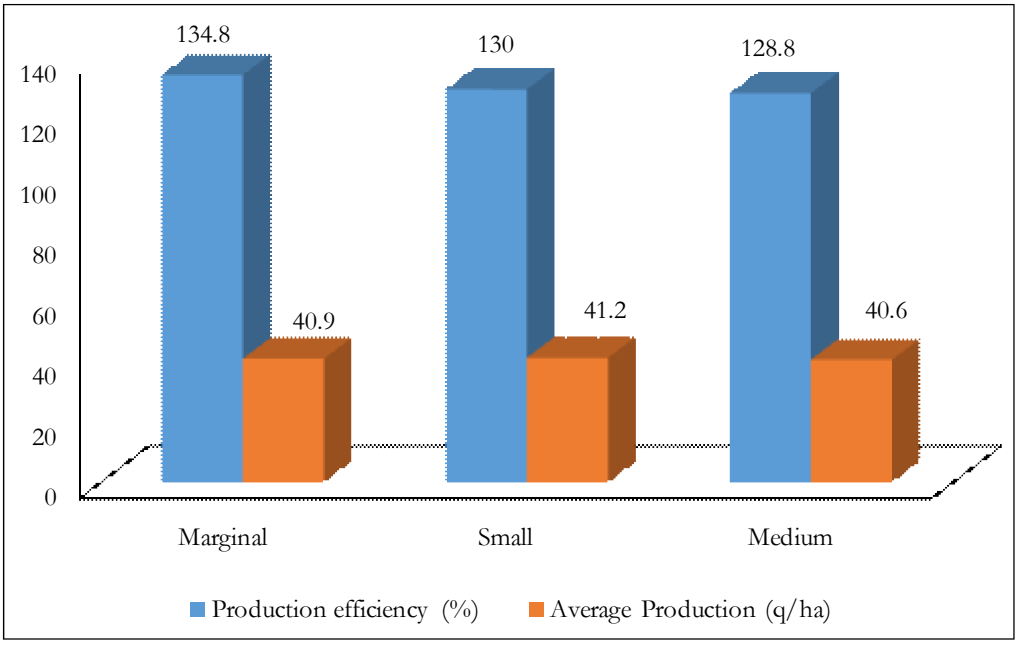

Table 2: Descriptive statistics of maize productivity under demonstrated and local plots

	Demonstrated plots	Local plots
Mean	46.43	31.60
Standard Error	0.21	0.14
Median	47.01	31.07
Standard Deviation	3.81	5.92
CV	0.08	0.18
Kurtosis	-1.08	-1.54
Skewness	-0.48	0.14
5% percentile	40.88	24.85
95% percentile	51.10	39.35
Interquartile range	6.13	12.43
Minimum	38.84	22.78
Maximum	51.10	45.56
Count	756	756

potential yield to estimate the gaps, namely technology and extension gaps (Hiremath *et al.*, 2009). The technology gap shows the gap in the demonstration yield over potential yield and it was 13.57 q/ha (Table 3). The observed technology gap was mainly attributed to the rainfed conditions prevailing in the district. The other reasons include dissimilarity in soil fertility status and marginal holdings. Therefore, to narrow down the technology gap, location specific recommendations are necessary. Further the extension gap was 14.83 q/ha which emphasized the need to educate the farmers through various extension means for the adoption of scientific practices in cultivation of maize. The technology index shows the feasibility of the improved practices at the farmer's field. The lower the value of technology index more is the feasibility.

Statistical differences in yields & Testing of Hypothesis: The comparison of absolute productivity under demonstrated and local pots has been depicted in Figure 3. However, the statistical differences was evaluated using 'independent two sample t-test', after checking for normality of data for both the groups. The results of 'independent two sample t-test' were presented in Table 4.

The value of F test statistic was 2.411 (p-value equals 0.00) which revealed that the sample standard deviation(s) of the Farmers Practice's population was considered not to be equal to the sample standard deviation(s) of the Demo's population. In other words, the difference between the sample standard deviation (s) of the Farmers Practice and Demo populations is big enough to be statistically significant. Therefore, the t-test with unequal variances was used to statistically compare the maize yields under demonstrated and local check plots. Since p-value

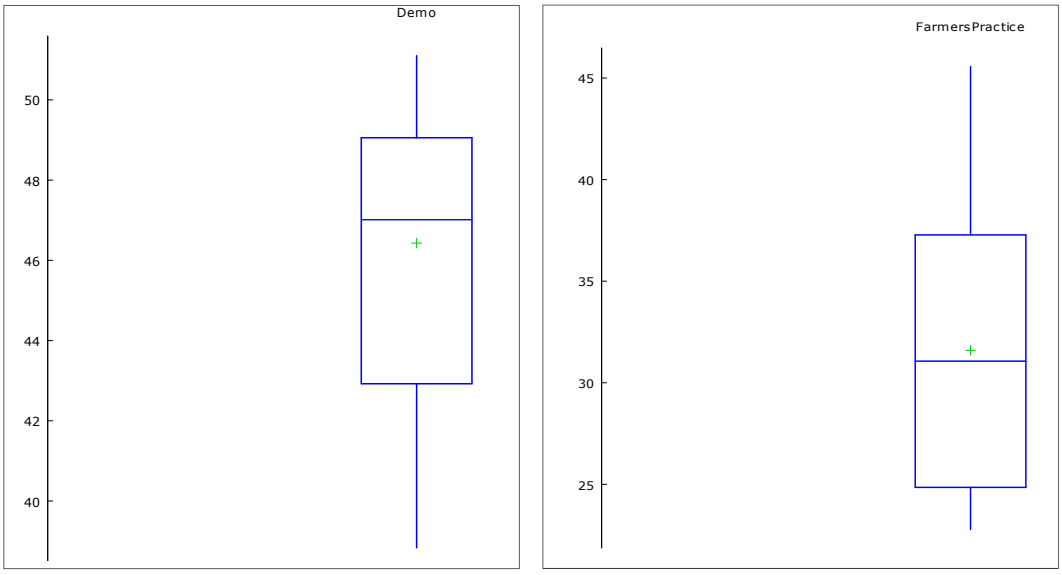

Figure 2: Box plots for maize yield under demonstrated and local plots

Table 3: Productivity of maize, yield gaps and technology index

Yield (q/ha)			% increase over local	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
Potential	Demonstration	Traditional Plots				
60.00	46.43	31.60	46.93	13.57	14.83	22.61

Figure 3: Comparative maize yield under demonstrated & traditional plots

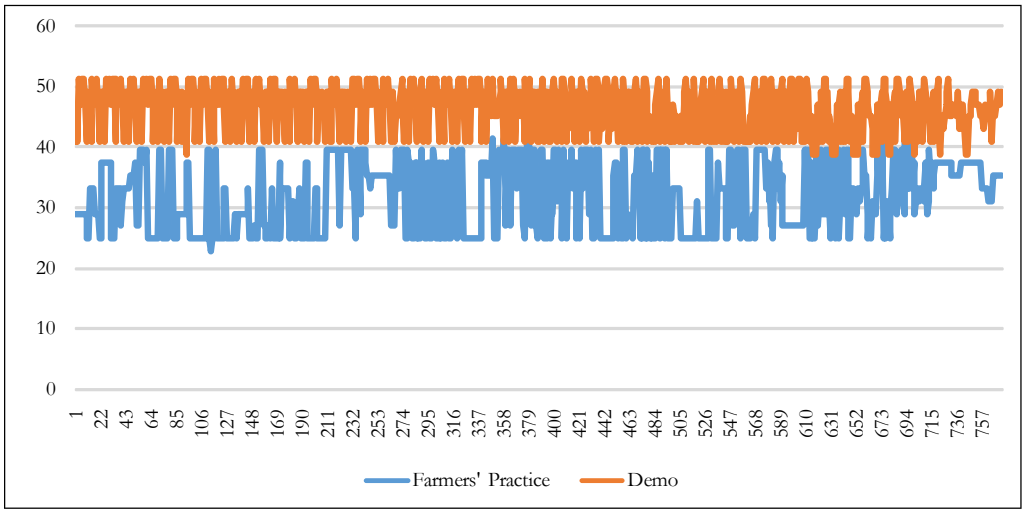

Table 4: Independent two sample t-test for comparison of means

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	**Sig.**	**T**	**Df**	**Sig.(2-tailed)**
Equal variances not assumed	2.411	0.000	-57.93	1289	.000

(0.00) for t statistic (-57.93) was less than 0.05 (α), H_0 was rejected. The average of the Farmers Practice's population is considered not to be equal to the average of the Demo's population. In other words, the difference between the average of the Farmers Practice and Demo populations is big enough to be statistically significant. The observed standardized effect size was large (2.98) which indicates that the magnitude of the difference between the two averages is large.

Economics of Front Line Demonstrations: The economics of recommended maize production technologies under both front line demonstrations was compared with that of local checks and the same has been presented in Table 5. The table revealed that demonstration plots recorded higher gross returns (Rs. 59802/ha.), net return (Rs. 34800/ha.) and B:C. ratio (1.75) as compared to the traditional plots where farmers got gross returns, net returns and B:C ratio of Rs. 34800/ha, Rs. 18834/- and 1.18 per hectare respectively. An additional net return of Rs. 19222/- per hectare was realized in case of demonstrated plots compared to local check plots.

Table 5: Economics of cereal production under front line demonstrations

Particulars		**Value**
Yield (q/ha)	Demo. Plots	46.43
	Traditional Plots	31.60
Total cost of cultivation (Rs./ha)	Demo. Plots	21745.30
	Traditional Plots	15966.02
Additional cost of cultivation over local (Rs./ha)	**5779.28**	
Gross returns including by-product(Rs./ha)	Demo. Plots	59802.40
	Traditional Plots	34800.20
Net Returns (Rs./ha)	Demo. Plots	38057.05
	Traditional Plots	18834.18
Additional Net Returns over local (Rs./ha)	**19222.87**	
B:C Ratio	Demo. Plots	1.75
	Traditional Plots	1.18

CONCLUSION

The kandi areas have vast potential for increasing agricultural production and maize being the principal crop has to be brought on top agenda for ensuring sustainable income and livelihood of farmers living in these areas. Maize can bring higher returns with increase in productivity through adoption of recommended scientific practices, as evident from the results obtained in the demonstrations laid on farmers' fields. The farmers need to encourage for adopting recommended practices on a regular basis through timely availability of critical inputs. To bridge the yield gap, there is a need to develop location-specific integrated approaches and to bridge the knowledge gap among farmers; intensive and effective training of farmers is needed. Concerted efforts are required from the extension agencies for promotion of new scientific technologies and technical know-how to the farmers for enhancing the farm incomes.

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Impact of Garment Construction Trainings on Scheduled Caste Women

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ABSTRACT

Training programme is generally conducted with a goal that the participants after being trained will translate the acquired knowledge and skill into action. Garment construction is a technical accomplishment, which requires knowledge of fabrics, principle of garment construction and skills involved in it. Present study was conducted in Hisar District of Haryana state, purposively. Two hundred thirty respondents from ten villages of four blocks (Hisar I, Hisar II, Barwala, and Hansi rural) were imparted trainings on garment construction. Out of these total 120 respondents were selected for the present study. The present study was undertaken to assess the gain in knowledge, acquired skills by the participants, adoption status of the respondents and attitude of the respondents regarding training. Knowledge level of respondents was also recorded high for sub-components viz., designing, cutting, stitching, surface enrichment, machine care and operation, entrepreneurial education and precautions. The respondents succeeded in acquiring high level skills on all the aspects of garment construction. Most of the respondents had favourable attitude toward garment construction.

Keywords: Knowledge, Skill, Attitude and adoption

INTRODUCTION

Socio-economic status is an important factor, which pervades all fields of social action in Indian society. This is needless to say that a man's position in the socio-economic status hierarchy determines, by-an-large, his behaviour in the society. People belonging to higher socio-economic status are said to be more modernized in their values and behaviours than the people who are in comparatively low ranges of the socio-economic status. Scheduled Castes constitute the weakest and poorest section of society. Central and state government has also taken great interest for capacity building of scheduled caste women in different areas for their upliftment. They comprise about 16.6 per cent of India's population (Census of India, 2011). Despite rapid urbanization, 75 per cent of India's people (some 120 million households) reside in rural areas. In India, Haryana stands at fifth position from the top in having scheduled castes population. The total scheduled castes population in Haryana is 40.91 lakhs which comprise 19.35 per cent of the state population, of which about 78 per cent live in rural areas out of which male and females are 21,88,585 (19.45%) and 19,02,525 (19.26%). They constitute 2.50 per cent of the country's SCs population and a majority of the SCs population (78.50%) of the state is residing in rural areas.

For strengthening and empowering scheduled caste women, training is the most important input for bringing desirable changes in human behavior in terms of knowledge, attitude and skill in which they are encouraged, motivated and assisted by trainers in a particular direction, because empowerment in the context of women's development is way of defining, challenging and overcoming barriers in a women's life through which she increases her ability to shape her life and environment. It has been realized in last few years that the wide spread poverty and stunt economic growth cannot be rectified unless gainful sustainable economic activity in women are encouraged. So, it is natural that women need special attention and focus.

MATERIAL AND METHODS

From Hisar District of Haryana state ten villages from four blocks (Hisar I, Hisar II, Barwala, Hansi rural) having predominately large number of scheduled caste population were selected purposively because training of garment construction was imparted in these villages. From each selected village, 10-15 respondents were selected randomly, thus making a total sample of 120 respondents. The data were collected personally through self structured pretested interview schedule and analysed with the help of frequency and percentages and mean score.

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RESULTS AND DISCUSSION

Knowledge of respondents: Knowledge level regarding garment construction was recorded for sub-components of product viz. designing and cutting, stitching and surface enrichment, machine care and operation and entrepreneurial education and precaution in all four block. It was observed that majority of respondents acquired high level of knowledge in all aspects of garment construction. Knowledge of respondents of Barwala block was high as compared to other three blocks. Ganeshan (2002), Prasnna (2002), Ahuja and Mohammed (2006), Kumari *et al.* (2009) and Tayal (2012) also supported the findings.

Attitude of respondents: Table 2 & Figure 1 indicated the attitude of respondents towards garment construction. Data reveal that in Hisar I block, Hisar II block, Barwala block and Hansi rural block majority (55.00%) of the respondents had favourable attitude followed by most favourable (28.33%) and least favourable (16.66%). Similar

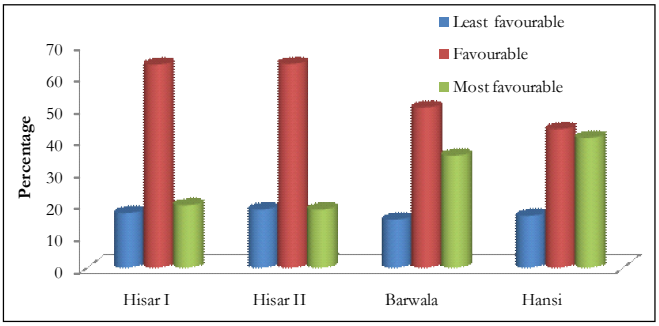

Figure 1: Attitude of respondents regarding garment construction

Table 1: Knowledge of respondents regarding garment construction

Components	Block					
	Hisar I (n=41)	Hisar II (n=22)	Barwala (n=20)	Hansi rural (n=37)	Total (N=120)	Mean Score
	Frequency (%)					
Designing & Cutting of garments						
Low (6-7)	-	-	-	-	-	10.76
Medium (8-10)	15(36.58)	9(40.90)	6(30)	18(48.64)	48(40)	
High (11-12)	26(63.41)	13(59.09)	14(70)	19(51.35)	72(60)	
Stitching of garments & Surface enrichment						
Low (8-10)	9(21.95)	4(18.18)	4(20)	12(32.43)	29(24.16)	11.96
Medium (11-13)	16(39.02)	7(31.81)	6(30)	8(21.62)	37(30.83)	
High (14-16)	16(39.02)	11(50)	10(50)	17(45.94)	54(45)	
Machine care and operation & Entrepreneurial education						
Low (11-14)	4(9.75)	2(9.09)	3(15)	7(18.91)	16(13.33)	19.15
Medium (15-18)	12(29.26)	8(36.36)	7(35)	12(32.43)	39(32.50)	
High (19-22)	25(60.97)	12(54.54)	10(50)	18(48.64)	65(54.16)	
Precautions						
Low (17-22)	3(7.31)	4(18.18)	4(20)	6(16.21)	17(14.16)	29.85
Medium (23-28)	17(41.46)	7(31.81)	5(25)	14(37.83)	43(35.83)	
High (29-34)	21(51.21)	11(50)	11(55)	17(45.94)	60(50)	

Table 2: Attitude of respondents regarding garment construction

Parameters	Block				
	Hisar I (n=41)	Hisar II (n=22)	Barwala (n=20)	Hansi rural (n=37)	Total (N=120)
	Frequency (%)				
Least favourable (0-24)	7(17.07)	4(18.18)	3(15)	6(16.21)	20(16.66)
Favourable (25-48)	26(63.41)	14(63.63)	10(50)	16(43.24)	66(55.00)
Most favourable (49-72)	8(19.51)	4(18.18)	7(35)	15(40.54)	34(28.33)

Table 3: Skill acquisition of respondents for garment construction training

Categories and scores	Block				
	Hisar I (n=41)	Hisar II (n=22)	Barwala (n=20)	Hansi rural (n=37)	Total (n=120)
	Frequency (%)				
Low (1-5)	14(34.14)	7(31.81)	7(35)	11(29.72)	39(32.50)
Medium (6-10)	20(48.78)	11(50)	9(45)	18(48.64)	58(48.33)
High (11-15)	7(17.07)	4(18.18)	4(20)	8(21.62)	23(19.16)

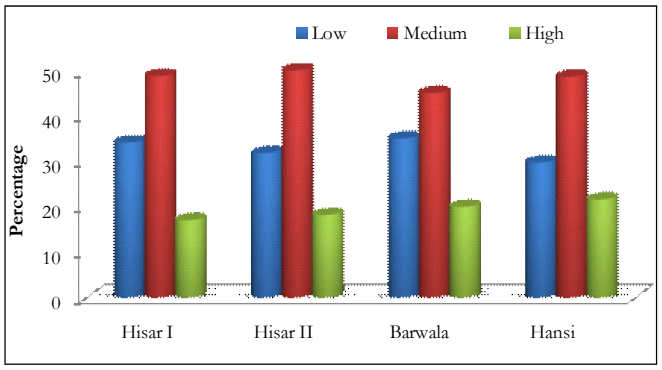

Figure 2: Skill acquisition of respondents

findings were also reported by Bishnoi (2001), Akansha (2006) and Deepti (2008).

Skill acquisition of respondents: Table 3 & Figure 2 indicated the skill acquired by the respondents towards garment construction. Data reveal that in all blocks (Hisar I block, Hisar II block, Barwala block and Hansi rural block) majority (48.33%) of the respondents acquired medium level of skills followed by low (32.50%) and high (19.16%).

Adoption status of respondents: The data presented in Table 4 indicated the status of respondents about adoption of garment construction as an enterprise in different blocks. It was observed that majority of the respondents (75.83%) did not adopt garment construction as an enterprise and the rest of the respondents (24.16%) adopted it as an enterprise. Turning towards purpose of adoption of garment construction as an enterprise revealed that In Hisar I block 48.78 per cent respondents adopted garment construction for household purpose and 21.95 per cent

Table 4: Adoption of garment construction as an enterprise

Categories	Block				
	Hisar I (n=41)	Hisar II (n=22)	Barwala (n=20)	Hansi rural (n=37)	Total (N=120)
	Frequency (%)				
Adoption status					
Adopted garment construction as income generating activity	9(21.95)	6(27.27)	5(25)	9(24.32)	29(24.16)
Adopted garment construction for household purpose	20(48.78)	11(50)	10(50)	17(45.94)	58(48.33)
Not adopted	12(29.26)	5(22.72)	5(25)	11(29.72)	33(27.50)
Purpose of adoption as income generating activity(n =29)					
Self employment	9(21.95)	6(27.27)	5(25)	9(24.32)	29(24.16)
Reasons for adoption as income generating activity					
Interest	4(9.75)	2(9.09)	2(10)	2(5.40)	10(8.33)
Time utilization	3(7.31)	3(13.63)	3(15)	4(10.81)	13(10.83)
Encouragement during training	2(4.87)	1(4.54)	-	3(8.10)	6(5)
Reasons for non adoption as an income generating activity					
Lack of technical skill	14(34.14)	6(27.27)	7(35)	9(24.32)	36(30)
Lack of credit	2(4.87)	2(9.09)	2(10)	3(8.10)	9(7.50)
Lack of confidence	2(4.87)	2(9.09)	-	4(10.81)	8(6.66)
Not interested	4(9.75)	1(4.54)	1(5)	4(10.81)	10(8.33)
Lack of time	10(24.39)	5(22.72)	5(25)	8(21.62)	28(23.33)

respondents adopted for self employment. While assessing the reason for adoption it was seen that in all the blocks most of the respondents had adopted it for time utilization followed by interest and encouragement during training. Among non adopted respondents majority of the respondents (78.04%) did not adopt garment construction as an enterprise due to lack of technical skill followed by lack of time and not interested in garment construction.

Overall impact of training: Table 5 and Figure 3 showed overall impact of training. Overall impact was measured in terms of knowledge, attitude, decision-making, skill adoption. It is clear from the table that overall impact was found medium (47.50%) followed by low (35%) and high (17.50%) respectively. Findings of the study are also in line with the findings of Singh *et al.* (2009).

Table 5: Overall impact of garment construction trainings (N=120)

Categories	Range	Frequency	Percentage
Low	(158-175)	42	35.00
Medium	(176-191)	57	47.50
High	(192-205)	21	17.50

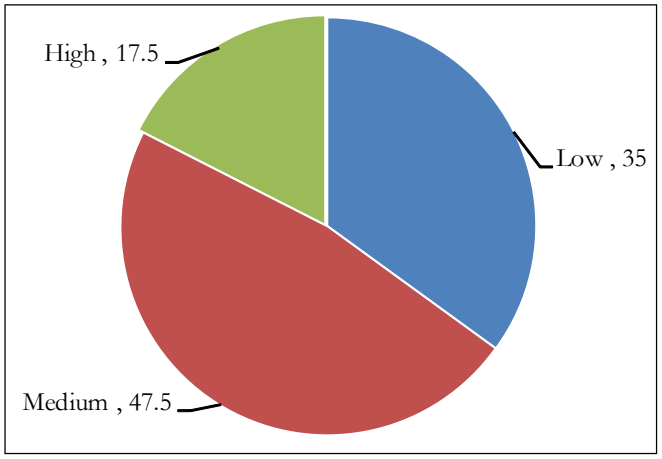

Figure 3: Overall impact of garment construction training

CONCLUSION

The findings of the present study revealed that knowledge of respondents regarding garment construction was recorded high. So it can be inferred that women succeeded in acquiring knowledge regarding garment construction. Data further revealed that, for garment construction 55 per cent respondents had favourable attitude followed by most favourable (28.33%) and least favourable (16.66%). Through garment construction training respondents could acquire sufficient skill and majority of the respondents acquired medium skill in training. Overall impact in terms of knowledge, attitude, skill acquisition, adoption and decision-making pattern was found to be medium level.

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Agricultural Credit Repayment Scenario among Small and Marginal Farmers: A Ground Reality of Hamirpur District of Uttar Pradesh

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ABSTRACT

The problem of non-repayment of loans by the farmers is causing a serious concern to the bankers and policy makers. On this line to understand the profile and repayment behaviour of small and marginal farmers the present study was undertaken in Hamirpur district of Bundelkhand region of Uttar Pradesh. The findings revealed that all the respondents borrowed from co-operative banks and co-operative agricultural societies repaid their loan after crop harvesting while the respondents availed long term loans from commercial banks repaid in installment mode. Majority of respondents repaid timely while long term loan repayment delayed. The findings indicate that 33% marginal and 31 per cent small farmers utilize credit for non-productive purposes. Major reasons for full repayment of agricultural credit were to avail future loan and better return from crops, while main reason for partial and non-repayment of agricultural credit was political agenda of political parties about policy of loan waiver i.e. excuse or *rin mafi* . High cost of cultivation of crops and lack of remunerative price were associated with partial repayment while illness or death of working head in family, marriage in family especially daughters and high cost of cultivation of crops as well as lack of remunerative price of produce were responsible for non-repayment of loan.

Keywords: Agricultural credit, Repayment behaviour, Small and marginal farmers

INTRODUCTION

To develop the agriculture sector in the country the infusion of credit is much needed in agriculture and rural sector. There is no doubt about the crucial roles of credit in economic development (Sllase and Teklehaimanot, 2013). The credit has a very important role to play in supporting agricultural production and investment activities. The commercialization and technological advancement has increased credit demands. Indian farmers, whose acreage generally comes under small and marginal category, are unable to cope-up with the modernization because of their own limited capital. All other factors also play important role but credit is the basic necessity for eradicating all others causes.

In India various agencies viz., Nationalized Banks, Commercial Banks, Regional Rural banks (RRBs). Land development Banks (LDBs), Co-operative Banks, Co-operative agricultural Societies, etc. are involved in providing agricultural and rural credit with or without assistance of National Bank for Agriculture and Rural Development (NABARD) to the rural population especially farmers. Banks extend the necessary credit facilities to the farmers for procurements of inputs and equip them with necessary machinery like tractors, tube well, etc. and to adopt the other modern technology to improve the production and productivity.

Non repayment behaviour of agricultural credit causes problems to bankers as well as to small farmers & their agricultural growth. Therefore, it is important to explore the profile and repayment behaviour of small & marginal farmers covering the socio-personal characteristics of farmers, mode of repayment, extent of repayment, purpose for which credit received and credit utilized, use of different sources for repayment and reasons for full partial and non repayment of credit.

MATERIALS AND METHODS

There are seven districts under Bundelkhand region of Uttar Pradesh. Among seven districts, one district namely Hamirpur and its all 07 blocks namely Gohand, Kurara, Maudaha, Muskara, Rath, Sarila, and Sumerpur were selected purposively. From each block 2 villages (near to bank(s) branch) and 25 small & / marginal farmers (as per availability) as respondents from each village were selected purposively. It means 50 respondents from 02

villages (each block) were selected. Thus, the sample size constituted of a total of 350 respondents were selected from 14 selected villages under 07 blocks and a district namely Hamirpur. The data were collected from respondents with the help of tested interview schedule and records available in credit advancing institutional sources i.e. District Co-operative Bank and/ their Cooperative Societies and /State Bank of India, Allahabad Bank (concerning bank branch).The data were tabulated and analyzed in the light of objectives. The study was carried out during summer season, 2018.

RESULTS AND DISCUSSION

Socio personal variables: On the basis of information collected, the majority of farmers belong to 31-60 years age group, about 53 per cent belong to backward category, more than 76 per cent belonged to middle to XII standard education level and 58 per cent respondent were under middle level social participation. All the respondents were practicing farming as main occupation. More than 70 per cent followed dairy as a subsidiary occupation. About 69 per cent respondents belonged to small farming land holding while 31.15 per cent had marginal land holding. About 48.28 percent small and marginal farmer's annual gross income is between Rs. 1-2 lakh/year while about 32 per cent small and marginal farmers annual gross income is up to Rs. 1 lakh/year. It indicates very grim picture of small and marginal farmers in this region. A large group (34.57%) of small and marginal farmers seeking information from neighbors, friends & relatives regarding agricultural credit followed by Bank officials, local leaders, traders, etc. (Table 1).

Reality of repayment behaviour: Mode of repayment of loan is very important. Table 2 indicated that about 25.42 per cent loan of commercial banks, 100.00 per cent loan of co-operative banks and co-operative agricultural societies were paid after crop harvest (short term loan) by both categories of land holders. In case of commercial banks large majority of respondents (75%) repaid their loan amount in installments, because they availed medium and large term credit.

Table 3 reveals that extent of loan repayment and repaid position. In case of commercial banks, 82 percent respondent comes under full repayment after crop harvest and rest were partial and non- repayment categories. For commercial banks 71 per cent respondents repaid timely loan while about 29% repaid delayed. In case of repayment

Table 1: Socio personal characteristic of the respondents (n = 350)

Socio-personal characteristics	Frequency	Percentage
Age (years)		
Below 30 years	97	27.71
31 - 60 years	226	64.57
Above 60 years	27	07.72
Category		
General	67	19.14
Backward	187	53.43
Schedule	96	27.43
Educational level		
Illiterate	39	11.17
Up to middle	78	22.28
Up to X	105	30.00
Up to XII	86	24.57
Up to graduation	36	10.28
Post graduation	06	01.70
Social participation (score range)		
Low (0 – 3)	89	25.43
Middle (4 – 6)	203	58.00
High (7 – 9)	58	16.57
Occupation		
Main occupation Farming	350	100.00
Subsidiary Occupation : Dairy	247	70.57
Poultry	09	07.58
Service	10	2.86
Business	16	4.57
Labor	61	1.42
Others	07	0.00
Operational land holding		
Marginal	109	31.15
Small	241	68.85
Total annual gross income/(Rs.)		
upto 1 Lakhs	111	31.72
1 – 2 Lakhs	169	48.28
2 – 3 Lakhs	45	12.86
3 – 4 Lakhs	12	3.43
> 4 Lakhs	13	3.71
Source of seeking information regarding agricultural credit*		
Neighbors, friends & relatives	121	34.57
Bank officials	82	23.43
Local leaders	43	12.28
Local input traders/dealers	44	12.58
Middlemen gents	49	14.00
Others official sources	11	03.14

*Multiple responses

Table 2: Distribution of respondent according to mode of repayment

Credit Institution (n)	Mode of repayment			
	After crop harvest (short term loan)		Installments regularly (medium & long term loan)	
	Frequency	Percentage	Frequency	Percentage
Commercial banks (n=177)	45	25.42	132	74.58
Cooperative banks (n=105)	105	100	-	-
Co-operative agril. societies (n = 207)	207	100	-	-

Table 3: Distribution of respondents according to Extent of repayment

Mode of repayment/ institution	Extent of repayment						Repaid			
	Full		Partial		Not at all		Timely		Delay	
	f	%	f	%	f	%	f	%	f	%
A. After crop harvest (crop loan)										
*Commercial banks (n = 45)	37	82.23	05	11.12	03	6.65	32	71.12	13	28.88
* Co-operative Banks (n=105)	78	74.30	19	18.09	08	7.61	77	73.34	28	26.66
Co-operative agril. societies (n=207)	142	68.60	44	21.26	21	10.14	139	67.15	68	32.85
B. Installments (long term loan)										
Commercial banks (n=132)	62	46.97	36	27.27	34	25.76	60	45.45	72	54.55
Total n = 489	**319**	**65.23**	**104**	**21.27**	**66**	**13.50**	**308**	**62.98**	**181**	**37.02**

F = Frequency; % = Percentage

through installment commercial banks loan repayee respondents (about 47%) repaid loan fully followed by 27 per cent partially and about 26 per cent non-repayment condition. Under repayment by installment condition, 45.45 per cent respondents repaid their loan timely while 54.55 per cent delayed to commercial banks.

Of all the borrowers those who had borrowed from the co-operative banks 74.30 per cent repaid the credit fully, 18 per cent partially and 7.6 per cent not paid. Of the borrowers of co-operative agricultural societies, 68.60 per cent repaid fully, out of which 67.15 repaid timely and 32.85 per cent repaid late, 21.26 per cent partially and 10.14 per cent did not repay. Thus, it can be concluded that a total of 65.23 per cent borrowers were full payee followed by 21.27 per cent partially and 13.50 per cent non payee. In terms of timely repayment about 63 per cent loan payee repay loan timely as against 37 per cent delayed. Repayment of loans depends on the terms of the loan and the utilization of the loan (Bhattacharjee, 2014).

Table 4 indicated that majority of marginal (94.50%) and small (86.72%) farmers credit received for crop loan (short term) purpose. Only 5.5 per cent marginal farmers receive credit for dairy purpose, while small farmers received credit from many agencies and many purposes like farm machinery, dairy and other purpose. The credit utilization scenario indicated that 66.97 per cent marginal and 68.88 percent small farmers' credit utilized for productive purpose. 33 percent marginal and 31 percent small farmer's credit utilized for non-productive purposes while they received credit for productive purpose. Tewari (2012) also found that 40 per cent of the loan amount borrowed by the farmers for agricultural purpose is used on non agricultural purpose such as marriages, education and health, etc. while Seema Tyagi (2015)(reported that the credit needs of rural women were diversified and consumption purposes rather than production purposes. Thus, it can be concluded that 100 per cent marginal farmers received credit for crop loan & dairy purposes but about 67 per cent utilized for productive purpose, while in case of small farmers, credit utilization percentage was about 69 per cent.

The credit once availed need to be repaid. Timely repayment of credit is beneficial to bankers, farmers and for increase in the growth of agriculture. So, farmers use different sources of income to repay the credit. The data related to use of different sources of income for repayment is given in Table 5.

Table 4: Purpose for which credit is received v/s credit utilized

Farming category	Purpose for which													
	Credit received										Credit utilized			
	Crop loan		Farm machinery loan		Dairy loan		Other		Total		Productive purposes		Non productive purposes	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Marginal (n=109)	103	94.50	-	-	06	5.50	-	-	109	100	73	66.97	36	33.03
Small (n=241)	209	86.72	37*	-	27*	-	13*	-	-	-	166	68.88	75	31.12

*Credit received from many agencies & many purposes

Table 5: Scenario of respondents about use of different sources of income for repayment

Purpose for which credit is obtained	Sources of income for repayment	Frequency	Percentage
Crop loan(n = 103 + 209 = 312)	Crop production	189	60.58
	Crop production + labor	72	23.08
	Crop production + dairy farming	40	12.82
	Crop production + service	04	01.28
	Crop production+ business	03	00.96
	Crop production + dairy farming + labor	04	01.28
Farm machinery loan (n = 37)	Crop production + machinery on rent	07	18.92
	Machinery on rent + labor	25	67.57
	Sale of machinery + crop production	05	13.51
Dairy loan (n = 27)	Dairy farming	12	44.45
	Crop production + dairy farming	09	33.34
	Crop production + dairy farming + labor service/business	06	22.21
Other purpose loan (n=13)	Crop production	04	30.78
	Crop production + again loan	06	46.15
	Crop production + labor/service/ business	03	23.07

Out of 312 (100%) borrower of crop loan, majority (60.58%) of respondents repay loan through crop production followed by 23 per cent from crop production + labor and with other source of income. 37 respondents received credit for farm machinery purpose, in which majority (67.57%) of respondents repaid credit through machinery on rent + labor followed by other sources. In case of dairy loan borrowers (27 respondents) 44.45 per cent repay credit through dairy farming followed by crop production and dairy farming (33.34%). About 46 percent respondents repay other purpose loan out of 13 respondents followed by other source of income for repayment. Thus, it can be concluded that the main source of income for repayment was crop production and fund generated by productive end use of credit.

Reasons for full repayment of agricultural credit by the small & marginal farmers: As shown in the data in Table 6 the main reasons of full repayment were to procure future loan (31.66%), better return from crops (28.21%) and to avoid excess payment of interest (21.00%) were the main reasons.

Reasons for partial repayment of agricultural credit by the small and marginal farmers: Perusal of the data in Table 7 revealed that most important reasons for partial repayment of agricultural credit were due to political parties issue that government excuse the loan (*loan mafi)* (27.88%) and high cost of cultivation of crops (11.54%) and other reasons quoted for partial repayment were lack of remunerative price of produce (10.58%), due to repayment of old debt, low returns from crops due to crop losses (7.69%), illness of family members as well as social & religions functions of society (5.77%).

Reasons for non-repayment of agricultural credit by the small and marginal farmers: The data in Table 8

Table 6: Reasons for full repayment of agricultural credit by the small & marginal farmers (Full loan payee n = 319)

Reasons	Full repayment	
	Freq.	%
Better return from crops	90	28.21
To procure future loan	101	31.66
Honesty & promptness nature of farmers	10	3.13
To maintain relation with banks	07	2.19
Additional income from subsidiary occupation	03	0.94
Timely availability & utilization	05	1.56
To avoid excess payment of interest	67	21.00
To avoided social stigma	36	11.28
Total	**319**	**100**

Table 7: Reasons for partial repayment of agricultural credit by the small & marginal farmers

Reasons	Full repayment	
	Freq.	%
Low return form crops due to crop losses	8	7.69
High cost of cultivation of crops	12	11.54
Lack of remunerative price of produces	11	10.58
Due to repayment of old debt	10	9.61
Due to utilization of loan for unproductive purpose		
i. Marriage in family	4	3.85
ii. Children education	3	2.88
iii. Daily needs	-	-
iv. House construction	4	3.85
v. Purchase of luxurious item	5	4.81
vi. Illness of family member(s)	6	5.77
vii. Other uncertainty causes	2	1.92
viii. Bad habits of family head	4	3.85
Due to social and religions functions of society	6	5.77
Due to political parties issue that government excuse the loan	29	27.88
Total	**104**	**100**

indicate the main reasons of non-repayment of agricultural credit as political agenda of political parties especially before election about loan excuse (*rin mafi)* (37.89%) followed by illness or death of family / working head within family (15.16%), marriage in family especially of daughter (10.60), lack of remunerative price of produces and high cost of cultivation of crops (9.09%), poor return from crop due to crop losses (7.57%), debt from private persons/agencies and bad habits of family head were the

Table 8: Reasons for non-payment of agricultural credit by the respondents (Non-loan payee n = 66)

Reasons	Full repayment	
	Freq.	%
Poor returns from crop due to crop losses	5	7.57
High cost of cultivation of crops	6	9.09
Lack of remunerative prices of produces	6	9.09
Marriage in family especially daughters	7	10.60
Illness/death of working head within family	10	15.16
Bad habits of family head	03	4.54
Political agenda of political parties about loan excuse (*rin mafi)*	25	37.89
Debt from private persons/ agencies	04	06.06
Total	**66**	**100**

reasons of credit non-repayment in Hamirpur district. Except *loan 'mafi'* issue. Similar trend was found in the studies of Virk *et al.* (2003), Mishra *et al.* (1981), Bisaliah and Nagraj (1985), Choudhary and Sharma (1985), Murugayan *et al.* (1983) and Arena and Aneka (1997).

CONCLUSION

Present study revealed that 109 (31.15%) marginal and 241 (68.85%) small farmers out of 350 total respondents, who received short and long term credit and their mode of payment were short and long term type as per nature of loan. Majority of respondents fully repaid crop loan as compare to long term loan. In terms of repaid time majority of crop loaner repaid timely while in case of long term loan majority were with delayed or late payer. Generally small and marginal farmers credit received and utilized for short term period in the form of crop loan while a large percentage of respondents credit utilize for non-productive purpose. The main source of income for repayment was crop production and funds generated by the productive and use of credit. The main reasons for full repayment were to procure future loans, better returns form crops and to avoid excess payment of interest. The main reasons for partial repayment of agricultural credit were due to political parties issue that government excuse the loan i.e*., loan mafi*, high cost of cultivation of crops and lack of remunerative price of produces, while the main reasons for non repayment were political agendas of political parties about loan excuse, illness or death of working head within family and marriage in family especially daughters.

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Adaptation and Coping Mechanisms of Farm Households for Reducing Vulnerability to Climate Change in Odisha

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ABSTRACT

Climate change events like cyclone has made highest impact on livelihoods followed by flood, drought and heat wave, respectively. The outlooks for the vulnerable regions are not good unless on-farm contingency plans, both short and long-term, are adopted. Therefore, present study has assessed the adaptation and coping mechanisms of the farm households in Balasore and Khurda districts of Odisha. Farmers from both the districts have shown a strongly positive response towards adaptation of technological innovations to cope up and mitigate the climate change scenario. Adoption of drought mitigating strategies is prominent in Khurda district while drainage and flood mitigation methods are prominent in Balasore district. The adaptation and preparedness to reducing vulnerability are influenced by existing institutional arrangements at local level which include prevalence of seed bank, custom hiring centre, community nursery, weather based agro-advisory, etc in the study areas.

Keywords: Extreme climatic events, Crop farming, Livestock farming, Fish farming, Natural resource management, Institutional innovations, Technological innovations

INTRODUCTION

The global climate change, which has attracted attention of thinkers from almost all fields, is threatening to have significant and far reaching impacts on the human society. It has differential impact on different parts of the globe. The projected magnitude of the adverse impacts is expected to be more in case of tropical and sub-tropical regions as per United Nations Framework Convention on Climate Change (UNFCC, 2000), particularly on the developing countries. Again, climate is a direct input to agricultural productivity. Hence, agriculture has been a major concern in the discussions on climate change. Studies show that without adaptation climate change is generally detrimental to the agricultural sector; but with adaptation, vulnerability can largely be reduced. Research on climate change-agriculture interactions has evolved from a top-down approach to a bottom up approach. The top-down mode starts with climate change scenarios, and estimates impacts through scenario analysis, based on which possible adaptation practices are identified. The bottom-up approach, on the other hand, takes on a vulnerability perspective where adaptation strategies are considered more as a process involving the socio-economic and policy environments, producer's perceptions and elements of decision making. The bottom-up approach explores the possible adaptation strategies in a particular socio-economic and climatic set-up.

Climate change and its impacts are challenging the agricultural development. Adaptive capacity is one of the primary factors facilitating resilience of a system (Smit and Skinner, 2002). Adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them (Gbetibouo, 2009 and Maddison, 2014). Resilience through adaptation is as important as mitigation; therefore, adaptive measures need greater attention, in terms of technological and institutional interventions to deal with climate change induced vulnerability and impact (Rao *et al.*, 2016). The technologies offering resilience to the changing contexts of agriculture became an imperative to keep the sector and its dependents secured (Jasna *et al.*, 2017). Krishi Vigyan Kendras (KVKs) are to play an important role in dissemination of such technologies and capacity building of farm households (Jasna *et al.*, 2016); however, knowledge and awareness of KVKs' personnel on climate change is lowto moderate (Ghanghas *et al.,* 2015).

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Odisha is one among the Indian states which has the highest proportion of poor persons in its population on the one hand. On the other hand, being on the bank of Bay of Bengal the state is exposed to the vagaries of climatic change. Mohapatra (2012) classified cyclone prone states of India where he indicated a majority of the districts in Odisha are frequently affected by cyclones and floods with different intensity levels and both the events are complementary in nature, a comprehensive assessment will help unravel the scale of vulnerability across the districts of Odisha and provide a better understanding of the adaptive capacity of households to these extreme events. Das and Ghosh (2018) in their study at coastal and non-coastal districts of Odisha observed a dent in crop productivity during calamity years which are severe in non-coastal districts during heat waves and cyclone while coastal districts face a decline in crop area and production during cyclone and flood.

On this backdrop, present study was conducted to assess adaptation and coping mechanisms of farm households for reducing vulnerability to climate change in Odisha.

MATERIALS AND METHODS

Present study has purposively chosen one coastal district and non-coastal district of Odisha that is Balasore and Khurda, respectively. These two districts are having different geographical location, variable ecosystem and climatic challenges and use to suffer from cyclone & flood and drought & heat wave, respectively. Simple random sampling method was followed for selection of two blocks under each district and two villages under each block and 15 farm households under each village. Thus, overall four blocks, eight villages and 120 farm households, 60 each from selected two districts included in the study.

Diversified livelihoods along with crop farming as the primary occupation were there for the majority in study area; therefore, adaptation and coping mechanisms mostly hover around it. In this context, Technological innovations were explored with respect to crop farming, livestock farming, fish farming and natural resource management. The adaptation of farm household through adoption of such innovations was recorded. What types of institutional innovations (custom hiring centre, user groups, farmers associations, etc.) for climate change adaptation have been implemented with what impact on farming and/or livelihood with respect to crop farming, livestock farming, fish farming and natural resource management were also studied. Short term as well as long term adjustment through general strategies, crop farming strategies, livestock farming strategies and fish farming strategies for reducing disaster vulnerability was documented as revealed by respondents sampled in present study. The data were collected through personal interview method with the help of structured interview schedule and collected data were analyzed by calculating frequency and percentage of farm households following each of the technological and institutional innovations for climate change adaptation.

RESULTS AND DISCUSSION

Adaptation to climate change by farm households pertains to their adoption of different technologies, strategies and institutional arrangements. Table 1 shows the list of technological innovations in terms of natural resource management adopted by the farmers of Balasore and Khurda districts of Odisha. In Balasore district, the most adopted innovation includes land modification as 98 per cent of sample households adopted this followed by water saving irrigation methods (77%) and solid waste management (65%). In Khurda district of Odisha trend of most adopted innovations follows water saving

Table 1: Technological innovations with respect to natural resource management for reducing vulnerability to climate change

Natural Resource Management Technologies	Frequency (%)	
	Balasore (n=60)	Khurda (n=60)
In-situ moisture conservation through mulching (straw mulch in vegetables, pulse and oilseed crops, polythene mulch in vegetable crop)	10 (16.66)	3 (5.00)
Water saving irrigation methods (broad bed furrow)	46 (76.66)	43 (71.66)
Land modification	59 (98.33)	16 (26.66)
Water harvesting (renovation of existing pond)	17 (28.33)	11 (18.33)
Solid waste management (compost, vermi-compost production)	39 (65.00)	37 (61.66)
Soil health improvement (green manuring)	-	4 (6.66)

irrigation methods where 72 per cent of the selected farm household have adopted this technique to adapt to the climatic vagaries. Followed by this the list includes solid waste management (62%), land modification (27%) and water harvesting techniques (19%) among the sampled farmers.

Table 2 presents the list of technological innovations with respect to crop farming adopted by the farmers of Balasore and Khurda districts of Odisha. In Balasore district, the most adopted crop farming practice includes cultivation of short duration of paddy varieties as 93 per cent of sampled households adopted this practice followed by water saving paddy cultivation methods (78%), growing flood tolerant rice varieties (68%) and pest & disease tolerant varieties (55%). Whereas in Khurda district of Odisha, farming practices include cultivation of short duration paddy by about 79 per cent of the sampled farmers followed by water saving paddy cultivation methods (60%), growing tolerant rice varieties against pest & diseases (50%) as well as against drought (35%).

Table 3 indicates the list of technological innovations for livestock farming as adopted by the farmers of Balasore and Khurda districts of Odisha. In Balasore district, around 83 per cent of the selected farm households go for preventive vaccination in livestock against various diseases. Next most adopted innovation is in the form of cattle feed (33%) and storm-resistant housing strategy for poultry birds (7%). In Khurda district of Odisha around 82 per cent of the selected farm population adopted preventive vaccination in livestock against various diseases, followed by cattle feed (23%) and using community land for fodder production during the time of climatic crisis (5%).

Table 4 shows the list of technological innovations for fish farming as adopted by the farmers of Balasore and Khurda districts of Odisha. In Balasore district only seven per cent of the selected household have adopted both management of fish ponds / tanks during water scarcity and excess water situation and fish feed (mineral mixture). No such adaptation is seen in Khurda district as

Table 2: Technological innovations with respect to crop farming for reducing vulnerability to climate change

Crop Farming Technologies	Frequency (%)	
	Balasore (n=60)	Khurda (n=60)
Short duration varieties of paddy	56 (93.33)	47 (78.33)
Tolerant rice varieties for drought	1 (1.66)	21 (35.00)
Tolerant rice varieties for flood	41 (68.33)	1 (1.66)
Pest and disease tolerant varieties	33 (55.00)	30 (50.00)
Water saving paddy cultivation methods (SRI, etc)	47 (78.33)	36 (60.00)
Crop diversification (through growing of pulses, oilseeds, etc)	7 (11.66)	-
Cultivation of Paddy Straw Mushroom	-	1 (1.66)

Table 3: Technological innovations with respect to livestock farming for reducing vulnerability to climate change

Livestock Farming Technologies	Frequency (%)	
	Balasore (n=60)	Khurda (n=60)
Use of community lands for fodder production during droughts / floods	-	3 (5.00)
Cattle feed (mineral mixture, urea and molasses, etc)	20 (33.33)	14 (23.33)
Preventive vaccination in livestock (BQ, FMD, HS for bovines, goat pox, etc)	50 (83.33)	49 (81.66)
Stress tolerant dual-purpose poultry bird (Nirbheek, Hitkari, etc)	1 (1.66)	-
Storm resistant two-tier housing for poultry birds	4 (6.66)	-

Table 4: Technological innovations with respect to fish farming for reducing vulnerability to climate change

Fish Farming Technologies	Frequency (%)	
	Balasore (n=60)	Khurda (n=60)
Management of fish ponds / tanks during water scarcity and excess water situation	4 (6.66)	-
Fish feed (mineral mixture)	4 (6.66)	-

no fish farmers are there amongst the sampled respondents.

A survey done by Sahu and Mishra (2013) suggests that people who have better access to irrigation facility they are adapting maximum of the possible adaptation options. People who do not adopt any of the techniques are those who do not have access to irrigation facility and have a very low level of income. Therefore, steps should be taken to encourage and facilitate their adaptation behaviour to climate change which can go a long way reducing their vulnerability. Mishra and Sahu (2014) examined the perception and adaptation behaviour of farmers to climate change in the face of the various socioeconomic and demographic conditions, taking Kendrapara district of Odisha (a state of India) as the study area. The results revealed that access to irrigation, ownership of land and land size of the farmers positively influenced various adaptations strategies. Education positively influenced migration. It was revealed that the major barriers for the farmers to adapt to climate change was their poor economic condition and the poor infrastructure facility in the area in terms of unavailability of irrigation water, lack of extension service, etc.

Table 5 shows the general coping strategies to face the changing climatic scenario by the farmers of Balasore and Khurda districts of Odisha. In Balasore district around 78 per cent of the selected farm households adopt drainage around crop field and habitat area to avoid the flood like situation. Apart from this, other strategy includes land sloping or modification (55%), on dyke plantations around pond boundary (50%), shifting habitat to high land areas (48%), etc. In Khurda district, around 50 per cent of the sampled farmers adopt the strategy of rainwater harvesting in the paddy field by raising bund height followed by rainwater harvesting through farm pond (33%) and land modification (28%).

Table 6 provides a list of the coping strategies used in crop farming in the context of changing climatic scenario by the farmers of Balasore and Khurda districts of Odisha. In Balasore district, as high as 90 per cent of the sampled farmers grow resistant varieties and short duration HYVs. Apart from these, strategies like drainage and land sloping (55%), ridge furrow irrigation method (35%) and raising bund height of crop fields (33%) have been adopted too. While in Khurda district about 93% of sampled farmers grow short duration varieties to escape from end season drought. Other coping mechanisms followed includes growing resistant varieties (62%), ridge and furrow irrigation method (27%), raising bund height of crop fields (23%) etc.

Table 7 contains the strategies used in livestock rearing to cope up with the changing climatic scenario among the farmers of Balasore and Khurda districts of Odisha. In Balasore, more than 76 per cent of sample farm households use different vaccinations for livestock and indigenous strategy of covering roof of shed by paddy straw to get relief from extreme heat. Other strategies include providing shed with concrete flooring (57%),

Table 5: General strategies for coping with climatic change events

General Strategy	Frequency (%)	
	Balasore (N=60)	Khurda (N=60)
Make boundary around the house	1 (1.66)	6(10.00)
Field drain in crop field and habitat area	47 (78.33)	13 (21.66)
Arranging / preparing materials for floating on the water in the event of flood	10 (16.66)	-
Shifting the habitat to high land areas	29 (48.33)	16 (26.66)
Rainwater harvesting through farm pond	21 (35.00)	20 (33.33)
Rainwater harvesting in the paddy field by raising bund height	27 (45.00)	30 (50.00)
Land sloping/ modification	33 (55.00)	17 (28.33)
Social forestry / plantation of trees along road side	1 (1.66)	-
Habitat area at a higher elevation	3 (5.00)	3 (5.00)
Renovations of village ponds to increase water holding capacity for multiple use management	3 (5.00)	6 (10.00)
On dyke plantations of trees around the pond boundary	30 (50.00)	9 (15.00)
Construction of Cyclone shelter	1 (1.66)	3 (5.00)

Table 6: Crop farming strategies for coping with climatic change events

Crop farming strategy	Frequency (%)	
	Balasore (N=60)	Khurda (N=60)
Growing of resistant varieties	54 (90.00)	37 (61.66)
Growing short duration HYVs	54 (90.00)	56 (93.33)
Ridge and furrow method irrigation	21 (35.00)	16 (26.66)
Growing of salt tolerant varieties	1 (1.66)	-
Well drainage and land sloping	33 (55.00)	4 (6.66)
Drainage with proper cleaning and repairing	11 (18.33)	-
Raising bund height of the crop fields	20 (33.33)	14 (23.33)

Table 7: Livestock farming strategies for coping with climatic change events

Livestock farming strategy	Frequency (%)	
	Balasore (N=60)	Khurda (N=60)
Vaccination	46 (76.66)	50 (83.33)
Transferring the cattle on high land areas	26 (43.33)	16 (26.66)
Covering the roof of shed by paddy straw to get relief from extreme heat	46 (76.66)	37 (61.66)
Shed with concrete flooring	34 (56.66)	34 (56.66)
Cage for poultry farming	7 (11.66)	1 (1.66)
Sheds at higher elevated area	4 (6.66)	3 (5.00)

transferring cattle to high land areas (43%), etc. In Khurda district around 83 per cent of selected farm household use vaccination followed by roof covering with straw to escape the heat effect (62%), shed with concrete flooring (57%), etc.

Table 8 contains the strategies used in fish farming to cope up with the changing climatic scenario among the farmers of Balasore and Khurda districts of Odisha. In Balasore district a uniform frequency of adaption of strategies to a tune of 7% is seen in the practices namely raising the bund height, covering of pond area by net to reduce the menace of fish catching birds, drainage of the excess water, rainwater harvesting in the pond, pond renovation to increase water holding capacity for irrigation and fish farming, renovation of the ponds with increased bund height etc. No such coping strategy is found in Khurda district as no fish farmers were there amongst the sampled respondents.

The coping mechanisms can be visualised as a network to maximize utility of resources from crop farming, livestock keeping and fish farming. The adopted strategies and coping mechanisms depended on households' perception on extreme events and the problem associated with it. The problems included crop failure, concomitant

Table 8: Fish farming strategies for coping with climatic change events

Fish farming strategy	Frequency (%)	
	Balasore (N=60)	Khurda (N=60)
Raising the bund height	4 (6.66)	-
Covering of pond area by net to reduce the menace of fish catching birds	4 (6.66)	-
Drainage of the excess water	4 (6.66)	-
Rainwater harvesting in the pond	4 (6.66)	-
Rainwater harvesting and use it for cultivation of carp fish	1 (1.66)	-
Pond renovation to increase water holding capacity for irrigation and fish farming	4 (6.66)	-
Renovation of the ponds with increased bund height	4 (6.66)	-

decline in income and employment opportunities, low yields, and escalation of food price, hunger and malnutrition, decrease in grazing land and fodder availability, and loss of properties and life. However, the coping mechanisms vary according to the nature of extreme events. Accordingly, the strategies practiced to reduce climate change events vulnerability are classified into four groups namely common strategies for any extreme events in general, specific strategies to reduce drought, flood and cyclone impacts.

The following coping mechanisms were also mentioned by the households during the survey and focus group discussions (FGDs) at study villages:

Reducing consumptions: A large number of respondents, mainly the marginal farmers and daily labourers, drastically cut food intake during calamity year. Further their preparedness to consume inferior diet helps to match the demand with restricted supply situation. The FGD revealed that consumption expenditures of sample households during calamity year declined by 10 per cent. The magnitude of decline is highest for expenditures towards family festivals followed by food, and other items. One interesting observation is that expenditure towards housing showed large increase in cyclone year in order to reconstruct the damaged house. The decline in crop production and losses of assets, income and employment opportunities contribute to significant increase in food insecurity. Food consumption fell by 5 to 15 per cent but more importantly, consumption of non-cereal items fell by more than 10 to 20 per cent, thereby increasing the nutritional insecurity. Borrowing and relief were perceived by the households helpful but failed to compensate the total fall in consumption.

Borrowing:Household sought loan or credit by relying on informal lenders, usually with much higher interest. Large numbers of borrowing were from such informal sources, many from SHGs and co-operatives and few from the banks. More than 80 per cent of the poorest households used to be solely dependent on informal money lenders (i.e. landlords, neighbours, etc.) at high rate of interest for financing their consumption requirement. They have least or no access to institutional credit. All their borrowing from money lenders were used to meet consumption requirements or emergency expenses. Around two-third of them also sold their land to the money lenders.

Livestock keeping: The other complementary side of household strategies to reduce climate induced natural disasters (CIND) vulnerability is related to livestock keeping. These strategies aimed at coping with mainly drought and flood. A shift from cattle and or sheep rearing to goat and or buffalo has been observed in recent year. Goat and buffalo were considered to be hardy as compared to sheep and cattle, respectively. Goats are non-selective animals, can survive on any type of feed/fodder/ food, and the buffalos highly tolerant to the extreme environments. In the past, farmers/households used to concentrate on selected types of animal mainly milch cow and bullocks. Now the respondents argue that this strategy no longer exists. They have changed towards keeping more than one type of animal. This is necessary because it gives a cushion to compensate losses during severe droughts or floods as different animals respond differently to the various environmental stress conditions. During or after any calamity, de-stocking of animals is an important strategy followed by nearly 20 per cent of households, who sell milch animals. Selling of animals is mainly due to fodder scarcity and to avoid losses through death as well as in order to earn some cash income for the household's survival. The distress selling price of cattle during calamity year is used to be 25 to 30 per cent less than the normal price.

Migration: During post disaster period, rural households looked for various income opportunities. Noticeable migration patterns to urban centres in search of employment were observed in the study villages. There was more migration among daily labour group than other. This is because the opportunities to earn locally through wage earning used to be dwindled as traditional employers and large farmers also get affected. Around 20 per cent of rural households are restored to seasonal out-migration in search of job or earning.

Drawing down inventories: A large number of rural households do build up stocks and inventories so as to meet future hardship. Therefore, drawing upon inventories, mainly household assets, is a well-known coping strategy. However, the landless daily labours, who are unable to build stocks during normal years resort to mortgage of family assets including residential units and cattle. Both landless labour and marginal farmers lost a substantial part of their assets (cattle and land) to feed their family during last calamity. The sequence of the assets transaction and the pattern of household response to various calamity events confirm the assertion that 'household will attempt to preserve their productive assets as long as they can'. In order to do so their initial responses are tightening the

belts and consuming less. Then they will draw upon inventories which they stored for contingencies and, if necessary, they dispose of non-productive assets as jewellery, utensils and other household items. When no other options are remained open, they go for disposing productive assets.

Cropping strategies: Earlier farmers used to cultivate high yielding varieties (HYVs) because of lower frequency of drought and flood. But over time the frequency and intensity of both drought and flood increased to a significant level. Thus, farmers got discouraged to sow the HYVs which are susceptible to drought, flood and a range of pest and diseases. Instead the varieties (in some case even low yielding) have become popular as those are resistance to diseases, early drought and water logging.

Water management: Due to fluctuation and uncertainty of rainfall, and its uneven distribution over time and space, more than 20 per cent respondents argued that they provide irrigation only during critical growth stages of the crop. Harvesting runoff water is being practiced in the study area. Since decades village households combat droughts with traditional ponds built either personally or with community participation. These ponds store runoff water which is used as a source of irrigation during the dry months. So, a minor failure of rainfall or a short dry spell is addressed. These ponds have another important use. Besides for domestic use (bathing, etc), these ponds are also used for fishing and duckery, which give some alternative income and food to the village households.

Table 9 indicates the institutional innovations / arrangements influencing the livelihood opportunities/ adaptation options of farm households in Balasore and Khurda districts of Odisha. In Balasore district, 60 per cent out of the 60 selected farm households to become resilient towards changing climatic scenario associate with self-help groups (SHGs) and Farmer's Interest Groups (FIGs). Apart from this, other institutional arrangements found are seed bank formation (5%), custom hiring centres (5%), etc. In Khurda district around 52 per cent of farm households attain adaptation by presence of weather based agro-advisory at village level. About 33 and 23 per cent of the farm households mentioned farmer's club and fodder bank as other two important institutional arrangements to provide impetus to adaptation.

The adaptation and preparedness to reducing vulnerability to CINDs largely depend on existing institutional arrangements at local level. Therefore, prevalence of seed bank, custom hiring centre, community nursery, weather based agro-advisory, etc in the study area have inculcated a culture of community-based activities for climate resilience in study areas.

According to Gulati *et al.* (2009) among all the adaptation measures identified and elaborated the community-based preparedness and mitigation planning is the key as it would greatly enhance the capacities of communities by broadening their coping range. Narayanan and Sahu (2016) reported that access to credit facilities and experiences of the households in farming were important factors to improve farmers' adaptation to climate change.

Table 9: Institutional innovations for climate resilient agriculture

Institutional innovation	Frequency (%)	
	Balasore (N=60)	Khurda (N=60)
Formation and strengthening of SHGs, FIGs	36 (60)	20 (33.33)
Formation and strengthening of Kisan club/ Farmers club, etc	-	21 (35)
Seed bank	3 (5)	3 (5)
Community Nursery	1 (1.66)	6 (10)
Fodder bank	-	14 (23.33)
Commodity groups	-	1 (1.66)
Community grain storage	1 (1.66)	4 (6.66)
Custom Hiring Centre	3 (5)	-
Weather based agro advisory at village level	1 (1.66)	31 (51.66)
Village Climate Resilience Development Committee / Village Climate Risk Management Committee /Climate literacy through a village level weather station	1 (1.66)	7 (11.66)
Other types of institutions for climate smart agriculture	10 (16.66)	-

CONCLUSION

Present study has recorded coping mechanisms to CIND vulnerability being adopted by households in study area, which have provided them with greater flexibility to reduce CIND risk. These coping mechanisms were able to sustain the poor people at marginal level (economically, ecologically and geographically). Also the field level experience shows that CIND vulnerability is a part and parcel of climatic vulnerable area including coastal Odisha and cannot be totally escaped. But household's vulnerability to various CIND events can be managed and its effects can be reduced to certain extent.

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Educational needs for Entrepreneurship Promotion and Barriers for Agripreneurship Development among Agricultural Graduates

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ABSTRACT

The study aimed at specifying the educational needs for entrepreneurship promotion and barriers for agripreneurship development among agricultural graduates under agriclinic and agribusiness centre (ACABC) scheme. The study included a sample of 30 trained farmer entrepreneurs, fifteen each from Uttar Pradesh and Maharashtra respectively who have undergone training conducted by ACABC. The barriers for agripreneurship development among agricultural graduates affected the farmer entrepreneurs of both the study locations differently. The farmer entrepreneurs of Uttar Pradesh had high technical barriers whereas those of Maharashtra had medium technical barriers. Similarly, in terms of social barriers, entrepreneurs of both the states had high social barriers like less family support and adverse family conditions which forced them to be employed rather than opting for entrepreneurship. Farmer entrepreneurs from Uttar Pradesh had medium psychological barriers while farmer entrepreneurs of Maharashtra faced high psychological barriers like low interest in agriculture studies. At times, the farmer entrepreneurs start their enterprise but find it difficult to expand or manage the enterprise. Therefore, it is necessary to arrange training at each and every level of enterprise development. Industrial training must be coupled with agricultural training so that high value, processed end products could be produced which would fetch higher prices.

Keywords: Agricultural, Agripreneurship, Barriers, Educational, Entrepreneurship, Graduates, Promotion

INTRODUCTION

Indian agriculture largely has evolved with time. Agriculture has witnessed strides from green revolution to self-sufficiency and gradually towards food surplus. Indian agriculture more or less has been carried out in conventional ways. But, at present, there is an urgent need to treat agriculture as a business and farm as an enterprise. So, our focus should be to promote entrepreneurship in agriculture, i.e. agripreneurship. With the increasing globalization, demand for agripreneurship has also risen. Many of the agriculture graduates are now turning towards agripreneurship. Profitable or commercial agriculture today is the central agenda of the Government of India. The volatility of agricultural growth in India has declined substantially over time, from a standard deviation of 6.3 percent between 1960 and 2004 to 2.9 percent since 2004 (Economic Survey, 2017). After LPG (liberalization, privatization and globalization) reforms in 1991, Indian economy got affected by world economy and became free market economy, which instilled a new confidence in farmers and paved the way for enterprise rising trends in agriculture sector, which increased individual needs for taking responsibility for running their own businesses (Alex, 2011). Government of India introduced many schemes to attract farmers and budding agriculture graduates to start their own enterprises. Agri-Clinics and Agri-Business Centre (ACABC) scheme was such a scheme, announced in 2002 which was propounded to provide motivation to agricultural graduates to take up their own entrepreneurial ventures.

Entrepreneurship is a new dimension of agriculture. The entrepreneurs are key persons of any country for promoting economic growth and technological change. The development of entrepreneurship is directly related to the socio-economic development of the society (Chaurasiya *et al.*, 2015). But the clarity of it as an occupation has been missing. There is need of education to not just promote entrepreneurship in near future but to clarify each and every doubt which arises at various stages of it. To plan for the enterprise, nature of product to be

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offered, packaging, advertisement and its promotion are some of the components which requires in depth study and analysis to understand the subject of entrepreneurship. Without a formal training at undergraduate level, the intricacies of enterprise running would be difficult and fetch much lower profits at longer run. There are certain barriers for agripreneurship development among agricultural graduates which are crucial and must be identified at early stages so that they can be minimized as much as possible. Only by minimizing barriers, it can be ensured that the favorable atmosphere for agripreneurship prevails. Long process of obtaining permits to establish small business; complex cumbersome rules of setting business, lack of entrepreneurial culture in the country are some of the technical barriers. The imbalance between the needs of the market and university, the high rates on loan for productive activities, lack of organised markets and misfit of educational content with the job market needs are some of the economic barriers. Family circumstances forcing agriculture graduates to get employment and non-cooperation of family members are some of the social barriers. Students' lack of interest in agricultural courses, lack of self-confidence and self-esteem, lack of risk taking ability and hard working spirit, fear of dealing with people are some of the psychological barriers faced by agriculture graduates. These barriers need to be eliminated if a proper culture of entrepreneurship is to be set up. This study reveals the barriers for agripreneurship development among agricultural graduates and their educational needs for entrepreneurship promotion.

MATERIALS AND METHODS

The present study was conducted in Maharashtra and Uttar Pradesh. Since these two states were the top two states where maximum number of agri-ventures was established under the scheme of ACABC in India (MANAGE, 2017 and Armorikar *et al.,* 2016). Out of 358 blocks in Maharashtra, 15 blocks were selected randomly and in Uttar Pradesh, out of 822 blocks, 13blocks were selected. The study is focused only on those successful farmer entrepreneurs who have converted their ideas by establishing a business model. The total sample size was 30 (15 from each state). Deriving accurate information is highly dependent upon survey method. In this study, interview schedule was used to collect data on socio-economic characteristics.

Barriers for agripreneurship development among agricultural graduates was measured with the help of a scale developed by Hajong (2014) in terms of four dimensions namely, technical barriers, economic barriers, social barriers and psychological barriers. Based on the information obtained in the survey, review of available literature and in consultation with the experts, a schedule was developed. Educational needs of agricultural graduates for entrepreneurship promotion were divided into four components namely Business planning, Product choice/ Development, Business process and Marketing/ Promotion. Ranking was done by the farmer entrepreneurs. Frequency and percentage analysis was conducted. Kruskal-Wallis (KW) Test, a nonparametric alternative to one-way ANOVA using SAS (Statistical Analysis System) was also used to analyse variables with ordinal level. The KW technique tests the null hypothesis that the k samples come from the same population or from identical population with same median. The Kruskal-Wallis H test (sometimes also called the "one-way ANOVA on ranks") is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable.

RESULTS AND DISCUSSION

Four components of barriers for agripreneurship development among agricultural graduates and were measured and the results are presented in Table 1 and 2 as follows.

Technical Barriers: Majority of the respondents (53.33%) had high technical barriers, followed by medium (40.00%) and low (6.67%) in Uttar Pradesh, while majority of the respondents (46.67%) had medium technical barriers, followed by high (40.00%) and low (13.33%) in Maharashtra. The reason could be complex and cumbersome rules for setting businesses, lack of an appropriate entrepreneurial culture in the country, less attention to learning practical skills, Lack of facilities, equipment and land for practical work. Joseph and Eswaran (2006) identified the perceived constraints in the functioning of SHGs and found that lack of government attention was first and foremost problem i.e., 39 per cent. High rate of interest was felt by 33.43 per cent of members, followed by insufficiency of loan for income generation, liability to repay the loan, conflict over loan sharing, problems in marketing of their products.

Economic Barriers: Majordity of the respondents (46.67%) had medium economic barriers followed by low

Table 1: Distribution of Farmer-entrepreneurs of Uttar-Pradesh as per barriers for agripreneurship development among agricultural graduates

Variables	Categories	Frequency	Percentage
Technical barriers	Low	1	06.67
	Medium	6	40.00
	High	8	53.33
Economic barriers	Low	5	33.33
	Medium	7	46.67
	High	3	20.00
Social barriers	Low	3	20.00
	Medium	3	20.00
	High	9	60.00
Psychological Barriers	Low	4	26.67
	Medium	7	46.67
	High	4	26.67

Table 2: Distribution of Farmer-entrepreneurs of Maharashtra according to barriers for agripreneurship development among agricultural graduates

Variables	Categories	Frequency	Percentage
Technical barriers	Low	2	13.33
	Medium	7	46.67
	High	6	40.00
Economic barriers	Low	3	20.00
	Medium	8	53.33
	High	4	26.67
Social barriers	Low	4	26.67
	Medium	5	33.33
	High	6	40.00
Psychological Barriers	Low	1	06.67
	Medium	2	13.33
	High	12	80.00

(33.33%) and high (20.00%) in Uttar Pradesh. Majority of the respondents (53.33%) had medium economic barriers followed by high (26.67%) and low (20.00%) in Maharashtra. The possible reason could be moderate rates of loans, improved government assistance and better market organization. Singh and Sharma (1990) observed that lack of finance (84.00%), lack of knowledge of improved practices (81.70%), high cost of HYV seeds (75.09%) and lack of irrigation facilities (61.00%) were the constraints experienced by contact and non-contact farmers.

Social Barriers: Majority of the respondents (60.00%) had high social barriers followed by equally low and medium (20.00%) barriers in Uttar Pradesh. Majority of the respondents (40.00%) had high social barriers followed by medium (33.33%) and low (26.67%) barriers in Maharashtra. Tarde and Nirban (2001) observed that majority (85%) of the local leaders in selected districts of Maharashtra had the problem of orthodox nature of the farmers and 79 per cent had the problem of factions in the village. 75 per cent of the leader's perceived low economic status of the farmers as a problem. Drug addiction of the farmers and service support from the concerned development agencies were the constraints reported by 70 per cent and 60 per cent of the leaders respectively.

Psychological Barriers: Majority of the respondents (46.67%) had medium psychological barriers followed by equally low and high (26.67%) in Uttar Pradesh. Majority of the respondents (80.00%) had high psychological barriers followed by medium (13.33%) and low (6.67%) in Maharashtra. Rao and Rupkumar (2005) studied the problems faced by the trained agripreneurs in Maharashtra. The results showed that lack of funds and risk aversion are the most important pre-start problems faced by small agricultural enterprises. The possible reason could be respondents could take medium risk and they had little interest in agricultural courses.

Barriers for agripreneurship development among agricultural graduates of Uttar Pradesh and Maharashtra: Factors affecting the establishment of agribusiness venture were compared using Kruskal Wallis test and the computed p value was found to be less than the p value at one percent significance level ($p<0.001$) for both the states (Table 3), therefore it is inferred that the barriers for agripreneurship development among agricultural graduates was different among farmer entrepreneurs for both the study locations.

Table 3: Kruskal Wallis test statistics for comparison of barriers for agripreneurship development among agricultural graduates of Uttar Pradesh and Maharashtra

Uttar Pradesh (N=15)		Maharashtra (N=15)	
Category	**Value**	**Category**	**Value**
Chi-square	52.148	Chi-square	53.094
df	3	df	3
Asymp. Sig.	0.000	Asymp. Sig.	0.000

Table 4: Educational needs for entrepreneurship promotion

Educational needs	Uttar Pradesh (Ranks)								Maharashtra (Ranks)							
Sector	I		II		III		IV		I		II		III		IV	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Business Planning	3	20.00	4	26.67	2	13.33	6	40.00	6	40.00	3	20.00	1	06.67	5	33.33
Product choice/Development	5	33.33	2	13.33	4	26.67	4	26.67	1	06.67	5	33.33	5	33.33	4	26.67
Business Process	1	06.67	6	40.00	6	40.00	2	13.33	2	13.33	5	33.33	7	46.67	1	06.67
Marketing/Promotion	6	40.00	3	20.00	3	20.00	3	20.00	6	40.00	2	13.33	2	13.33	5	33.33

Educational needs for entrepreneurship promotion: Educational needs for entrepreneurship promotion is imperative in today's situation. This kind of education serves as prerequisite for better management of the enterprises. In this research, educational needs for entrepreneurship promotion comprised of four components namely, business planning, product choice/ development, business process and marketing/ promotion. It was found that in Uttar Pradesh, 40 percentage of farmer entrepreneurs ranked business planning on 4th rank while 26.67 per cent of respondents ranked it as second. 20 per cent of respondents ranked it as first followed by the 13.33 per cent respondents who ranked it as third. The reason could be most of the respondents were well versed with the enterprises they wanted to get in as it was their family business or some or the other known person did similar kind of business; so they did not want any training for the same. Further, 33.33 per cent of the farmer entrepreneurs ranked product choice/development as first rank as it was the most important component of enterprise setting and the growth and development of the enterprise depends mostly on the quantity and quality of the product offered. Similarly, an equal percent of respondents i.e. 26.67 per cent ranked it as third and fourth while 13.33 per cent of the respondents ranked it as second. Hereafter, an equal percent of respondents ranked business process as second and third rank; the reason for the same could be how the product is developed, quality check, standard measurement, packaging, storage and keeping quality matters. Better the business process, better the price it would fetch. Further, 40 percent of the respondents ranked marketing and promotion as first rank because many a times, customers on the receiving end always seek the high quality products. In a competitive market, various products are available in the market which contains nearly equal components in it but marketing makes a difference as it helps the customers to choose a certain product among variety of other products of the same nature.

In Maharashtra, 40 per cent of the farmer entrepreneurs ranked business planning as 1st. According to them, business planning is the first and most important step while setting up any enterprise. Enterprise management, market analysis, enterprise description are some of the areas that needs planning on prior basis. 33.33 per cent of the respondents ranked it as fourth while 20 per cent of them ranked it as second. An equal percentage (33.33%) of respondents ranked Product choice/ Development as second and third as they were of the perception that the educational need for Product choice/ Development is necessary. But 26.67 per cent of farmer entrepreneurs ranked it as fourth and a minor segment (06.67%) of the farmer entrepreneurs agreed to rank it as first because respondents were of the opinion that the training under ACABC was sufficient to make one aware about the product choice. Further, 46.67 per cent ranked Business Process as third rank, the reason could be because these processes are a collection of inter-linked tasks which find their way in the delivery of a service or product and if the initial tasks are well planned and executed, it does not require to learn it separately. Similarly, 40 percent of the respondents ranked marketing and promotion as first rank, as the purpose of marketing is to attract attention and create interest. Marketing can create a brand image, change that image and get people interested in what is there for sale. 33.33 per cent of the farmer respondents ranked Marketing/ Promotion as fourth rank and an equal percent of the respondents ranked it as second and third rank.

CONCLUSION

It can be concluded that the barriers for agripreneurship development among agricultural graduates were different among farmer entrepreneurs of both the study locations. The farmers of Uttar Pradesh had high technical barriers whereas Maharashtra's respondents had medium technical barriers. The possible reason was Maharashtra has a smooth

loan procedure, less complex administrative rules and others, while Uttar Pradesh has a more complex procedure regarding loans. Similarly, in terms of social barriers both the states had high social barriers like less family support and adverse family conditions which forced them to get employed rather than going for entrepreneurship. Farmer entrepreneurs from Uttar Pradesh had medium psychological barriers while Maharashtra had high psychological barriers like they had less interest in agriculture studies. Sometimes the farmer entrepreneurs start their enterprise but find it difficult to expand or manage the enterprise successfully. It is necessary to arrange training at each and every level of enterprise development. Industrial training must be coupled with agricultural training so that high valued, processed end products could be produced which would fetch more prices. There should be provision of training at affordable prices. There should be arrangement of awards, recognition for sincere trainees so that it works as a motivating factor to attend future trainings. In our country farmers do not think or act like business person .So training should be devised regarding the same so that it trains the mind of trainees in that direction. Training should also include an element of tracking of consumption pattern of consumer so that later it could be utilized for suitable product development.

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Enhancing Rural Economy through Broom Grass Cultivation in Karbi Anglong District of Assam

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ABSTRACT

Tiger grass or broom grass (*Thysanolaena maxima* Roxb: Poaceae), which is locally known as *'phooljharu'* is one of the major non-timber forest products of North Eastern states and naturally grows in the hilly lands of Karbi Anglong district of Assam as undergrowth. This non-timber forest product of the district collected by the tribal peoples is an important source of income during November – March. But now this forest wealth is depleting gradually due to decline in forest cover, *jhum* cultivation as well as decline in its natural regeneration. Of late, its cultivation as a cash crop has become popular among the farmers of the North Eastern Hill Region. However, information on economic potentialities, management system, cultivation and domestication is scanty. A study undertaken through field survey on status and potentiality of this cash crop for economic upliftment of the rural people of Karbi Anglong district of Assam found a gross return of Rs 5.21 lakh and a net return of Rs 3.62 lakh from a hectare of land in four years with a B:C ratio of 3.28. The highest yield was recorded in the third year and thereafter declines gradually necessitating its replanting after six years of planting. Broom grass cultivation is a good profitable enterprise especially in hilly areas which can create employment opportunity for both male and female and play a vital role in poverty reduction.

Keywords: Broom grass, Phooljharu, Non-timber forest product, Cash crop, Jhum cultivation

INTRODUCTION

Tiger grass or broom grass (*Thysanolaena maxima* Roxb: Poaceae), which is locally known as *'phooljharu'* is one of the major non-timber forest products of north eastern states and naturally grows in the wild across the region. This non-timber forest produce species have good potential for generating local employment and can be used for enhancing rural income.

Generally, it grows in temperate and sub-tropical parts of India, Bhutan, Myanmar, China, East Asia, Nepal, New Guinea and Malaysia up to 2000 m (Watson and Dallwitz, 1992). The plant has a significant role in the conservation of soils of the denuded hilly areas (Khisa *et al*., 1999) and has been identified as an important non-timber economic forest product for integrating hill farming and agroforestry systems (Alam, 1995, 2010). Its fibrous root mat effectively protects the top soil and nutrients from erosion on hill slopes, in landslides affected areas and in agricultural fields as the water run-off and soil loss are reduced by up to 88% compared with bare areas (Sharma *et al*., 2001). Broom grass cultivation could be an effective instrument for generation of cash income in rural area, as its cultivation needs minimum input of labour and generates a very attractive economic return (Tiwari *et al.,* 2012). The cultivation of broom grass can diversify the livelihoods which is an important feature of rural survival and is closely allied to flexibility, resilience and stability (Pal *et al.,* 2017*)*.

It grows naturally in the hilly lands of Karbi Anglong district of Assam as undergrowth. It is one of the most important non-timber forest products of the district collected by the tribal peoples in the hilly areas of Karbi Anglong and an important source of income during December – March. But now the forest wealth is depleting gradually. There is little information on marketing, economic potentialities, management system, cultivation and domestication of broom grass is available. Therefore, a study was undertaken on status and potentiality of this cash crop for economic upliftment of the rural people.

MATERIALS AND METHODS

The present study was conducted in five villages viz. *Uche Engti Kathar Gaon, Amlokhi, Thong Timung Gaon, Bey gaon*

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(*Deoani*) *and Deithor of Karbi Anglong* district during 2015-2016. Field and market survey was done through observation and discussion with local ethnic peoples, planters, traders, vendors, manufacturers and stockiest. Primary data were used for this study. The primary data were collected with the aid of structured schedule which was administered to twenty five selected broom grass growers from five villages of the district. The data generated from the information include input and output quantities and their unit prices.

RESULTS AND DISCUSSION

Broom grass is mainly cultivated in the denuded hill slopes and abandoned Jhum lands in Karbi Anglong district of Assam. The crop is grown in closer spacing and an average of 3000 plants was observed to maintain in the study villages. The yield was found low in first year and the highest yield was recorded in the third year and thereafter declines gradually. The maximum growth took place from 2nd year onwards when annual increment in number of culms per tussock was very high (Table 1). However, broom grass production may vary from area to area both in natural and artificial plantations (Alam *et al*., 2017).

Cost of cultivation: As shown in Table 2, of all the variable items, labour constituted the largest (about 86%) of the total variable cost in the first year. From second year onward only labour cost was involved. This shows the importance of labour in broom grass farming in the study area and hence contributes to employment generation in rural areas. This is followed by cost of seedlings which make up about 14% of the cost. Fertilizer was not commonly applied to broom grass in the study area.

Cost and return analysis: Estimate for cost of cultivation, yield and economic returns of cultivation were found on the basis of data provided by the broom grass growers from five villages under study. The 1st year production cost per hectare was calculated as Rs. 64000.00 and in the 2nd and 3rd year it was calculated as Rs. 30000.00. Maximum cost involved in the 1st year and subsequently reducing in next two years and again increased in the fourth year (Table 2). The total production cost for one hectare for four years, the maximum productive period, was calculated as Rs. 159000.00. The highest yield was recorded in the third year and thereafter declines gradually necessitating its replanting after six years of planting. The year wise net return up to 4th year were found Rs. 44725(-), Rs. 34320, Rs. 214275 and Rs. 157855 (Table 3). The B:C ratio calculated for four years of production was found to be 3.28 which is a clear indication that broom grass cultivation in the study area is profitable enterprise.

Table 1: Yield parameters of broom grass recorded at farmers' field

Yield parameters	1st year	2nd year	3rd year	4th year
Culms/tussock	15	50	190	150
Total yield of culms/ha (3000 plants)	45000	150000	570000	450000
Total no. of brooms or Jhadu/ha (Av. 35 sticks/Jhadu)	1285	4288	16285	12857
Total income (@ Rs 15 per Jhadu)	19275	64320	244275	192855

Table 2: Cost of cultivation of broom grass in the hill slopes of Karbi Anglong

Item	Year				
	1st year	2nd year	3rd year	4th year	Total
Jungle cutting and removal of debris	5000	-	-	-	5000
Ranging and clearance of lines including stacking for 3000 plants	1000	-	-	-	1000
Digging of pits Nos.	9000	-	-	-	9000
Cost of seedlings/propagules	9000	-	-	-	9000
Transportation of seedlings and planting	10000	-	-	-	10000
Weeding and soil working (2 times)	20000	20000	20000	22000	82000
Harvesting and drying of brooms	5000	5000	5000	6000	21000
Making bundles, transportation and other expenses	5000	5000	5000	7000	22000
Total	**64000**	**30000**	**30000**	**35000**	**159000**

Economic potentialities: The economics of making the products in this study has been identified and came to know that different types of articles namely- soft broom for sweeping, brush for white washing, dried culms for fencing/wall, door for house, dried material for fueling (leaves, stick, panicle), green leaves, culms for fodder, shade for agricultural crop field (seed bed), door-mat from wastage material were produced from broom grass. One man (8 hours /day by an adult) can make 50 nos. of soft brooms per day; its making cost being Rs. 15 and selling price Rs. 25, a net profit of Rs.10 per broom and total net average profit of Rs.500 per day can be obtained. Since the Broom grass is not available throughout the year, the entrepreneurs can process and store the raw materials in different sizes and as a result they can engage themselves to produce other processed articles all year round (Purohit and Chowdhury, 1995).

Table 3: Cost and returns analysis of broom grass cultivation

Item	Year				
	1st year	2nd year	3rd year	4th year	Total
Gross return/ha	19275	64320	244275	192855	520725
Gross cost/ha	64000	30000	30000	35000	159000
Net return/ha	(-)44725	34320	214275	157855	361725
B:C ratio	-	-	-	-	3.25

The information generated from this study provided general idea about the economics of cultivation and can be helpful to the farmers and others growers who intend to take up its plantation as a cash crop. However, it varies according to labour efficiency, wages, soil fertility, cultural practices, market price and demand etc.

CONCLUSION

From the above mentioned results of the study, it is clear that broom grass cultivation is a good profitable enterprise. Broom grass is a perennial, high value, non-perishable cash crop and has great economic potentialities in the economy of the country especially in hilly areas. It is urgent need to domesticate through introduction of rhizome cutting plantation techniques in the hilly areas and create employment opportunity for male and female of the country and play a vital role for poverty reduction.

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Farmers Perception about Single Window Delivery System

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ABSTRACT

Agricultural Technology Information Centre (ATIC) is a single window delivery system for the Institutes technology and services to the farmers. To bridge this gap of information, Agricultural Technology Information Centers (ATIC) have been established in the country. The study was conducted to have idea about the farmers' perception about single window delivery system. The data was collected from 150 farmers those who have visited and registered at IARI-ATIC during the year 2016 and 2017. Farmers those who have visited ATIC earlier (recent past) were selected randomly for the study. A majority of the farmers visited were from Delhi-NCR, Uttar Pradesh and Haryana. The study revealed that a majority of the farmers' (77.33%) purpose of visit to IARI-ATIC was for purchase of Pusa seed. A majority of the farmers (42%) visits ATIC two times in a year. The major source of information to the farmers about IARI technology is television (78.76%) followed by newspapers (54.66%), fellow farmers (52.66%), radio (43.33%) and input dealers (31.33%). The level of satisfaction towards paddy was highest followed by wheat and mustard variety. A majority of the farmers were observed significant response about improvement in ATIC activities i.e. good improvement in sale of Pusa seed (71.33%) followed by *Krishi* advisory services (70%) and Pusa helpline (65.33%).

Keywords: Advisory services, Feedback, Single window delivery, Level of satisfaction

INTRODUCTION

India's agricultural revolution has generated the search by the farmers for availability of quality seeds, planting materials, easy accessibility to diagnostic services for soil fertility and plant protection, availability of appropriate information packages through printed, audio, video and electronic media and consultancy services. Often, it has been seen that the farmers are not aware as to whom and where to approach for seeking site-specific solutions to their field problems. There is greater need for coordination and intensive interaction between the researchers and technology users. A better integration can be achieved by establishing a formal management mechanism between the scientists of various relevant disciplines on one hand and technology user on the other. This linkage mechanism should have the mandated facilities and designated functions.

National Agricultural Research System (NARS) has generated number of agricultural technologies for the benefit of the farmers. But the farmers are not able to use these technologies due to lack of access to the information. To bridge this gap of information and to harness the potential of ICT, Agricultural Technology Information Centres (ATICs) have been established in the country. There are 47 ATICs working under ICAR Institutes and State Agricultural Universities (SAUs). ATIC of ICAR-Indian Agricultural Research Institute, New Delhi (IARI) was established in 1999 as a 'single window delivery system' for the technology, information services and products of the Institute for the benefit of the farming community. ATIC provides farm advisory services and facilitate information-based decision making among farmers.

It was felt that the facility of a 'single window' approach at the entrance of the ICAR Institutes/State Agricultural Universities would enable them to have the access to the required information for the solutions to their problems related to the areas in which the concerned institution is engaged. Because of the dominance and concentration of small and resource poor farmers, public institutions like Indian Council of Agricultural Research (ICAR) Institutes and State Agricultural Universities (SAUs) will continue to play a vital role in supply of technological

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information, products and inputs for increasing the overall productivity in agriculture (http://www.agriinfo.in). It is observed that ATIC products, services and information were rated very important and useful by the respondents (Dar *et al.,* 2014). Majority of the ATIC beneficiary and non-beneficiary had medium satisfaction in the services of ATIC. Majority of the ATIC beneficiary farmers were most satisfied with "soil testing service" in diagnostic services, "supply of seeds" in supply of research products and information provided through "magazines" in the information services through publications and information provided through "television" in the information services through audio-visual aids (Khan *et al*., 2012).

The rationale for establishment of Agricultural Technology Information Centers (ATICs) lies in: Providing diagnostic service for soil testing, plant and livestock health; Supplying research products as seeds and other planting materials, poultry strains, livestock breeds, fish seed, processed products, etc. emerging from the institutions to various clientele; Disseminating information through publishing literature and communication materials as well as audio visual aids; Providing an opportunity to the Institutes/ SAUs to have resource generation through the sale of their technologies.

The objectives of establishing ATICs are to: i) provide a single window delivery system for the products and services to the farmers and other interested groups as a process of innovativeness in technology dissemination; ii) facilitate direct access of the farmers to the institutional resources available in terms of technology advice, technology products etc., for reducing technology dissemination losses; and iii) provide mechanism for feedback from the users to the Institutes' scientist.

According to DARE/ICAR annual report (2017–18) a total of 7.03 lakh farmers visited 47 ATICs for technological solutions during the year; technological information was provided to 2.36 lakh farmers both through print and electronic media. A majority of the farmers (4.52 lakh) got quality technological inputs namely 17,827.59 quintals seed, 12.44 lakh planting material, 899 livestock, 0.09 lakh poultry birds and 228.7 quintals bio-products through ATICs. Besides, 1.86 lakh farmers were benefited by diagnostic and advisory services like, soil and water testing, plant diagnostics, veterinary advisory services, soil health cards etc. Considering the above scenario of Agricultural Technology Information Centres (ATICs), the present study was conducted to assess the 'farmers' perception about single window delivery system' at ICAR-Indian Agricultural Research Institute, New Delhi.

MATERIALS AND METHODS

The study was conducted to have idea about the farmers' perception about single window delivery system. The data was collected from 150 farmers those who have visited and registered at IARI-ATIC during the year 2016 and 2017. Farmers those who have visited ATIC earlier (recent past) were selected randomly for the study. A majority of the farmers visited were from Delhi-NCR, Uttar Pradesh and Haryana. The data were collected with the help of pre-tested interview schedule. The collected data were analyzed by using simple statistical tools viz., measure of central tendency, which led to the following major findings.

RESULT AND DISCUSSION

Purpose and frequency of Farmers' Visit to ATIC: The data related to the purpose of visit of farmers to ATIC (Table 1) revealed that a majority of the farmers' (77.33%) purpose of visit to IARI-ATIC was for purchase of Pusa seed. This is because of Pusa seed is very popular among the farming community and non- availability of Pusa seed in local areas. Low level of farmers' interest was observed in other activity like exposure visit, Pusa publication and advisory services. As shown in table 2 that the frequency of visiting ATIC by the farmers two times in a year is 59 out of 150 farmers (39.33%) followed by once in year is 56 out of 150 farmers (37.33). It is noticed that farmers visit to ATIC once or twice in a year before the *kharif /rabi* crop season especially for purchase of

Table 1: Distribution of farmers according to their purpose of ATIC visit (n=150)

Purpose of Visit	Frequency	Percent
Purchase of Pusa Seed	116	77.33
For advisory Services	18	12.00
Purchase of Pusa Publication	14	9.33
Member of Exposure visit Team	02	1.33

Table 2: Distribution of farmers according to their frequency of visit

Frequency of visit to ATIC	Frequency	Percent
Once in a month	8	5.33
3-4 times in a year	27	18.00
Two times in a year	63	42.00
Once in a year	52	34.66

IARI Pusa seed and planting materials. The findings are in line with Sharma *et al.* (2008).

Status of Advisory Services provided to the farmers: The data related to advisory services provided to the farmers from IARI-Agricultural Technology Information Centre (ATIC) is given in Figure 1. It is revealed that increasing trends of visiting farmers was observed at ATIC for advisory services. ATIC is providing single window delivery system for the Institute's technology to the farmers and Pusa seed, farm publication throughout the year. During 2015-16 the highest number of farmers (39,655) visited ATIC from 18 states followed by 39,520 (2014-15), 29,526 (2013-14), 21,500 (2012-13).

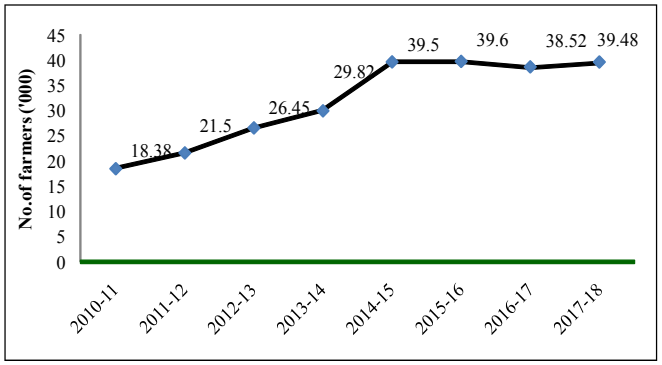

Figure 1: Status of advisory services provided to farmers

Trends of Calls and Farmers queries Received at Pusa Call Centre: The trends of telephone calls received from farmers at ATIC Pusa Call Centre are given in Figure 2. It is found that increasing trends of telephone calls was observed from 2011-12 to 2015-16 at ATIC Pusa Call Centre through Pusa Helpline. The highest calls of 12,273 were recorded during 2015-16 followed by 11,905 (2016-17) and 11975 (2017-18). The increasing trends of telephone calls through Pusa Helpline was observed at ATIC from 2011-12 to 2015-16 this increasing trends of calls may be due more possession and use of mobile by

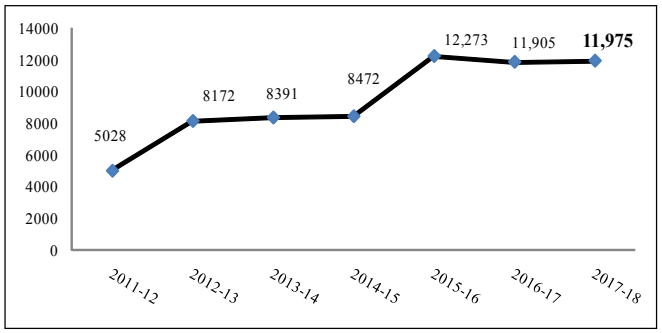

Figure 2: Trends of Telephone Calls received at ATIC through Pusa Helpline

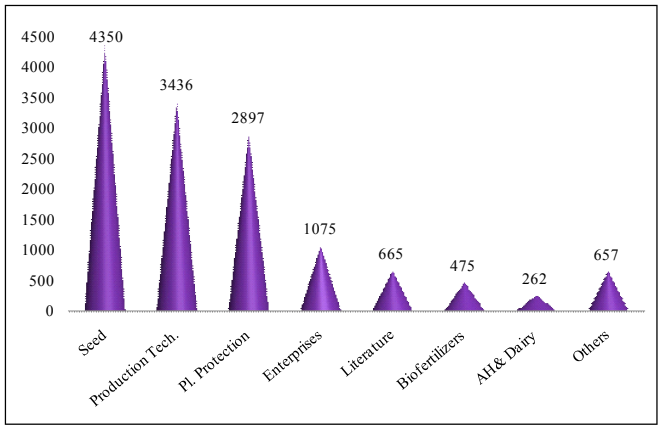

Figure 3: Farmers queries received through Pusa Helpline

the farmers. The data in Figure 3 revealed that a majority of the farmers' query through Pusa helpline is about availability of Pusa seed (4350), followed by production technology (3436), plant protection measures (2897), queries related to agricultural enterprises (1075), literature availability (665), biofertilizers and animal husbandry and dairy related issues (262).

Source of information about IARI Technology: The source of information to the farmers about IARI Technology is depicted in Table 3 revealed that the major source of information to the farmers about IARI technology is television (78.76 %) followed by newspapers (54.66%), fellow farmers (52.66%), radio (43.33%) and input dealers (31.33%). It is observed that about 41.33 and 23.33 per cent farmers accessing information and advisory services through *Kisan Call Centre* and Pusa Helpline, respectively. Furthermore, it is observed that harnessing the use of information and communication technology (ICT) because of more possession of mobile telephony by the farming community.

Status of Seed sale and Level of Satisfaction of farmers about IARI Technology: The status of seed at

Table 3: Source of information to the farmers about IARI Technology

Source of Information	Frequency	Percent
Television	118	78.76
Radio	65	43.33
Newspapers	82	54.66
Kisan Call Centre	62	41.33
Pusa Helpline/ Pusa Agricom	35	23.33
Friends	22	14.66
Fellow farmers	79	52.66
Input dealers	47	31.33

IARI-ATIC during 20111-12 to 2017-18 is depicted in Figure 4 revealed that an increasing trends of Pusa Seed and publication sale was observed at ATIC from 2011-12 (Rs.15.37 lakhs) to 2017-18 (Rs. 98.93 lakhs). This indicates the popularity of Pusa seed among the farming community and more availability of Pusa seed to the farmers during crop season from ATIC.

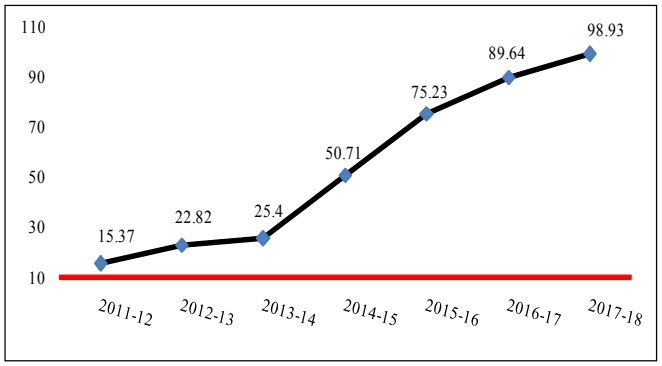

Figure 4: Seed and publication sale (Rs. lakhs)

The data related to level of satisfaction of farmers about IARI crop varieties is given in Table 4 revealed that a majority of the farmers (76% & 68%) were more satisfied with IARI paddy varieties Pusa 1509 and Pusa 1121, respectively. In case of IARI wheat varieties, 74 per cent farmers were more satisfied with HD 3086 followed by 72 per cent farmers (HD 2967). In case of Mustard, about 65 per cent farmers were more satisfied with Pusa Vijay variety followed by satisfied (29%). In pigeonpea, 51.33 per cent farmers were more satisfied with variety Pusa 991 and Pusa 992 followed by satisfied (36.66%). In addition, mungbean variety of Pusa Vishal 57.33 per cent of the farmers were more satisfied followed by satisfied (32%). In case of lentil c.v. L4076 (Pusa Shivalik) 48 per cent farmers were observed more satisfied and about 35 per cent were found satisfied about the variety. Regarding vegetable kit, 59.33 per cent farmers were observed to be more satisfied and 28 per cent were satisfied and about 13 per cent were not satisfied with the vegetables kit because of non-availability of seed in small quantity. In case of flower seed i.e. Pusa *Narangi Gainda* and *Basanti Gainda* about 55 per cent farmers were observed more satisfied and 40 per cent farmers were found satisfied. It can be seen from the above table the level of satisfaction toward paddy was highest followed by wheat and mustard variety.

It is also observed that (Table 5) a majority of the farmers were satisfied from information services of ATIC (72.66%) however; they were also satisfied from technology product (64%) and advisory services (60%).

Farmers Feedback received at ATIC: The feedback of the farmers on Pusa Farm publications (Table 6)

Table 4: Level of Satisfaction of farmers about IARI variety (n=150)

Name of crop	Variety	More Satisfied	Satisfied	Not Satisfied	Av. yield (t/ha)
Paddy	Pusa1121	102(68.00)	41(27.33)	7(4.66)	4.5
	Pusa1509	114(76.00)	36(24.00)	-	5.5
Wheat	HD 2967	108(72.00)	42(28.00)	-	5.2
	HD 3086	112(74.66)	38(25.33)	-	5.4
Mustard	Pusa Vijay	98(65.33)	44(29.33)	8(5.33)	2.2
Pigeonpea	Pusa 991/Pusa 992	77(51.33)	55(36.66)	18(12.00)	1.6
Mungbean	Pusa Vishal	86(57.33)	48(32.00)	16(10.66)	1.0
Lentil	L4076 (P. Shivalik)	72(48.00)	52(34.66)	26(17.33)	1.2
Vegetables seed	Vegetable Kit	89(59.33)	42(28.00)	19(12.66)	-
Flower seeds	PNG/PBG	82(54.66)	60(40.00)	8(5.33)	20-25

Table 5: Level of Satisfaction of the farmers about product and services

Services	Very Much Satisfied		Satisfied		Not Satisfied	
	f	%	*f*	%	*f*	%
Technology product	96	64.00	43	28.33	11	7.33
Advisory services	90	60.00	56	37.33	4	2.66
Information services	109	72.66	39	26.00	2	1.33

Table 6: Feedback of farmers on Pusa Farm Publications

Farm Publication	Very Good		Good		Fair	
	f	%	*f*	%	*f*	%
Technological Options (English)	90	60.0	45	30.00	15	10.00
Technological Options (Hindi)	98	65.33	49	32.66	3	2.00
Sabjee Phaslon Kee Kheti	107	71.33	39	26.00	4	2.66
Kharif Phaslo Kee Kheti	97	64.66	35	23.33	8	5.33
Rabi Phaslokikheti	92	61.33	48	32.00	10	6.66
Samekitkeet Prabandhan	75	50.00	59	39.33	16	10.66
Prasar Doot	83	55.33	58	38.66	9	6.00
Champion Kisaanokee Directory	88	58.66	45	38.00	17	11.33
Phalo Kee Unnat Praudyogikiya	81	54.00	52	34.66	18	12.00
Krishi Machinery	72	48.00	65	43.33	13	8.66

Table 7: Feedback of farmers on Pusa Helpline

Feedback on advisory services	Satisfied with the answer		Not satisfied with the answer	
	f	%	*f*	%
Pusa Agricom (toll free)	142	94.66	8	5.33
Pusa helpline	139	92.66	11	7.33
Advisory services (face to face)	138	92.00	12	8.00

revealed that more than 60 per cent of the respondents opined that the farm publications like Technological Options (English and Hindi), *Sabjee Phaslon Kee Kheti, Kharif Phaslo Kee Kheti and Rabi Phaslonkikheti were rated very good publication of ATIC*. In addition, more than 50 per cent of the respondents opined that the publications namely *Samekitkeet Prabandhan, Prasar Doot, Champion Kisaanokee Directory* and *Phalo Kee Unnat Praudyogikiya* were rated very good for the farmers point of view. Also 48 per cent farmers scored *Krishi* machinery book as very good publication for the benefit of farmers.

Besides farm advisory services at ATIC, farmers were given farm advice through Pusa Helpline (011-25841670, 25846233, 25841039 and 25803600), and Pusa Agricom 1800-11-8989 (toll free) telephone numbers. The data related to farmers feedback on advisory services (Table 7) revealed that more than about 95 per cent farmers were found satisfied with the answers of their queries through Pusa Agricom (toll free), followed by Pusa helpline numbers (92.66%) and face to face advisory services (92%). It can be seen (Table 8) that a majority of the farmers were observed significant response about improvement in ATIC activities i.e. good improvement in sale of Pusa seed (71.33%) followed by *Krishi* advisory services (70%) and Pusa helpline (65.33%).

Farmers Feedback related to field crops: To provide mechanism for feedback from the users to the Institutes' scientist is one of the mandates of ATIC and it is an on-

Table 8: Feedback of farmers on Improvement in ATIC activities

ATIC Activities	Good Improvement		Improvement		No Improvement	
	f	%	*f*	%	*f*	%
Krishi Advisory Services	105	70.00	43	28.33	2	1.33
Pusa helpline	98	65.33	48	32.00	4	2.66
Sale of Pusa Seed	107	71.33	40	26.66	3	2.00
Sale of Farm Publication	88	58.66	49	32.66	13	8.66
PrasarDoot	82	54.66	68	45.33	-	-
Crop Cafeteria	89	59.33	52	34.66	10	6.66

going process. The specific feedback related to the field crops like wheat, paddy, pigeonpea and pulses were received at ATIC. The major feedbacks reported by the farmers were less tillering, lodging, disease problem, uneven maturity and unavailability of pulses seed. Other feedback received were high cost of Pusa seed, black spot in wheat seed and poor packing material of wheat and paddy seed. Fruits and vegetable crops related feedback were seed availability of most of vegetable crops is a major problem, vegetable kit should be small for kitchen garden, non-availability of papaya seeds and fruits plant sapling etc.

CONCLUSION

In this study farmers trend has been reported that farmers' purpose of visiting ATIC is to buy Pusa seed and frequency of visiting two times in a year was fairly favorable. Farmers were preferring to buy seed because they were aware from the valid source of information viz., television (DD Kisan), input dealer (through horizontal communication) and from newspaper. Once the farmers were cultivating the variety developed at Pusa there satisfaction level shows that they will prefer to visit again and again. The level of satisfaction towards paddy, wheat and mustard. The best method to know how the farmer preferring the services and materials available at ATIC is through significant response. The farmers' response towards technological options, vegetable cultivation and *kharif* crops publication were of interest so farmers preferred this information in the local dialect that is in Hindi. ATIC plays a crucial role for providing a 'single window delivery system' for the products, technology and services to the farmers/entrepreneurs and other stakeholders. Hence, there is need to strengthen this single window services for the benefit of end users.

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Performance Evaluation of Submergence Tolerant Rice Varieties through on Farm Trails in Assam

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ABSTARCT

Flash flood or submergence is a common phenomenon in rice growing rainfed lowland areas of Assam that seriously affects crop establishment leading to severe yield losses. A few submergence-tolerant winter rice varieties have been developed by introgressing *SUB*1 gene into mega rice varieties such as Ranjit Sub 1, Bahadur sub 1, Swarna sub 1 and IR64 sub 1. Ciherang sub 1 is another variety also is recently under trail for flood affected areas of Assam. On Farm Trails (OFT) were conducted at Nalbari district during 2013-15 and at Morigaon district during 2016-17 with these lines under rainfed lowlands situation of farmers' field along with local and improved variety as check with an objective to evaluate the performances of these submergence tolerant rice varieties. The varieties with *Sub1* survived after complete submergence for up to 9 to 12 days, whereas varieties without *Sub1* did not survive and wherever survived show very low yield. The varieties with sub 1 gene Ranjit Sub 1, Bahadur Sub 1 and Swarna Sub1 have shown 100 per cent, 100 per cent and 32.47 per cent more yield respectively when compared with local check. During 2016, the varieties Ranjit Sub 1 and Bahadur Sub 1 were under flood water continuously for 12 days and local check couldn't survive whereas the varieties during 2013-2014 were under flood water for 9 -10 days at tillering stage of the crop. The extension gap for varieties were found in the range of 6.81 to 56 q ha^{-1} against the local check. Technology gap for varieties were found in the range 6 to 18.22 q ha^{-1} and 9.1 to 21.1 q ha^{-1} during comparison with local checks and submergence tolerant rice varieties as check respectively. Similarly technology index showed the variation of 6.67 to 35.17 percent. Overall the result indicated the scope of submergence tolerant rice varieties would help to enhance their production even after flood affects. The economic analysis also resulted higher net return due to the new varietal adoption with higher yield from Rs. 17043.00 to Rs. 45000.00 ha^{-1} against the net return values Rs 13557 to Rs 21144 ha^{-1} from check varieties. The results suggest that rice varieties with *Sub1* have great potential and sustainable for improving the productivity of rainfed lowland rice prone to flash flooding.

Keywords: Flash-flooding, Rainfed lowlands, Rice, *Sub1*, Submergence

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's single most important food crop and the staple food for more than half of the world's population (IRRI, 2006). More than 90 per cent world rice is grown and consumed in Asia (Tyagi *et al.,* 2004).The total area planted under rice crop in India was 44.10 million ha accounting for around 4.3 per cent area of the total area for food grains cultivation (INDIASTAT, 2014-15), which is the largest in the world as against the total area of 161.70 million ha (STATISTA, 2013-14). India is the leading exporter of rice for the years 2013-2015 (INDIASTAT, 2015). Rice is the only crop plant adapted to aquatic environments because of its well-developed aerenchyma tissues that facilitate oxygen diffusion through continuous air spaces from shoot to root and avoid anoxia development in roots. However, complete submergence due to frequent flooding can adversely affect plant growth and yield. Rice production in the flood prone ecosystems of this region depend mainly on monsoon rainfall. The farmers sow traditional as well as improved varieties but the ecosystem require more adaptive varieties with challenges ranging from temporary submergence of one to two weeks to long periods of stagnant water. The farmers in submergence and flood-prone areas are poor and have scanty or no resources and fewer options for their livelihoods. The main constraint is a lack of suitable high yielding varieties that can tolerate complete submergence and have good grain quality. However, these flood-prone ecosystems have enormous potential for more food production to meet the ever increasing demands for rice supply because of the predominance of good

soils and freshwater resources. New submergence tolerant varieties Ciherang-Sub1 was developed introgressing SUB 1 gene in popular variety from Indonesia, i.e. Ciherang with the previously developed IR64-Sub1 as the donor. A few submergence-tolerant rice varieties have been developed by introgressing SUB1 gene into mega rice varieties of South Asia. Two of these, Swarna-Sub1 and Sambha Mahsuri-Sub1, are already released in India for the commercial cultivation. Recently the scientists of Assam Agricultural University, Jorhat has developed the new variety of the rice during 2013 after a three years research. During 2010 for the introgression of submergence tolerance gene SUB 1 derived from FR13A in the rice variety Ranjit and Bahadur and the two new rice varieties Ranjit Sub 1 and Bahadur Sub 1 which can survive and give a higher yield after remaining submerged in water upto 15 days. FR13A was released in Odisha as a pureline selection in 1940 from a local variety, Dhullaputia. Since flooding is one of the major hazards of rice cultivation in Brahmaputra basin areas, tolerant varieties are urgently needed to help protect the farmers from submergence. The technologies offering resilience to then changing climatic context of agriculture become an imperative to the sector and its dependents secured (Jasna *et al.,* 2017). Nalbari district is located in central western part of Assam and Morigaon district is situated in central part of Assam primarily dependent on agriculture are heavily flood affected. The principal crop of the districts is paddy. Despite many varieties already developed by Assam Agricultural University; wider choices of HYVs suited to submerged land types with its appropriate management technologies are found lacking in the districts. Keeping this in mind, OFTs being one of the first line methods of testing of technology were carried out in a systematic manner on farmer field to show the worth of new variety of submergence tolerant and convincing farmer to adopt improved production management practices for enhancing productivity of submergence tolerant varieties.

MATERIALS AND METHODS

The study was carried out from 2013 to 2015 in the district Nalbari situated in lower Brahmaputra zone is between 26°N to 58°05N latitude and between 91°07E to 91°47 E longitude during 2016-17, in .Morigaon district is situated in the central part of Assam, is between 26.15°N and 26.5°N latitude and between 92°E to 95.5°E longitudes of Assam. The soil was acidic. Total 13 trails in13 locations were carried out with different submergence tolerant varieties like Ciherang Sub 1, IR 64 Sub 1, Swarna Sub 1, Ranjit Sub 1,Bahadur Sub 1 in Nalbari and Ranjit Sub 1, Bahadur Sub 1 in Morigaon district. Using the recommended package of practices, demonstrations were conducted on total area of 2.72 ha. Details of farming situation, soil type, date of sowing, date of harvesting, rainfall received during the crop season for respective OFTs are mentioned in Table 1. Description of the varieties with

Table 1: Parentage, seasonal suitability and varietal characters of different varieties tested under different frontline demonstration

Variety	Parentage	Seasonal suitability	Varietal characters
Ciherang Sub 1	-	Winter (*Kharif*)	Submergence tolerant for 10-15 days, Photo sensitive, crop duration 110-115 days
IR 64 Sub 1	IR 5657-33-2-1 x IR 2061-465-1-5-3	Winter (*Kharif*)	Submergence tolerant for 10-15 days, Photo sensitive, crop duration 90-115 days
Swarna Sub 1	Swarna 3 x IR 49830-7-1-2-3	Winter (*Kharif*)	Submergence tolerant for 10-15 days, Photo sensitive, crop duration 145-150 days, husk colour is much lighter than Swarna and whitish in colour so called as Dhala swarna
Jalashree	Pankaj x FR13A 2000	Winter (*Kharif*)	Submergence tolerant for 10-15 days, Photo sensitive, crop duration 150-165 days, 45-50 q/ha
Ranjit Sub 1	Pankaj x Masuri	Winter (*Kharif*)	Submergence tolerant for 10-15 days, Photo sensitive, crop duration 155-165 days, Semi dwarf (99 cm) plant with quality grain of short fine, tolerant to BLB, susceptible to blast, SB & GM yield : 50 q/ha
Bahadur Sub 1	-	Winter (*Kharif*)	Submergence tolerant for 10-15 days, Photo sensitive, crop duration 150-160 days, Semi dwarf (114 cm) plant with compact panicle with brown husk colour, AWP, resistant to LB, tolerant to neck blast, BLB, moderately susceptible to GM yield : 50 q/ha

Table 2: Detail information about the demonstrations conducted during *kharif* in rainfed medium land in different years

Variety	Year of study	Area (ha)	No. of demon-strations	Date of sowing	Date of harvesting	Submerence date	Rainfall (mm) during June-November
Ciherang Sub 1	2013	0.13	3	25.06.2013	7.11.2013	28.07.2013 to	1070.6
IR 64 Sub 1	2013	0.13		25.06.2013	26.10.2013	05.08.2013	
Swarna Sub 1	2013	0.13		25.06.2011	22.11.2013		
Jalashree (Check)	2013	0.13		20.06.2013	27.11.2013		
Ciherang Sub 1	2014	0.4	3	26.06.2014	6.11.2014	30.07.2014 to	1363.6
Jalashree (Check)	2014	0.2		11.06.2014	28.11.2014	08.08.2014	
Ranjit Sub 1	2015	0.4	3	12.06.2015	30.11.2015	25.07.2015 to	1657.2
Bahadur Sub 1	2015	0.4		05.06.2015	25.10.2015	04.08.2015	
Swarna Sub 1 (Check)	2015	0.2		09.06.2015	05.11.2015		
Ranjit Sub 1	2016	0.2	4	09.06.2016 & 19.07.2016	26.11.2016	22.07.2016 to 02.08.2016 (12 days)	1236.7
Bahadur Sub 1	2016	0.2		09.06.2016	16.11.2016		
Swarna Masuri (Check)	2016	0.2		09.06.2016	29.11.2015		
Total			13				

their parentage and seasonal suitability are mentioned in Table 2. The demonstration yield was compared with the local or improved check. To estimate the extension gap, technology gap and technology index the following formulae were used (Yadav *et al.,* 1999).

a Extension gap = Demonstration yield-Check yield

b Technology gap = Potential yield (Pi)- Demonstration yield (Di)

c Technology index = (Pi-Di) / Pi x 100

RESULTS AND DISCUSSIONS

All the demonstrated varieties grown during *kharif* season of 2013 were completely submerged continuously for nine days after 25 days of transplanting i.e. at tillering stage. But after that when water receded and it has gone out and new tillers came out thereby crop survived. Again during 2014, the varieties demonstrated were submerged after transplanting continuously for 10 days and they survive after flash flood receded. During 2015, the varieties again submerged continuously for 10 days and it survived again. During 2016, at Morigaon district the demonstrated varieties Ranjit Sub 1 and Bahadur Sub 1 were under water continuously for 12 days. Ranjit Sub 1 and Bahadur Sub 1 were submerged completely for 12 days in one location at seedling stage on seedbed only as it was sown lately due to initial flood while in other locations the same varieties were under continuous submergence for 12 days at tillering stage. It has been observed that the varieties which were submerged at nursery bed also has been survived and other one at tillering stage were also survived. The result was found to be much better with 56 q/ha and 54 q/ha from Ranjit Sub 1 and Bahadur Sub 1 respective .This may be due to silt deposition after flood.

Extension gap: All the tested varieties grown during 2013 recorded higher grain yield over the check one though they were under submergence (Table 3). The percent yield increase of tested submergence tolerant varieties Ciherang Sub 1, IR 64 Sub 1 and Swarna-Sub1 over that of check varieties during 2013 were 31.18,2 26.7 and 32.47 Respectively (Table 3). During 2014, submergence variety Ciherang Sub 1 recorded 3.12 percent increase in yield high yielding submergence variety Jalashree as check. The percent yield increase was recorded 3.7 and 2.91 in Ranjit Sub 1 and Bahadur Sub 1 over the check Swarna Sub 1 during 2015. It has been found 100 percent yield increase of tested varieties Ranjit Sub 1 and Bahadur Sub 1 over the local variety as check which was completely damaged after submergence. Extension gap which represents the productivity gain possible with the existing technologies were 7.95 q ha^{-1}, 6.81q ha^{-1} and 8.28 q ha^{-1} in 2013, 0.1 q ha^{-1} in 2014, 1.4 q ha^{-1} and 1.1 q ha^{-1} in 2015 and 56 q ha^{-1} and 54 q ha^{-1} in 2016. The value of the extension gap was recorded highest for tested varieties. This may be due to higher yield of demonstrated varieties in comparison to

Table 3: Crop yield, Potential yield (Pi), Extension gap (Eg), Technological gap (T) and Technological index (Ti) of varieties in different years

Year	Variety	Days of sub-mergence	Crop yield		% increase over check variety	Pi (q/ha)	Eg (q/ha)	Tg (q/ha)	Ti (%)
			Demon-stration (Di)	Check					
2013	Ciherang Sub 1	9 days	33.45		31.18	45	7.95	11.55	25.67
	IR 64 Sub 1	9 days	32.31		26.7	45	6.81	12.69	28.2
	Swarna Sub 1	9 days	33.78		32.47	52	8.28	18.22	35.03
	Local I jung (Check)	9 days		25.5		40		14.5	36.25
2014	Ciherang Sub 1	10 days	35.4		3.12	45	0.1	9.6	
	Jalashree (Check)	10 days		35.3		45		9.7	21.3
2015	Ranjit Sub 1	10 days	39.2		3.7	60	1.4	20.8	34.67
	Bahadur Sub 1	10 days	38.9		2.91	60	1.1	21.1	35.17
	Swarna Sub 1 (Check)	10 days		37.8		52		14.2	27.31
2016	Ranjit Sub 1	12 days	56		100	60	56	4	6.67
	Bahadur Sub 1	12 days	54		100	60	54	6	10
	Swarna Masuri (Check)	12 days		Not survived					

the check varieties. Smallest value of extension gap was recorded in 2013.

Technology gap and index: Technology gap as depicted in the Table 3, was highest for Bahadur Sub 1(21.1q ha^{-1}) followed by Ranjit Sub 1 (20.8 q ha^{-1}) variety. A good relationship was observed among the technology gap, potential yield of varieties and the farming situation on the varieties grown. Higher potential yield resulted higher value of technology gap. Overall the values of technology gap indicated suitability of varieties as on the farmers field under different situation.

Technology index can also be used as an indicator of feasibility of growing the varieties under real farming situation. Lower the technology index more is feasibility of growing the varieties. The technology index value was lowest (6.67%) for Ranjit Sub 1 during 2016 followed by Bahadur Sub 1 in the same condition (10%). The highest value was recorded by local Ijung grown (36.25%). The result were confirmed by wider adoption of submergence tolerant varieties like Ranjit Sub1 and Bahadur Sub 1.

Economic analysis: Irrespective of type of rice, average net return as sown in the Table 4, was higher in demonstrated varieties over the check. The variety Ranjit Sub 1 in 2016 recorded the maximum net return (Rs. 45000 ha^{-1}) followed by Bahadur Sub1 (Rs.42000 ha^{-1}). The higher value of net return in case of Ranjit Sub 1 is attributed to the higher average gross return (Rs 70000 ha^{-1}) followed by Bahadur Sub1 (Rs 67500 ha^{-1}). Average return over local check was also maximum (Rs 45000 ha^{-1}) for Ranjit Sub 1 followed by Bahadur Sub 1 (Rs 42000 ha^{-1}), Ciherang Sub 1 variety recorded the lowest value (Rs 1184 ha^{-1}).

Thus, from the study it can be concluded that both production and productivity of rice in the area of flash flood and flood affected areas in the districts could easily be increased by bridging the extension gap and technological gap through the conduction of OFTs extensively for testing the suitability of the variety for doubling farmer's income Thus it envisaged to assess the change in use of rice production technologies as per Nag, A.et al (2011) Horizontal area expansion of some the demonstrated varieties like Ranjit Sub1, Bahadur Sub1 have been observed in flood affected areas of Nalbari and Morigaon district. Ranjit Sub 1 and Bahadur Sub 1 seed already has been sold by the beneficiaries during 2016 @ Rs. 25/kg covering an area of around 22 ha during *kharif*, 2017.

CONCLUSION

The study confirms that submergence tolerant varieties tested superior performance in terms of yield and net return as well as better adaptation. Adaptation of these varieties would enhance their income even affected by flood.

Table 4: Economic analysis of on farm trials

Year	Variety	Cost of cultivation (Rs ha^{-1})		Gross return (Rs ha^{-1})		Net return (Rs ha^{-1})		Return over check (Rs ha^{-1})	B:C (Demo)	B:C (Check)
		Demonstration	Check	Demonstration	Check	Demonstration	Check			
2013	Ciherang Sub 1	23893		41813		17920	13557	4363	1.75	
	IR 64 Sub 1	23345		40388		17043		3486	1.73	
	Swarna Sub 1	24193		42338		18145		4588		1.74
	Local Ijung (Check)		18318		31875		21144		1.94	
2014	Ciherang Sub 1	22809		44250		21441		1184		
	Jalashree (Check)		22981		44125				2.05	1.92
2015	Ranjit Sub 1	23820		49000		26000		5743	2.03	
	Bahadur Sub 1	23900		48625		24725		4468		
	Swarna Sub 1 (Check)		21323		41580		20257		2.15	1.95
2016	Ranjit Sub 1	25000		70000		45000		45000	2.07	
	Bahadur Sub 1	25500		67500		42000		42000		
	Swarna Masuri (Check)		19450		Nil		Nil			

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Performance of Oyster Mushroom through Use of Different Agro Byproducts

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ABSTRACT

Mushrooms are fleshy fungi which require limited space, higher yield per unit area and time, less expensive technology and cropping intensity can be increased several folds. They are a rich source of nutrients, particularly proteins, minerals and vitamins such as vitamin B, C and D. In the present study, some locally available agro byproducts like wheat, pearl millet and mustard straw substrates were evaluated for cultivation of *Pleurotus sajorcaju*. In terms of total yield, maximum yield of oyster mushroom (825.00 g/kg of dry substrate) was recorded on wheat straw. Pearl millet straw substrate alone showed maximum spawn run period of 23 days. Significant variation in biological efficiency of oyster mushroom was recorded on different substrates. Mean cost benefit ratio of 1:2.83, 1:3.52 and 1:3.24 were obtained at experimental yields of T1, T2 and T3, respectively. Thus the production technology of oyster mushroom can be very well utilized for crop diversification. From the above findings, it can be concluded that dissemination of mushroom production technology to farmers and farm women along with nutritional benefits of mushroom, should be given high priority for attaining food and livelihood security.

Keywords: Mushroom, Agro byproduct, Substrate, Income

INTRODUCTION

Cultivation of edible mushrooms are the world's greatest untapped resources of nutritious food and also help to diversify the farm based enterprises and income generating (Kakon *et al.,* 2012; WHO, 2011). It is a biotechnology process, which aids in reducing and equally protecting the environment from excess solid waste (Mshandete and Cuff, 2008; Sánchez, 2010). Pleurotus species, commonly known as oyster mushrooms, are edible fungi cultivated worldwide especially in south East Asia, India, Europe and Africa (Mandeel *et al.,* 2005). Oyster mushrooms are the third largest commercially produced mushroom in the world (Obodai *et al.,* 2003).

Oyster mushroom is a valuable mushroom with good marketability and is relatively easy to grow. It requires no arable land for production and the abundant agricultural waste found countrywide offers opportunity for production, which in turn provides a more economical and environmentally friendly disposal system (Stamets, 2009; Olfati and Peyvast, 2012; Philippoussis and Diamantopoulou, 2012). The cultivation of Pleurotus sajorcaju has a promising future in the country like India, because it requires simple and inexpensive cultivation techniques (Chang and Miles, 2004). Therefore, these interesting attributes make it an excellent option for cultivation of Mushrooms. It's simple cultivation techniques allows that agro wastes may be used to produce a highly nutritious food and of high commercial value (Mandeel *et al.,* 2005). For this reason, there is need to have a constant supply of the substrates which is readily available with low cost price rather than depend on specific types of materials or some seasonal forest supply for cultivation of mushroom (Onuoha *et al.,* 2009).

Strengthening mushroom production sector could be essential in order to enable the rural economy to keep its vibrancy and development, increasing and diversifying business and employment opportunities in the rural areas, and providing income opportunities of small family farms. Furthermore, the use of these residues in bioprocesses may be one of the solutions to bioconversion of inedible biomass residues into nutritious protein rich food in the form of edible mushrooms (Mshandete and Cuff, 2008).

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The spent substrates from mushroom cultivation can also potentially be used as an animal feed supplement, possibly providing additional animal feed resources (Obodai *et al.,* 2003). The expansions of mushroom cropping decline the price of mushrooms and hence it safe guard food insecurity (Sarker *et al.,* 2007).

Recently, cultivation of oyster mushroom (*Pleurotus spp.*) is gaining popularity as an income generating enterprise in Madhya Pradesh. Normally wheat straw is used as substrate for oyster mushroom cultivation. Very often, availability of these substrates become a limiting factor, as they are the main cattle feed in this region. Keeping in view the above facts in mind, it was found that large volumes of unused lingo-cellulosic byproducts are available in rural areas of Morena district. These by-products are left to rot in the field or are disposed off through burning. Utilizing these by-products for mushroom cultivation using locally available technologies may be one of the solutions to transforming these inedible wastes into accepted edible biomass of high market value. Thus, there is need to identify alternative and suitable substrate for mushroom cultivation. The present investigation was undertaken to evaluate oyster mushroom production on three different locally available substrates i.e. wheat, pearl millet & mustard. Those investigations were also to find the best substrate among others for effective cultivation of oyster mushroom with increase economic status of farm women.

MATERIAL AND METHODS

The awareness programme on mushroom production & market demand was held for farm women through RVSKVV-Krishi Vigyan Kendra, Morena. The farm women were given skill training on different types of mushroom production. Then on firm trial on oyster mushroom production was conducted using different substrates. The technology was spread through other extension activities and large scale dissemination was done with the help of print media, electronic media & different ICT tools.

Cultivation: The agro waste, wheat, pearl millet and mustard straws, were collected separately from houses of farm women which were selected for on farm trials and front line demonstrations of mushroom production through RVSKVV-Krishi Vigyan Kendra, Morena. These straws were used as cultivation substrate, following the method prepared by Bano and Shrivastava (1962) with slight modifications.

Inoculation of the bags, i.e. spawning was carried out through multilayered spawning and the spawn was added at the rate of 2% of the wet weight basis of substrate. After inoculation, the bags were kept in house where the temperature and humidity were maintained around 25ºC and 80 to 90% moisture respectively with sufficient light and ventilation till the cottony growth proliferates. When the substrate was completely covered by the white cottony mycelia growth, the polythene bags were removed. Formation of fruit bodies was evident within 3-4 days after removal of poly bags. The beds were maintained up to the harvest of the fourth flush. A small layer of substrate was scrapped off from all the side of the beds after each harvest. Each of the three treatments was replicated three times.

Harvesting: Mushrooms were harvested by twisting to uproot from the base. Mushrooms were harvested four times from a bag. After completing the each harvest, the bags were scraped at the place where the 'D' shaped cut had been done. Water spraying was continued until the mushrooms were ready to be harvested.

Data Collection: Data were collected on the following parameters:

(i) Days Required for Completing Mycelium Running: Days required from inoculation to completion of mycelium running were measured.

(ii) Time from Stimulation to Primordia Initiation (days) and fruiting body formation (days): Time required from stimulation to primordia initiation (days) and fruiting body formation (days) were recorded.

(iii) Average Weight of Fruiting body (gm/10 buds): Average weight of fruiting body was calculated by dividing the total weight of ten buds by the total number of ten fruiting bodies.

(iv) Yield: Total weight of all the fruiting bodies harvested from all the four pickings were measured as total yield of mushroom.

(v) Biological Efficiency: The biological efficiency was determined by the following formula:

$$\text{B.E.}(\%) = \frac{\text{Fresh weight of mushroom}}{\text{Dry weight of mushroom}} \times 100$$

(vi)Economic cost and Benefit Cost Ratio: The economic cost and benefit cost ratio for different low cost substrate were computed based on present market price of mushroom and cost of different inputs in the markets.

RESULTS AND DISCUSSION

The present study was conducted to compare the effects of different agro-wastes on the growth, yield, and economic parameters of oyster mushroom. The results indicated that there was a quite momentous variation in the time interval needed for completion of spawn running, pinhead formation and fruiting body formation on different substrates. The analysis of yield on all the three substrates (wheat, pearl millet and mustard straws) used for the cultivation of oyster mushroom showed differences.

Effect of Different Substrates on Spawn Running (Days): The results showed differences among treatments in terms of days taken for spawn running of oyster mushroom. T1 took minimum number of days 20.59 whereas treatments T2 and T3 showed 23.00 and 21.14 days, respectively to complete mycelial growth (Table 1). Shah *et al.* (2004) found that fruiting bodies of oyster mushroom became suitable for harvest within 3-6 day of primordia initiation in the spawn packet.

Effect of Different Substrates on Pinhead formation and Fruiting body formation (Days): It was found that time taken for pinhead formation was 29.35 days in T1 as compared to 27.38 and 27.01 days in T3 and T1, respectively. It was observed by Khan *et al.* (2001) that after spawn running pinhead formation took 7-8 days and fruiting body formed after 3-5 days, sporocarps may be harvested after 10-12 days. The result showed that time consumption in fruiting body formation was 34 days in T2 treatment. In T1 and T3 treatment, fruiting body formation took 31 and 33 days, respectively.

Effect of Different Substrates on Average Weight of Fruiting Body (g/10 buds): Effect of different substrates had great effect on average weight of fruiting body. The average weight of fruiting body in different treatment ranged from 17.76-22.95 g/10 buds. The highest average weight of individual fruiting body was observed in the treatment T1 (22.95 g/10 buds) followed by T3 (19.84 g/10 buds) treatment and the lowest average weight of individual fruiting body was in the treatment T2 (17.76 g/10 buds).

Oyster mushroom yield

(i) ***Yield of Mushroom in 1st Flush (g/kg of dry substrate):*** Treatments in the first flush showed difference in terms of yield. Among the treatments, T1 took maximum yield 320.14 g/kg of dry substrate in 1st flush showing differences with treatment T2 which produced 268.71 g/kg of dry substrate. In comparison to T1 and T2, T3 showed production of 306.24 g/kg of dry substrate in 1st flush (Table 2). Dhoke *et al.* (2001) observed significant effect of different agro-wastes on yield of oyster mushroom.

(ii) Yield of Mushroom in 2nd Flush (g/kg of dry substrate): In 2nd flush, T1 took maximum yield 274.4 g/kg of dry substrate. T2 and T3 showed production of 196.99 and 240.92 g/kg of dry substrate in 2nd flush (Table 2). The harvesting time also varied depending upon the type of substrate (Sarker *et al.,* 2007).

(iii) Yield of Mushroom in 3rd Flush (g/kg of dry substrate): Treatments showed that T1 (took maximum yield 163.52 g/kg of dry substrate in 3rd flush. T2 and T3 showed production of 37.80 g and 143.20 g/kg of dry substrate in 3rd flush (Table 2). Among various species of mushrooms, cultivation of *Pleurotus spp* is picking very fast

Table 1: Morphological parameters of oyster mushroom on different substrates

Treatments	Spawn running (days)	Pinhead formation (days)	Fruiting body formation (days)	Weight of fruits (g/10 buds)
T1	20.59	27.01	31	22.95
T2	23.00	29.35	34	17.76
T3	21.14	27.38	33	19.84

**The values are mean of five replicates.*

Table 2: Yield performance of oyster mushroom on different substrates

Treatments	Yield (g)/kg of dry substrate					Biological efficiency
	First flush	Second flush	Third flush	Fourth flush	Total	(BE %)
T1	320.14	274.40	163.52	66.94	825.00	82.5
T2	268.71	196.99	137.80	41.50	645.00	64.5
T3	306.24	240.92	143.20	51.64	742.00	74.2

**The values are mean of five replicates.*

due to its easy cultivation technology, adaptability to wide range of temperature and ability to grow on a variety of lingo-cellulosic substrates (Gogoi and Adhikary 2002).

(iv)Yield of Mushroom in 4th Flush (g/kg of dry substrate): Treatments in the fourth flush showed difference in terms of yield. Among the treatments, T1 showed maximum yield 66.94 g/kg of dry substrate in 4th flush showing differences with treatment T2 which produced 41.50 g/kg of dry substrate. In comparison to T1 and T2, T3 showed yield of 51.64 g/kg of dry substrate in 4th flush (Table 2).

(v) Total Yield (g/kg of dry substrate): In terms of total yield, maximum yield of oyster mushroom (825.00 g/kg of dry substrate) was recorded on wheat straw (Table 2), which was higher than the mustard and pearl millet straws used as substrate. However, lowest yield was noticed with pearl millet straw (645.00 g/kg of dry substrate). The maximum yield of oyster mushroom on all the substrate was recorded at first harvest which subsequently reduced at second and third harvest. The subsequent reduction in yield during second and third harvest might be due to the consumption of ligno-cellulonitic material of the waste by oyster mushroom during the initial period of fruiting. The probable reason for the best performance of oyster mushroom on wheat straw might be that the nutrients required for the mushroom particularly for its spawn run and pin head development were supplied by wheat straw which decomposed quicker than the other agricultural waste material. Where ever the poor yield under pearl millet straw might be due to lower liqno-cellulonitic contents. *Pleurotus sajorcaju* was found to utilize all the agricultural wastes and were observed suitable for spawn run, yield and biological efficiency (Das *et al.*, 2000). Mishra and Shukla (2007) attributed the oyster mushroom growth and yield to temperature substrate and R.H (moisture regime). Some of the agro wastes could be used as alternative substrates for mushroom cultivation.

Biological efficiency (%): Significant variation in biological efficiency of oyster mushroom was recorded on different substrates. Highest biological efficiency was observed on wheat straw (82.5%) which was comparable to mustard straw (74.2%). The biological efficiency of pearl-millet substrates was 64.5% (Table 2). Amin *et al.* (2007) found the highest biological yield 247.3g/packet. Kalita *et al.* (2001) observed biological efficiency for different substrates ranged from 35.2-60.9%. Obodai *et al.* (2003) found biological efficiency (BE) followed a pattern and ranged from 61.0-80.0%.

Economic profitability analysis: Economic profitability analysis showed that oyster mushroom cultivation is income-generation entrepreneurship that farmers, farm women and unemployed youth can easily adopt. Mean cost benefit ratio of 1:2.83, 1:3.52 and 1:3.24 were obtained at experimental yields of T1, T2 and T3, respectively (Table 3). The cause of these variations between the results of this study might be due to consideration of other costs involved in the production of oyster mushroom. Sarker *et al.* (2007) mentioned the performances of substrates were significantly differed based on benefit cost ratio. They reported the highest cost benefit ratio of 6.50 with wheat straw.

Outcome: The performance of substrates other than the wheat straw ensures the possibilities of utilizing the locally available substrates for oyster mushroom cultivation. There

Table 3: Economic profitability analysis of oyster mushroom on different substrates

Treatments	Cost of cultivation/bed (Rs.)	Net income/ bed (Rs.)	B:C ratio
T1	Rs. 26	Rs. 47.50	2.83
T2	Rs. 20	Rs. 50.30	3.52
T3	Rs. 22	Rs. 49.30	3.24

**The values are mean of five replicates.*

was efficient utilization of the straws of different crops for oyster mushroom production. Therefore, the mushroom cultivation may become one of the most profitable agribusiness that could produce food products from different substrates and help to dispose them in an environment friendly manner.

Thus the production technology of oyster mushroom can be very well utilized for crop diversification, increase in cropping intensity, recycling of agrowaste, generation of employment and subsidiary income and enhancement of socio-economic conditions of the peoples particularly the rural mass of Morena district of Madhya Pradesh. Thus it can be concluded that dissemination of mushroom production technology to farmers and farm women along with nutritional benefits of mushroom, should be given high priority for attaining food and livelihood security.

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The Yield Behavior of Tuberose (*Polianthes tuberose):* The Socio-ecological and Entrepreneurial Interpretation

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ABSTRACT

Tuberose cultivation and its entrepreneurial pursuits have been offering both economic and ecological prospect in West Bengal since long. Village Panchkahaniya of Nadia District has traditionally been the area for tuberose cultivation which provides both ecological and economic sustenance to the dwelling villagers in and around places. The present study focuses on both the operational and managerial aspects of the enterprise in terms of a score of socio-ecological variables. A count of 70 farmers, selected through multistage random sampling process, has been interrogated as sample respondents. The variables *viz.* area under tuberose, cost of tuberose cultivation, loan access has been found significantly impacted on the yield of tuberose. The variables *viz.* education, area under tuberose has recorded the significant functional contribution on yield of tuberose as evinced through stepwise regression analysis. The following factors have been isolated out of 12 exogenous variables based on respective factor loading and Eigen value *viz.* peripheral ecology, farm economy, capacity building, family farming. The empirical study rightly offers huge scope for micro-level policy and management strategy as well.

Keywords: Entrepreneurship, Income from tuberose, Social ecology, Peripheral ecology, Yield of tuberose

INTRODUCTION

People across the world are always euphoric in buying flowers. In Indian economy, flower is not only beautiful, but also immensely prospective in today's economy as well (Sarkar *et al.,* 2011). Nadia is one of the leading flower producing districts in West Bengal, and huge number of growers, farm laborers, traders and entrepreneurs are involved in this economy. So, getting into the complexity of micro level economy of tuberose offers a pre-condition for having effective research design in terms of set of variables under study. The floriculture economy has been envisaged to increase and improve production economy, farm ecology, branding, and supply chain management (Roy, 2004). Tuberose cultivation is labour intensive and extremely sensitive to market response. The whole of market imperfection offers a barrier to accessing remunerative price by the flower growers. Floriculture has by far a greater annul growth potential of 25 to 30 per cent, which is around 10 times more than that of cereals or any other agricultural produce. With this background, the present study has been undertaken to delineate the general status of production, productivity and entrepreneurship nature of tuberose. Here in this study, yield behavior has been estimated, as dependent variable, in terms of yield quantity per unit area, seasonality character of yield and income equivalence of yield in monetary terms which again, has been predicted from a score of 12 predictors, socio-economic and agro-ecological by nature

MATERIALS AND METHODS

The study was conducted in village Pachkahania Fatepur Panchayat of Haringhata block in Nadia district, West Bengal. 70 tuberose growers have been selected through random sampling method from a score of 140 tuberose growers. The selection process follows a systematic random sampling with class interval 2.

A pilot study was conducted in the selected villages before constructing the data collection devices. In course of this survey informal discussion was carried out with some tuberose growers and other resource persons of the localities. An outline of socio-economic background of the farmers of the concerned village, their opinion towards different types of tuberose plantation, their productivity, and entrepreneurship generated from

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tuberose and other agricultural enterprise, income generation were obtained that helped in the construction of reformative working tools. Yield behavior of tuberose has been considered as the dependent variable (y), which has been predicted by a score of 12 independent variables, socio-economic and agro-ecological by nature.

A set of statistical tools viz. coefficient of correlation (r), multiple regression analysis (β) and PCA have been followed to estimate the dependency relation, functional interaction and Eigen conglomeration of system variables leading to a comprehensive understanding on the yield behavior of tuberose, a very economically promising and ecologically significant floral enterprise of Nadia district of, West Bengal, India.

RESULTS AND DISCUSSION

The Table 1 presents the co-efficient of correlation between the yield of tuberose (y) and other 19 independent variable. It has been found that the following variables have been emerged as the significant predictors of yield of tuberose (y), and these predictor variables are; area under tuberose (X_5), cost of tuberose cultivation (X_7), loan access (X_{12}).

Land under tuberose (X_5), has recorded a positive but significant correlation to imply that for the respondents having higher size of land holding, are also generating higher yield. Cost incurred in tuberose cultivation (X_7) has recorded to have positive but significant correlation with the yield of tuberose (y). This implies that respondents, who gave proper attention to proper planting and took care of management, got higher level of yield from tuberose. Loan (X_{12}) has recorded to have positive but significant correlation with the yield of tuberose to imply the participation of banking sectors in tuberose enterprise.

Table 1: Co-efficient of correlation (r) between yield of the tuberose (y) and other 12 exogenous variables

Exogenous variables	Dependent variable (y)
Age (X_1)	0.065
Education (X_2)	-0.068
Family size (X_3)	0.003
Homestead (X_4)	-0.076
Area under tuberose (X_5)	0.998**
Area under other crop (X_6)	-0.163
Cost of tuberose cultivation (X_7)	0.923**
Training (X_8)	-0.086
Yield of other crop (X_9)	-0.113
Distance from the market (X_{10})	-0.027
Income other than tuberose (X_{11})	-0.163
Loan access (X_{12})	0.508**

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

Table 2 presents the estimation of cause effect relationship between the yield of tuberose (y) and 12 causal variables. It has been found that the collectivity of 12 variables together have explained 65 per cent of variance embedded with the consequent variable y.

Table 2: Multiple regression analysis: Yield of tuberose (y) vs 12 causal variables

Model	B Value	Std error of B	Reg coefficient of B	T value of B
Age (X_1)	.209	12.219	.008	.744
Education (X_2)	1.570	.211	.021	.326
Family size (X_3)	-.390	1.350	-.003	.249
Homestead (X_4)	.005	1.096	.000	.723
Area under tuberose (X_5)	30.192	.134	1.006	.971
Area under other crop (X_6)	-.257	.642	-.014	.000
Cost of tuberose cultivation (X_7)	-.003	.327	-.009	.434
Training (X_8)	-.716	.006	-.010	.670
Yield of other crop (X_9)	-1.18	1.263	.000	.573
Distance from market (X_{10})	-.002	.002	.000	.994
Income other than tuberose (X_{11})	-.002	.096	-.004	.981
Loan (X_{12})	.003	.001	-.004	.677

Multiple R - SQ = 0.65 Multiple R = 0.861, R-BAR SQ (ADJUSTED R-SQ)=0.875

Table 3 presents the step down regression analysis to imply which are the few variables of the whole plethora of variables that have been retained at the last step (11^{th}) to contribute substantially on the consequent variable, that is, yield of tuberose. The variables X_2 and X_5 has been retained at the step 11 to implied that these variables are extremely important causal variable to interpret the reason and spectrum of variance of the consequent variable, in its behaviour and performance. So, education (X_2), area under tuberose (X_5), are the 2 most important causal variable to interpret the variance embedded with the yield of tuberose (y). The present R^2 value has been found 65.13 per cent to imply that even with the drifting of 10 variables in previous steps, there has been a substantive contribution from these two causal variables to elicit their strategic implication.

Table 4 presents the factor analysis to estimate the degree of conglomeration of apparently different exogenous variables, based on Eigen values into some discernable factor. It has been found from the table that Factor-1 has accommodated the following variables land under other crop (X_6), yield of other crop (X_9), income other than tuberose (X_{11}) and this factor can be renamed as peripheral ecology. This has contributed, 27.412% of variance. Factor-2 has accommodated the following variables, Land under tuberose (X_5), Cost of tuberose cultivation (X_7), Loan (X_{12}), and, this factor can be renamed as farm economy. This has contributed 17.839% of variance. Factor-3 has accommodated the following variables Education (X_2), Training (X_8), and this factor can be renamed as capacity building. This has contributed 16.049 per cent of variance. Factor-4 has accommodated the following variables, distance from market (X_{10}). As this factor contains only 1 variable so renaming has not done. Factor-5 has accommodated the following variables. Family size (X_3), Homestead (X_4) and this factor can be renamed as family farming. This has contributed 8.395% of variance. Factor-6 has accommodated the following variable Age (X_1) As this factor contains only 1 variable so renaming has not done.

Table 3: Stepwise regression analysis: Yield of tuberose (y) vs 12 casual variable

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
Education (X_2)	0.702	0.534	0.010	1.315	0.193
Area under tuberose (X_5)	29.967	0.217	0.999	137.855	0.000

R^2 = 65.13 per cent

Table 4: Principal component analysis

Factor	Variables	Factor loading	Eigen value	Variance (%)	Cumulative variance (%)	Factor renaming
1	Land under other crop (X_6)	.908	3.289	27.412	27.412	Peripheral ecology
	Yield other than tuberose (X_9)	.876				
	Income other than tuberose (X_{11})	.908				
2	Land under tuberose (X_5)	.823	2.141	17.839	45.251	Farm economy
	Cost of cultivation of tuberose (X_7)	.795				
	Loan (X_{12})	.643				
3	Education (X_2)	.880	1.926	16.049	61.300	Capacity building
	Training (X_8)	.891				
4	Distance from market (X_{10})	-.823	1.157	9.645	70.944	_
5	Family size (X_3)	.624	1.007	8.395	79.339	Family farming
	Homestead (X_4)	-.703				
6	Age (X_1)	-.577	.845	7.046	86.384	_

CONCLUSION

Any enterprise in Indian agriculture, it may be the crop or livestock, fishery or orchard, the three basic dimensions should be income generation, enhancement of yield, creation of livelihood. The contradiction that inflicts into farm economy of India lies in the fact that the time when crop yield is better, the market price goes down. The other cases, extreme and disastrous, where in both income and yields are remarkable but livelihood scenario goes so bleak. So, the issues of sustainability in agriculture, agri-horti enterprise should be re-engineered in such a way that the change in income and yield, when it is in a positive direction, the livelihood generation will follow it isochronously. So, the study has been conducted to elicit as to how and where these three aspects in tuberose enterprise are being impacted by a score of twelve socio-ecological and management variables In elucidating the nature and behavior of all these variables *viz.* income, yield, man days in tuberose enterprise, the variable training, has gone universal to change income yield and man days together. The flow of credit, either from formal and nonformula sectors, to these enterprises has really been instrumental to effect on yield and man days. Family size has here been the major source of man days relegating it into the productive and managerial function of tuberose enterprise. The distance from market has been found critical in augmenting income and man days. We need to extend support skill development and create employment generation opportunities for rural youth in tube rose cultivation and post harvest management, especially in the cold chain sector.

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Correlates of Improved Production Technology Adoption for Fetching Maximum Yield Potentials of Chickpea

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ABSTRACT

The mounting population of India would need pulse production at large scale to provide health and food security. To achieve targeted chickpea production adoption of improved production technologies is must in major pulse crop like chickpea. Study was undertaken in Harda district to ascertain correlates of improved production technology adoption for fetching maximum yield potentials of chickpea through front line demonstrations (FLDs).The finding shows that education, size of land holding, annual income, marketing facilities and farm machinery were most important factors to effect the adoption of chickpea production technologies as the 'r' values were found 0.278 in case of education (significant at 5 per cent level of probability). Farmers harvested 15-25 percent more yield during year 2014-15 to 2016-17 by adoption of improved production technology.

Keyword: Correlation coefficient, Improved chickpea cultivation technology, Pulse production, Technology adoption

INTRODUCTION

It is well known facts that that the Chickpea (*Cicer arietinum*) in India is an important leguminous food grain. India is the largest producer of chickpea with about 63% of the total area under chickpea production lying in India. Chickpea is a highly nutritious grain legume crop. In India highest production has been received from Madhya Pradesh by 39%, and followed by Maharashtra (14%), Rajasthan (14%), Andhra Pradesh (10%), Uttar Pradesh (7%), Karnataka (6%) and other remaining states & UTs of India (10%). The pulses are the integral part of the cropping systems of the farmers all over the country because these crops fit in well in the crop rotation and crop mixtures followed by them. Chick pea contributes about 50 per cent of the total pulse production of India. It is used for human consumption as well as for feeding to animals Yadav (2009). This evident from Table 1 that the chickpea crop is most important pulse and having highest contribution in total pulses production of India with 41.20 percent contribution during year 2016-17. Chickpea seems as backbone of pulses and needs more attention to maintain this production status in future to fulfill the pulse need of our country in holistic manner.

Table 2 reflects the area, production & productivity of chickpea in Madhya Pradesh which is highest contribution among all pulse growing state of our country

Table 1: Production status of pulses in India (Unit: 000 Tones)

Pulses/Year	2014-15	Share in Total Production	2015-16	Share in Total Production	2016-17	Share in Total Production
Chickpea	7330	42.74 %	7060	43.18 %	9120	41.20 %
Pigeon Pea	2810	16.38 %	2560	15.65 %	4230	19.11 %
Urd	1960	11.42 %	1950	11.92 %	2890	13.05 %
Moong	1500	08.74 %	1590	09.72 %	2130	09.62 %
Other Pulses	3550	26.69 %	3190	19.52 %	3770	17.03 %
Total Pulses	17150		16350		22140	

Source: Directorate of Economics and Statistics (DES): Based on 2nd Advance Estimates for 2016-17

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Table 2: Area, production and productivity of chickpea in Madhya Pradesh State

Year	Chickpea Production in Madhya Pradesh		
	Area Unit:(000 ha)	Production Unit: (000 tones)	Productivity Unit: (kg/ha)
2011-12	2629	2845	1083
2012-13	2722	3321	1221
2013-14	3482	2555	809
2014-15	2933	4509	1537
2015-16	2621	3294	1256

Source: http://mpkrishi.mp.gov.in/Compendium/AreaProduction_DifferentCrop.aspx

Table 3: Area, production and productivity of chickpea in Harda District (MP)

Year	Chickpea Production in Harda District		
	Area Unit:(000 ha)	Production Unit: (000 tones)	Productivity Unit: (kg/ha)
2011-12	18.00	31.10	1731
2012-13	25.64	39.54	1204
2013-14	26.70	27.70	1037
2014-15	22.52	30.40	1350
2015-16	25.40	60.69	2400

Source:. DDA (2016-17), Agricultural statistics general information, Department of Agricultural Development and Farmers Welfare, Harda (MP).

that is why strengthening of chickpea production may ascertain the major contribution in pulse production system in India. In India highest production has been received from Madhya Pradesh by 39 percent.

Table 3 reflects the production status of district Harda where this study was conducted. The highest productivity was reaped in the year 2015-16 by 2400 kg/hectare during period of last five years covering year from 2011-12 to 2015-16 in the Harda district of Madhya Pradesh.

MATERIALS AND METHODS

Harda districts of Madhya Pradesh was selected purposively for the study, Farm Science Centre of Jawaharlal Nehru Krishi Vishwa Vidyalay, Jabalpur had organized Front Line Demonstrations (FLDs) on chickpea production during 2014-2016. Out of 3 chickpea FLDs locations, 4 from Harda block, 4 from Khirkiya block and 4 from Timarani block were selected randomly. The twelve farmers from each FLDs villages of selected locations was interviewed randomly basis for making the sample size of 144. A well structured and pre-tested interview schedule which was duly finalized in supervision of experts used to collect the information from the respondents. The interview schedule used under the study was having eight statements regarding improved chickpea production technology adopted by farmers in the district as use of HYVs of chickpea, recommended dose of Seed, use of recommended fertilizers, seed treatment before sowing, use of weedicide, use of Insecticides/pesticides, water management and marketing and storage etc. The responses obtained towards these statements were recorded on spot during study. A score of three was given to regular adoptees, two to less frequent adoptees, one to very less frequent practitioners and Zero (0) to every non-practitioner. The score ranges from 24 to 0 based on the answers given by the respondents. Individual score was later converted to standardize score of adoption index with the help of the following formula: Adoption (Chickpea Technology) = Obtained Adoption Score X 100@Highest Obtainable Score. In order to know the relationship between the variables, correlation coefficient was calculated and similarly, the average relationship between the variables was calculated by multiple regression analysis, rank, percentage statistical tools were used to make study more pragmatic.

RESULTS AND DISCUSSION

It may be observed from the values of coefficient of correlation presented in Table 4 that education (r =0.278*) and caste (r =0.197*) were positive and significantly related to the adoption of improved technologies at 5 percent

Table 4: Correlation analysis of selected socio-personal variables of farmers with adoption of improved Chickpea cultivation technologies

Independent Variables	Correlation Coefficient (r value)
Age	-0.116*
Education	0.278*
Occupation	0.328**
Caste	0.197*
Size of land holding	0.384**
Annual average income	0.502**
Marketing facilities	0.422**
Farm machinery	0.206**

*Significant at 5 per cent level of probability **Significant at 1 per cent level of probability

level of probability. It means caste and education were important factors for increasing the level of adoption of demonstrated technologies under the FLDs programme of chickpea. It may be due to the fact that education increases the knowledge and understanding power of an individual, which helps to perceive new technologies quicker and enables a person to adopt innovations with confidence. Similarly, occupation (r =0.328**), size of land holding (r =0.384**), annual average income (r =0.502**), marketing facilities (r = 0.422**) and farm machinery (r =0.206**) were positive and significantly related to the adoption of improved technologies at 1 per cent level of probability. It indicates that size of land holding as a factor affects the adoption of farming technologies. It may be due to the fact that adoption of farming technologies is a dependent variable to be affected by size of land holding and annual average income of the respondents. The independents variables marketing facilities was also found a deterministic factor to affect the level of adoption positively, may be due to the fact that cultivation of chickpea needs assured marketing supply. Therefore, availability of marketing facilities must have helps the respondents in the adoption of farming technologies in a better way. On the other hand, age (r = -0.116*) was non-significantly related to the adoption of farming technologies. As the data reveals that the age of the respondents was not significantly related to the adoption of the farming technologies, may be due to fact that the respondents belonged to a same age category. The results of this study are in line with the findings given by Choudhary (2001); Joseph and Padaria (2007); Ram (2010).

Table 5 reflects that eight independent variables put together explained variation in the dependent variable i.e., adoption of improved chickpea cultivation technologies among the respondents. The calculated "F" value of the estimation was 3.9616** and found significant at 5 per cent and 1 per cent level of probability. Thus, the result implied that the eight selected socio-personal variables would account for a significant amount of variation in the adoption of improved chickpea cultivation technologies. From the observation of "t" values for the test of significance of coefficient of regression (b-value) in the Table 2, it was found that the t-values were significant for the size of land holding (2.6393*) occupation (1.3950*) and Farm machinery (4.1294**). This indicates that these variables were most important for predicting the adoption

Table 5: Multiple regression analysis of selected socio-personal variables of selected farmers with adoption of improved chickpea cultivation technologies

Independent variables	b-value	S.E. of 'variables ' b'	't' value
Age	-0.0240	0.0321	-0.7772
Education	-0.3129	0.6217	0.5176
Occupation	0.3547	0.2217	1.3950*
Caste	-0.3890	0.8252	-1.0264
Size of Land holding	1.2890	0.6761	2.6393*
Annual average income	-0.3157	1.2766	-0.3457
Marketing facilities	0.1454	0.6537	0.3081
Farm machinery	0.7146	0.2395	4.1294**

*Significant at 5 per cent level of probability **Significant at 1 per cent level of probability
Multiple R=0.80040; Standard Error= 10.4619; R^2 = 0.48588; Intercept Constant = 67.936;
Degree of Freedom= 11.02; Calculated F= 3.9616**

of improved chickpea cultivation technologies by adoptee farmers. The regression coefficient were not significant for the values namely, age, caste, education, annual average income and marketing facilities. The results were supported by the findings of Kher and Halyal (1991); Hales and Anderson (1994); Ram (2010).

The adoption category was defined under this study according to scientific recommendation and exactness of dose or value used by farmers in their chickpea production process. Below 30 percent adoption of recommended dose or value was put under partial adoption for each technology, 31-60 percent exactness under medium and above 61 percent exactness as under fully adoption category. The detail of results found are given in Table 6.

It is evident from Table 6 that majority 68.00 percent (rank I) of the farmers from demo attended category had fully use of high yielding chickpea varieties, while 36 percent (rank II) had medium and 10 percent (rank III) had partial use of high yielding varieties of chickpea. This finding was found opposite as earlier revealed by Sahu 2010 in Unnao district of UP where they found the majority under medium category; it means district Harda of MP is better in using HYVs of chickpea. Thus, it can be inferred that the farmers from demo attended category showed higher extent of adoption of HYVs of chickpea production compared to the farmers from other category.

Table 6: Demonstration attended Farmer's distribution according to their adoption of improved chickpea production technology

Chickpea Production Technologies	Adoption Categories	Frequency Distribution of Farmers Under Study (N=144)	
		Under Demo farmers	Rank
Use of HYVs of Chickpea	Partial Adoption	10 (06.95)	III
	Medium Adoption	36 (25.00)	II
	Fully Adoption	98 (68.05)	I
Recommended dose of Seed	Partial Adoption	13 (09.03)	III
	Medium Adoption	45 (31.25)	II
	Fully Adoption	86 (59.72)	I
Use of Recommended Fertilizers	Partial Adoption	18 (12.50)	III
	Medium Adoption	48 (33.33)	II
	Fully Adoption	78 (54.17)	I
Seed Treatment before Sowing	Partial Adoption	51 (35.42)	II
	Medium Adoption	66 (45.83)	I
	Fully Adoption	27 (18.75)	III
Use of Weedicide	Partial Adoption	101 (70.14)	I
	Medium Adoption	32 (22.22)	II
	Fully Adoption	11 (07.64)	III
Use of Insecticides/pesticides	Partial Adoption	22 (15.28)	III
	Medium Adoption	80 (55.55)	I
	Fully Adoption	42 (29.17)	II
Water Management	Partial Adoption	19 (13.19)	III
	Medium Adoption	68 (47.23)	I
	Fully Adoption	57 (39.58)	II
Marketing and Storage	Partial Adoption	14 (09.72)	III
	Medium Adoption	53 (36.81)	II
	Fully Adoption	77 (53.47)	I

Figures in parentheses indicate percentages of responses received from farmers

In case of recommended dose of seed, it is evident from Table 3 that majority of demo attended farmers were using appropriate seed rate. As such, 59.72 percent (rank I) of demo farmers was found in fully adoption category. As far as, the use of recommended fertilizers was concerned, majority 54.17 percent (rank I) of the farmers from demo category had recommended application of fertilizers, while 33.33 percent (rank II) had the fully use of recommended fertilizers and 12.50 percent (rank III) had partial use of fertilizers. Thus, it can be concluded that farmers from the demo group showed higher extent of adoption of improved chickpea cultivation technologies on use of recommended fertilizers dose as compared to the farmers from the non demo attended category. It is also evident from the Table that the majority 45.83 percent (rank I) of the farmers from demo category had medium seed treatment before sowing, while 35.42 percent (rank II) had partial seed treatment and 18.75 percent (rank III) had fully adoption means good seed treatment before sowing the chickpea seed. Thus, it can be inferred that the farmers from demo category showed higher extent of adoption of improved chickpea cultivation technologies on seed treatment as compared to the farmers from non demo category. Majority 70.14 percent (rank I) of the farmers from demo category had partial use of weedicide and in case of use of insecticide/pesticide use and 55.55 percent (rank I) had medium level of weedicide use, Therefore, it can be conferred that farmers are good enough in using the insecticide/pesticide for crop protection. The findings of this study are also in line study

made by Bekle and Pillai 2011. A majority 47.23 percent (rank I) at medium level of adoption of the farmers from demo group was able to mange water in chickpea field as per recommendation and 39.58 per cent were using better water management practices at different critical stages of irrigation which shows awareness towards getting high yield of chickpea by farmers. This is also evident from the table no. 3 that the farmer from demo category was found able to harness good price of produce by selling their produce at society's level which again was found a good sign towards farmer's motivation to grow chickpea at large level in Harda district of MP by adoption of improved chickpea production technology the farmers under demonstration attended category was found able to harvest chickpea yield an average 15-25 percent more during year 2014-15 to 2016-17 in Harda district of Madhya Pradesh. This study also being supported by Rajeev 2013 he also reported that improved technology enhanced chickpea yield from 300 kg to 500 kg/ha as compared to farmers practice with an overall increase of 28.18 percent through FLDs in Shivpuri District MP and Singh 2017 again reported that 11.78 percent to 47.82 percent range of chickpea yield advantages were noticed during 20011-12 to 2014–15 at 56 districts of Uttar Pradesh.

CONCLUSION

On the basic of the study it can be concluded that caste, education, size of land holding, annual average income and marketing facilities were found to be significantly and positively related to the adoption of improved chickpea cultivation technologies of FLDs respondents. Age and value of orientation were found to be non-significantly associated with the adoption of improved chickpea technologies of FLDs respondents. The regression of coefficients was found to be significant and positive for the size of land holding and value orientation with the adoption of improved chickpea cultivation technologies of FLDs respondents. On the other hand, regression coefficients were found to be non-significant with the five selected independent variations, viz., age, caste, education, annual average income and marketing facilities with the adoption of improved of chickpea cultivation technologies of FLDs respondents. The adoption of improved chickpea production technology by the farmers under demonstration attended category was found able to harvest chickpea yield an average 15-25 percent more during year 2014-15 to 2016-17 in Harda district of Madhya Pradesh.

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Fish-cum-Livestock Integrated Farming for Efficient Farm Resource Utilization in Tripura-A Case Study

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ABSTRACT

Farm resource utilization capacity of an integrated farming system was estimated through resource cost ratio (RCR) approach. The system was demonstrated by Krishi Vigyan Kendra, South Tripura in a rural village, Bagma. The farming system was diversified by integrating fisheries, dairy and duckary components beside the installation of a biogas unit. The resource cost ratio of the integrated farming system during the year 2016–17 was 0.07 indicating a substantial social profitability. The farm spent only 0.07 units of non-marketable resources to produce one unit of marketable output in the form of fish, milk egg and meat. The farm received higher social profit (Rs. 2,13,130) than private profit (1,54,510.), might be due to the effect of integrated farming system approach where farm utilized cow-dung and biogas slurry as pond manure. Further, sensitivity analysis on the integrated approach in farming proved that the RCR would be higher, i.e., 0.14 if the farm were specialized without integration approach. Integration approach had an impact on farm resource utilization in terms of social profitability or RCR. Besides reducing the risk of failure of an enterprise, the integrated farming approach showed positive social externalities.

Keywords: Integrated fish farming, Resource cost ratio, Social profitability

INTRODUCTION

Integrated fish farming refers to a combination of practices that incorporate recycling resources from one farm enterprise to another to optimize production efficiency. Integrated farming can make a significant contribution to food security for lower income people in the developing world (Mathias, 1994). Integrated fish farming is a popular activity in Asian countries and fish supplies about 30% of the total animal protein in the diet of Asians, 20% in Africa and 10% in Latin America (FAO, 1996). Chinese farmers have developed the art of integrated fish farming to a high degree; about 80% of Chinese fish production received animal manure inputs (Chen *et al.*, 1994). Hopkins and Cruz (1982) studied integrated animal-fish farming systems in the Philippines and concluded that livestock manure is an important source of nutrients for fish cultivation in ponds. A study on fish-poultry integration in Pekanbaru City, Indonesia (Ahmed and Fatimah, 1994) found that poultry fish farming is profitable both financially and technically. Duan *et al.* (1994) showed that integration of fish culture with livestock and poultry is an efficient model. Rahman *et al.* (1994) studied the costs and returns from integrated broiler-fish farming in Bangladesh and showed that integrated polyculture of Asian carps is technically feasible and economically viable. El Tito (1992) in his comparative study of integrated and conventional crop and vegetable faming systems, went on to define integrated farming systems as 'an holistic pattern of land use, which integrates natural regulation process into farming activities to achieve a maximum replacement of off-farm inputs and to sustain farm income'. In India, fewer studies have been conducted to measure the resource use efficiency of integrated farming. Debnath *et al.* (2009) studied the resource use efficiency and social profitability of an integrated aqua-farm in Tripura. Goswami *et al.* (2004) emphasized rice–fish culture as more techno-economically viable than monoculture of paddy in the state of Assam of Northeast India.

Populace of northeast India have high preferences for animal protein in general and fish in particular. Tripura,

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one of the landlocked states of northeast India, witnessed an impressive growth in fish production during last decade where fish culture is recognized as a vital activity for economic development. Total fish production in the state was estimated to be 77,227.69 mt in 2017-18. Aqua-farming activities by several entrepreneurs in this state are the key strength of fisheries development (Debnath *et al.*, 2009). Some of these entrepreneurs use available local resources efficiently to avoid private as well as social or environmental benefits. Krishi Vigyan Kendra, South Tripura initiated an Integrated Fish-cum-Livestock farming demonstration programme since 2009 in South Tripura district. It was demonstrated through active participation of farmers with advanced technological guidance from KVK, South Tripura. This paper examines the resource cost economics of an Integrated Fish-cum-Livestock farm that has been demonstrated by KVK during the year 2016-17.

MATERIALS AND METHODS

The primary cross section data on farming inputs and outputs for the year 2016–17 were used in this study. The farming details used in this study were collected through field visits and personal interview during the period of demonstration.

The Resource Cost Ratio (RCR) approach is a variant of Domestic Resource Cost Ratio (DRCR) that Morris (1990) has applied to determine the comparative advantage between countries. Datta (2001) has argued about the robustness of DRCR in the study of global competitiveness of Indian agri-business products as against the traditional measure of competitiveness. Debnath *et al.* (2010) reinterpreted DRCR and suitably adapted to be applied at micro-level i.e. at individual farm level. Present study assessed the social costs and benefit at individual farm level besides the conventional private cost and benefit. Debnath *et al.* (2009) have used same approach for estimation of resource use efficiency and social profitability of an integrated aqua-farm, Tripura.

In the RCR approach, all the possible inputs and outputs of a production unit are categorized as marketable and non-marketable. Here, factors of production (inputs) which enter in the production system from the market by the producer are considered as marketable input, for example skilled labour, manure, fish feed, lime etc. And those which enter in the market from the production system (even if it is self-consumed, it must not be used as an input in production system) are the marketable outputs, for example, produced fish, produced milk in fish-cum-livestock farm etc. (even if it is consumed by the producer's family also). On the other hand, the non-marketable inputs are those which are relatively less marketable than that of the products (like fish) in the local area. Here, unskilled labour was categorized as a non-marketable input for resource cost ratio approach. It is considered so as unskilled can't get steady jobs like the standard skilled labours, in other words, they are not as marketable as standard skilled labors especially in local market situation. The outputs which don't enter into the market rather get reused in the production system are the nonmarketable outputs. For example, duck droppings from Fish-cum-Duck integrated farm which is reused as manure for aquaculture is a non-marketable output. Non-marketable outputs also include the environmental and social outputs from aquaculture activities (if not marketed).

Fisheries and livestock (duck and cattle) based integrated farming system was established in rural village Bagma, Tripura. The farmer's (S. Majumder's) farm that provided the stimulus for this study has produced fish, milk, egg, duck meat, biogas and manure. The system was diversified by integrating fisheries and duckary (khaki Campbell) besides installing a biogas plant (capacity = 5.5 m^3). Biogas plant was vertically integrated to the system for efficient utilization of cattle manure for cooking and manuring of fish pond though it's a byproduct. The livestock unit consisted of one cow-shed that accommodate 10 cattle and one duck-house having capacity of rearing 30 Khaki Campbell ducks (male = 07, female = 23). Beside the supplemented feed, the cows were fed with grass and fodder produced from the farm. Major portion of produced milk was sold to nearby milk marketing society besides home consumption of small quantity. Ducks were feed with supplemented feed procured from market alongside wasted kitchen rice and farm produced low-priced rice. Both the livestock units were managed in the adjacent area of one small fish culture unit of 0.16 ha. Multi-stocking and multi-harvesting techniques in fish culture management were followed to attain maximum profit. Fish of any size group (small to large) is demanded by consumers of Tripura and fetches a good market throughout the year. Such fish market in local situation creates the opportunity for multi-stocking

and multi-harvesting approach in fish culture. Using this principal and keeping the pond water volume-fish biomass ratio in mind, supplementary fish feed was provided @ nearly 2 per cent fish weight. Lime application was carried out with split dose of 12 kg bimonthly for whole culture period of one year.

The valuation of these inputs and outputs are done in both producer prices as well as at economic prices. Here, producer price is the price of inputs/ outputs items expressed in monetary term that are paid or received by actual producer in the localized market and the economic price is the real price of inputs/outputs items expressed in monetary term without the effect of all possible externalities (third party effect: either good or bad, or parties not directly involved in the production or use of commodity). All the inputs and outputs of both marketable and non-marketable categories were structured in a matrix considering its producer's price and economic (or opportunity) price. The matrix termed as Policy Analysis Matrix (PAM) has been used to calculate several indices of RCR (Table 1).

All these indices are self-explanatory in their terms, but the characteristic of RCR and its possible results should be illustrated to make it more simple and convenient to understand. RCR is the ratio of net cost of non-marketable resources (H-F) and the net value addition effected through marketable route (E-G). Some of the key inferences of this approach can be explained as:

1. Usually, $0 < RCR < 1$ on the assumption that $(E-G) > 0$.
2. Social profit is inversely related to RCR Social profit
   = [(E + F)-(G + H)]
   = [(E-G)-(H-F)]
   = (E-G) [1-(H-F) / (E-G)]
   = (E-G) [1-RCR]
3. When social profit = 0 and (E-G) > 0, then (1-RCR) = 0 and hence RCR = 1

In the case of economies of scale and scope, the value of output products tends to increase either because of a large scale of operation or greater product diversification. Possibilities include: (1) decline in the difference between the economic value of non-marketable outputs and inputs, when non-marketable input costs decrease, decline in non-marketable input cost or the value of non-marketable outputs increases; (2) rise in the economic value of the difference between marketable outputs and inputs that occurs with a rise in the marketable output or a fall in the cost of a marketable input. The RCR may fall for integrated aquaculture because of a combination of these reasons. Addition of a new product like biogas or biogas slurry may result in a less-than proportionate increase in input costs due to the large scale of integration.

RESULTS AND DISCUSSION

RCR analysis: The analysis was carried out with primary data and relevant assumption to impute different cost and important particulars are presented in Table 2. The marketable and non- marketable inputs (Table 3) and outputs (Table 4) are summarized at producer as well as economic price. RCR analysis and policy analysis matrix

Table 1: Policy Analysis Matrix and RCR indices

Item		Output		Input	
		Marketable	Non-marketable	Marketable	Non-marketable
I. Policy Analysis Matrix (PAM)					
Producer price		A	B	C	D
Economic price		E	F	G	H
II. RCR indices					
1. Private profit	=	(A + B)-(C + D)			
2. Private profit per unit farm area (ha)	=	(1) / farm area (hectare)			
3. Private cost	=	(C + D)			
4. Private profit per unit private cost	=	(1) / (3)			
5. Social profit	=	(E + F)-(G + H)			
6. Social profit per unit farm area (ha)	=	(5) / farm area (hectare)			
7. Social Cost	=	(G + H)			
8. Social profit per unit social cost	=	(5) / (7)			
9. Resource Cost Ratio (RCR)	=	(H-F) / (E - G)			

Table 2: Imputed cost of primary data based on assumption

Items	Primary data and assumption	Imputed cost (INR)
Cattle shed (one)	Construction cost = 1,00,000 Life time = 10 years	Annual replacement cost: Producer price = 10000 Economic price = 10000
Duck house (one)	Construction cost = 20,000 Life time = 10 years	Annual replacement cost: Producer price = 2000 Economic price = 2000
Cattle	No. of cattle = 10 Life time = 10 years Purchase cost = 8000 each	Annual replacement cost: Producer price = 8000 Economic price = 8000
Biogas plant	No. of biogas plant = 01 Life time = 10 years Construction cost = 40000 Subsidy = 80 per cent	Annual replacement cost: Producer price = 800 Economic price = 4000
Wasted Kitchen rice as duck feed	Quantity fed monthly= 60 kg Period of feeding = 9 months Opportunity cost = Rs. 4 per kg	Producer price = 0 Economic price = 2160
Low priced rice as duck feed	Quantity fed monthly = 90 kg Period of feeding = 9 months Production cost = Rs. 4 per kg Opportunity cost = Rs. 6 per kg	Producer price = 3240 Economic price = 4860
Family labour	No. of man-hour = 2 Opportunity cost per man-hour = Rs. 20	Producer price = 0 Economic price = 14,600
Home consumption of milk	Milk consumed per month = 45 lit Opportunity cost = Rs. 35 per lit	Producer price = 0 Economic price = 18900
Home consumption of Egg	Quantity consumed per month = 25 nos. Opportunity cost = Rs. 5 each	Producer price = 0 Economic price = 1500
Home consumption of fish	Fish consumed per month = 20 kg Opportunity cost = Rs. 150 per kg	Producer price = 0 Economic price = 36000
Duck droppings	Utilized as pond manure Quantity produced = 1.5 MT Opportunity cost = Rs. 2000 per MT	Producer price = 0 Economic price = 3000
Cow dung and biogas slurry (pond manure)	Total quantity produced = 32 MT Quantity utilized for pond manure = 16 MT Opportunity cost = Rs. 1000 per MT Utilized for cooking purpose Opportunity cost is equivalent cost of	Producer price = 0 Economic price = 16000
Biogas		Producer price = 0 Economic price = 4800
	LPG cost (Rs. 400 per month)	

(Table 5) of the integrated farming system revealed that the farm earned a private profit of Rs. 1,54,510 from 0.30 ha area during 2016–17. The farming system was able to earn a private profit of Rs. 1.14 per unit of private cost (Table 5). Indices of social profitability analysis of PAM (Table 5) showed that the farm could receive higher social profit than private profit. This might be due to the effect of Integrated farming system approach where farm utilized cowdung and biogas slurry as manure for fish culture. The private cost for pond manure was imputed to be zero, where the farm enjoyed an economic benefit in terms of non-marketable output by recycling the livestock waste as pond manure for fish culture. Hence, the opportunity cost of livestock manure was considered in economic price in resource cost ratio analysis. Total social profit of the farming system was estimated to be Rs. 2,

Table 3: Marketable and non-marketable inputs

S. No.	Particulars	Producer price (INR)	Economic price (INR)
I. Marketable inputs			
1.	Cattle house	10,000	10,000
2.	Duck House	2,000	2,000
3.	Pond renovation	3,000	3,000
4.	Duck	2,500	2,500
5.	Cattle	8,000	8,000
6.	Biogas plant	800	4,000
7.	Fish seed	6,300	6,300
8.	duck feed (market feed)	5,000	5,000
9.	fish feed (Supplemented)	4,800	4,800
10.	Lime	1,500	1,500
11.	Cattle feed	70,000	70,000
	Sub-total (I)	*1,13,900*	*1,17,100*
II.	**Non-marketable inputs**		
1.	labour	18,000	18,000
2.	Family labour	0	14,600
3.	Waste kitchen rice (as duck feed)	0	2,160
4.	Low-priced rice (as duck feed)	3,240	4,860
	Sub-total (II)	*21,240*	*39,620*

Table 4: marketable outputs and non-marketable outputs

S. No.	Particulars	Producer price (INR)	Economic price (INR)
I.	**Marketable outputs**		
1.	Duck meat (sold)	6,500	6,500
2.	Cow Milk	1,92,000	1,9,2,000
3.	Home consumption of milk	0	18,900
4.	Egg (sold)	6,150	6,150
5.	Home consumption of egg	0	1,500
6.	Fish (sold)	85,000	85,000
7.	Home consumption of fish	0	36,000
	Sub-total (I)	*2,89,650*	*3,46,050*
II.	**Non-marketable Outputs**		
1.	Biogas	0	4,800
2.	Cow dung & biogas slurry (manure)	0	16,000
3.	Duck droppings	0	3,000
	Sub-total (II)	*0*	*23,800*

13,130 and the system earned 1.36 units of social benefit per unit of social cost. Social profit per hectare was estimated to be Rs. 7, 10,433, whereas the private profit per ha was Rs. 5, 15,033. The resource cost ratio of the integrated farming unit during the year 2016-17 was 0.07 indicating higher social profitability and good capacity to produce marketable outputs by utilizing local non-marketable resources. The resource alteration and transformation capacity of integrated farming system was reflected in this study. The farm spent only 0.07 units of non- marketable resources i.e. local factors of production to produce one unit of marketable output in the form of fish, milk, egg, and duck meat.

Sensitivity analysis of integrated approach in farming: A sensitivity analysis was done to quantify the extent of advantage because of his integrated approach in the farming system of the selected farm. Debnath *et al.* (2011) and Debnath *et al.* (2009) used sensitivity analysis while studying two farming systems. It is generally an extended study to understand the farming system better. For this, a hypothetical specialized farm has been considered where the integration system is absent. The major changes for hypothetical specialized farm were: 1) Absence of biogas plant, and hence, no production of biogas, 2) Animal wastes would be marketed rather re-using in farming system, 3) No unskilled family labour would be utilized and same quantity of labour would be availed from local market situation. Hence, the specialized farm would not receive any economic value for animal waste as non-marketable output. Specialized farm would have the advantage of selling animal wastes in the market. Considering such a hypothetical specialized farm, PAM structure would be same as mentioned in Table 5. Interestingly, the RCR goes up from 0.07 to 0.14 because of integration which indicates that the integration approach had an impact on resource use efficiency of the farming unit. The non-utilization of family labour and livestock wastes as input component for farming system would reduce the efficiency of the farming to convert local non-marketable resources like unskilled labour to non-marketable outputs like fish, milk, meat etc. Hence, RCR is found to be lower in case of integrated system than the RCR of hypothetical farming without integration. Integration approach in farming system of selected farmer had a positive impact towards social profitability of farming.

Table 5: Policy analysis matrix and RCR indices

Items	Outputs		Inputs	
	Marketable	**Non-marketable**	**Marketable**	**Non-marketable**
Present Farm				
Producer price (INR)	2,89,650 (A)	0 (B)	1,13,900 (C)	21,240 (D)
Economic price (INR)	3,46,050 (E)	23,800 (F)	1,17,100 (G)	39,620 (H)
Without integration				
Producer price (INR)	2,89,650 (A)	0 (B)	1,20,100 (C)	32,600 (D)
Economic price (INR)	3,46,050 (E)	0 (F)	1,20,100 (G)	32,600 (H)
RCR Indices			**Present Farm**	**Without integration**
1) Private profit		(A + B) – (C + D)	Rs. 1,54,510	Rs. 136950
2) Private profit per unit farm area (ha)		(1)/ farm area (ha)	Rs. 5,15,033	Rs. 114125
3) Private cost		(C + D)	Rs. 1,35,140	Rs. 152700
4) Private profit per unit private cost		(1) / (3)	1.14	0.90
5) Social profit		(E + F) – (G + H)	Rs. 2,13,130	Rs. 193350
6) Social profit per unit farm area (ha)		(5)/ farm area (ha)	Rs. 7,10,433	Rs. 161125
7) Social Cost		(G + H)	Rs. 1,56,720	Rs. 152700
8) Social profit per unit social cost		(5) / (7)	1.36	1.27
9) Resource Cost Ratio (RCR)		(H – F) / (E - G)	0.07	0.14

CONCLUSION

Substantial resource transformation capacity was demonstrated by KVK, South Tripura through the development of fish-cum-livestock integrated farming system. It is an initiative to combine different factors of production either marketable or non-marketable inputs to produce different marketable products viz. fish, milk, egg and meat besides the waste recycling services to the society. Present study quantified the concept in terms of resource cost ratio. Diversification in the farming system reduced the risk of failure of one enterprise and showed positive externalities to the society. Sensitivity analysis proved the positive advantage of integration approach for farming as compared to specialized farming as per as social profitability in terms of RCR and the farm resource transformability is concern. Further, the system ensured Food and Agriculture Organization's technical guidelines (FAO, 1997) for diversification of aquaculture for income generation with responsible resource utilization and minimum adverse impacts on the environment and local communities.

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Awareness Regarding Fuel Conservation to Motivate Rural Women Regarding Adoption of Solar Cooker at Household Level

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ABSTRACT

The Energy scenario in India is complex and facing many problems. Every state is passing through energy crisis at some point of time in every year. The demand for energy is increasing day to day with the increase in population. It is anticipated that the deficit between demand and supply of energy is going to be 10-15 percent in the next 10 year period. The present energy resources and the finances are not sufficient to meet the demand. One of the ways of bridging this gap is the use and application of renewable energy source/technologies especially solar appliances at home and field. A solar cooker is the simplest technology which has been developed for cooking the food without requiring any conventional fuels. Several advantages over solar cooker has been claimed such as no smoke emission, no soot deposition in the cooking utensils, retains nutrients, environment friendly and conserves precious conventional resources of the country. Today as an outcome of the concentrated work of the solar activists several types of solar cookers have been developed and disseminated. Continuous effort on a large scale by government, universities and voluntary agencies is the need of the hour to promote solar cooking among the people. The public should shed their inhibition, traditional habits and cultural practices and come forward to adopt this simple technology.

Keywords: Adoption, Awareness, Fuel conservation, Household, Motivate, Solar cooker, Women

INTRODUCTION

The energy is a basic requirement for economic development in almost all major sectors of Indian economy. Energy needs are increasing day by day. The biggest advantage of solar cookers is their eco-friendliness. By using one, dependence of electricity will be less. To operate it, one thing we need is sunlight and one can save time, energy and money by using it. The household sector is responsible for about 15 to 25 percent of primary energy use in developed countries. In order to cope up with household energy crises, it is very important to adopt the household energy saving technologies at faster speed. Therefore, the relevant information regarding the use of solar gadgets should be provided to the rural home maker so that they can efficiently make food with prior planning and fewer loads on the electrical appliances. Solar cooker is one of the early devices developed in the country. The ministry of Non-Conventional Energy Sources, India has been promoting the box type solar cooker in the country since 1982-83 in view of its advantages over other designs. A box type solar cooker consisted of an insulated box with a glass cover and a top lid, which has a mirror on its inner side to reflect sunlight into the box when the lid is kept open. The inner part of the box is painted black usually four black painted vessels are placed inside the box along with the material to be cooked. The cooking time is about 1 ½ hrs to 3 hrs depending upon the items being cooked and the intensity of solar radiation. Since the cooking inside the cooker is slow, the food cooked retains the nutrients better than that cooked in the conventional devices. Besides cooking the meals, the solar cooker can be used to prepare simple cakes, to roast groundnut, cashew nuts and *papads,* dry grapes, etc. It, however cannot be used for preparing *chapatties* or for frying purposes. A normal box cooker of 0.6m x 0.6m size having a weight of around 12 kg is capable of cooking 2 kg of food and can save 3 to 4 LPG Cylinder a year if used regularly. India's residential sector is one of the major consumers of energy whose energy demand will grow with prosperity and population growth. Household energy use in India is sourced both from conventional and non-conventional sources. People especially women need to make aware about simultaneous use of both energy sources because

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education also influences the stated importance of energy conservation, as low education households reveal that they are primarily motivated to save electricity for financial reasons and high education households indicate they are motivated by environmental concerns (Mills *et al.,* 2011).

Keeping this in view, an effort was made by KVK Barnala, Home Science component, for imparting knowledge, conducting demonstrations cum trainings at village level so that women should contribute towards the saving of energy.

MATERIALS AND METHODS

The study was undertaken in two adopted villages of *Barnala* district, i.e., *Handiaya* and *Dhanaula-Khurd*. The data was collected from 60 rural women through questionnaire for collecting general view of women regarding use of solar cooker. For experimental purpose, 30 women were selected and solar cooker were provided to them for two months duration. Then after, analysis was done for the collected data and observations.

RESULTS

Table 1 reveals that more than half of the respondents (55%) belonged to the age group of 30-35 years. Majority (26.6%) had education upto 8th standard. Thirty-one per cent families were belonged to business class had village level shops and thirty percent were from agricultural background. Twenty- three per cent were daily wagers. 63 percent had family income less than 15000 per month. Mostly small (46%) and medium (43%) families were prevalent in that village. Majority i.e., 53 percent were land less and maximum of respondents (63.3%) paid the electricity bill of amount ranging between Rs. 1000-Rs. 2000.

Regarding use of heating unit in home, all cent per cent (100%) were using LPG followed by ordinary *Chulha* (51.6%). Amount Rs. 200 per month was paid by the family for its fuel from different sources. On an average, majority of farmers (55%) used one cylinder for 2 months having family size upto 6 members (Table 2). Also it was found that smoke from *chulha* is not good for health as major problems of health are associated with the long duration use of smoke as indoor air pollution from fuel smoke is a major health concern in the developing world (Fullerton *et al.,* 2008).

Table 1: Distribution of respondents according to their Socio-personal profile of respondents (n=60)

Attributes	Number f (%)
Age (Yrs)	
25-30	12 (20%)
30-35	33 (55%)
<35->40	15 (25%)
Education	
Illiterate	02(3.3%)
5th	05(8.3%)
8th	16 (26.6%)
+2	13(21.6%)
Matric	24(40%)
Family occupation	
Govt. Service	04 (6.6%)
Pvt. Job	05 (8.3%)
Business	19(31.6%)
Agriculture	18(30%)
Daily wager	14(23.3%)
Family income (Per month)	
>15000	38 (63.3%)
15000-35000	18(30%)
Above 35000	04 (6.6%)
Family Size	
Small (2-4)	28(46.6%)
Medium (5-7)	26(43.3%)
Large (above 8)	06(10%)
Land possession	
1 kile to 4 kile	19 (31.6%)
Above 4 kile	09(15%)
Landless	32 (53.3%)
Electricity bill paid (for 2 months)	
Rs. 1000-Rs. 2000	38 (63.3%)
Rs. 2000-Rs. 5000	22 (36.6%)
Rs. 5000-Rs.10000	-

It is evident from Table 3 that as far as possession of solar cooker in the village, one respondent had solar cooker, and that was purchased in the year 2016. Only 18.3 percent respondents were aware about solar cooker, 41.6 percent had only seen and 53.3 percent had heard only about solar cooker. Regarding its advantage, 51.6 percent were aware and only 23.3 percent had knowledge about its maintenance and 10 percent knew about its care. Awareness regarding

Table 2: Distribution of respondents according to the use of different heating units in the kitchen (n=60)

Type of heating units	Frequencies	Percentages
Ordinary *Chulha*	31	51.6
Average Cost of fuel used for one month for *chulha*	200 per month (31)	51.6
Kerosene stove	-	-
LPG	60	100
One Cylinder used for how many months		
(a) less than one month	0	
(b) for one month	22 (Avg. family size=9 members)	36.6
(c) for 2 months	33 (Avg. family size=6 members)	55
(d) for 3 months	05 (Avg. family size=3 members)	8.3
(e) More than 3 months	-	-
Biogas plant	-	-
Solar cookers	-	-
Electric *Tandoor*	-	-
Microwave oven	-	-

Table 3: Distribution of respondents based on awareness of solar cooker (n=60)

Solar cooker technology	Response (f)
Possession of solar cooker	1(1.6%)
Only seen	25(41.6%)
Only heard	35(58.3%)
Aware about advantages	11(18.3%)
Save fuel energy	31(51.6%)
Smoke free cooking	31(51.6%)
Available free of cost	31(51.6%)
Dust free cooking	31(51.6%)
Knowledge about maintenance	14(23.3%)
Care about handing	14(23.3%)
Use cotton cloth while taking out	06(10%)
Not to open again and again	06(10%)
Changing direction increase the efficiency	06(10%)

all new technologies is very important in any field but when talking about women comfort and concern; it becomes very essential as women perform various roles in indoor and outdoor so, if any household technology that can save her time and money is worthwhile for women.

Table 4 shows that before trainings only 2 recipes were known to 18.3 percent of respondents, 3 recipes were known to 15 percent respondents and only one respondent knew more than 3 recipes. After trainings, more than ten (10) recipes were prepared by 80 percent of the respondents. On the basis of baseline survey, 50 per cent respondents were interested to keep solar cooker for trials. It is evident that trainings are very much required by rural women to update new technique. Study on rural women of Kandi area of Punjab was conducted by Kaur (2001) revealed that women were not aware of cooking techniques which can lessen the cooking time and lead to less consumption of fuel. They are not aware about the alternate cooking sources, but after trainings most of women were aware and taking use of solar cooking devices. After getting general view regarding use of solar cooker, an experiment was undertaken on 30 home makers. Solar cooker were given to 30 women for two months rotation for cooking. Demonstrations were also given to home makers for making of different food items. So, the result of experimental phase was given below:

Table 4: Distribution of respondents based on interest to keep solar cooker and also want trainings for its proper use (n=60)

Particulars	Response (f)
Interest to keep solar cooker	50(83.3%)
Want trainings for its proper use	50(83.3%)
Want demonstrations of recipes made on solar cooker	50(83.3%)
Number of recipes known	
Only 2	11(18.3%)
Only 3	09 (15.0%)
More than 3	01(1.6%)

Table 5: Distribution of solar cooker to the respondents on the basis of base line survey (n=30)

Particulars	Response (f)
Distribution of solar cooker	30 (50%)
Adoption status (n=30)	
Adopters	25(83.3%)
Discontinuers	05 (16.6%)
Non-adopters	**30(50%)**

It is given in Table 5 that out of 30 respondents, who took the solar cookers for testing, used it for two months, 25 numbers were interested to keep it or purchase it on subsidy basis whereas 5 numbers of respondents discontinued the use of solar cooker.

It is given in Table 6 that the reasons identified by hundred per cent adopters to adopt solar cooker as: saved fuel energy, smoke and dust free cooking, provided good taste, flavor and color to food. It is suggested that energy savings are higher while using solar cooking. Apart from these, other benefits are: No operation expenditure required, Saves fuel, Saves time also as four items can be cooked at a time, No loss of nutrients, No need of continuous supervision by the worker, No smoke and no soot, so it is eco-friendly and hence saves environment, Easy and safe to use, Food will not burn or overcooked and flavor of food is retained due to slow cooking, It is easy to move as wheels are provided with them.

Photograph 1: Solar cooking demonstration

Photograph 2: Recommended padded gloves and mat

Table 6: Average and percentage of respondents (adopters) according to reasons for their adoption (n=25)

Reasons	Average and percentage
Saves fuel energy	25 (100%)
Smoke free cooking	25(100%)
Available free of cost	25(100%)
Dust free cooking	22(88%)
Reduces electricity bill	25 (100%)
Provides good taste, flavor and color of food	20 (80%)

Table 7: Average and percentage of respondents (Discontinuers) according to reasons for their discontinuation (n=05)

Reasons	Average and percentage
Not habitual to use solar cooker	4(80 %)
Dependence on weather	5(100 %)
Long duration cooking	5(100%)
Difficultly in moving out from home	5(100%)
Needs attention for changing direction	5(100 %)
Unwilling to invest money on purchase	5 (100%)
Unwilling to switch over from the LPG and *chulha*	5 (100%)
Large quantity of food cannot be cooked	4 (80%)
Takes too much time for cooking	5(100%)
Purely depend on weather for cooking	5(100%)

Table 7 reveals that reasons observed by discontinuers (5 number respondents) were, dependence on weather, long duration cooking, difficulty in moving out from home, needs more attention for changing direction. Unwilling to invest money on purchase, unwilling to switch over from LPG and *Chulha*, large quantity of food cannot be cooked, purely depend on weather for cooking. For taking out hot containers padded gloves and mat were recommended and popularized for use to avoid burns caused by hot surfaces of the containers.

CONCLUSION

There is a great scarcity of conventional energy sources such as coal, oil, gas and electricity in the country. Moreover our surroundings are getting polluted by the smoke produced by daily use of wood fuel especially in the rural areas. To overcome both these problems, the use of solar energy can be of great advantage. Solar cooker is a very effective strategy to save fuel and environment. It can be used for 7-8 months in a year. In this, food is cooked with the heat of sun and almost all types of cooking can be done in solar cooker except frying and chapatti making. The day when fossil fuels get exhausted one needs to turn on the perennial sources of energy – the radiating sun, the blowing wind, the surging tide, and other sources of biomass are not far off. The efforts of the project revealed that a number of hurdles need to be crossed before then. Solar cookers find a place in the Indian kitchen. Continuous effort on a large scale by government, universities and voluntary agencies is the need of the hour to promote solar cooking among the people. The public should shed their inhibition, traditional habits and cultural practices and come forward to adopt this simple technology.

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Access and Usage of Information and Communication Technology (ICT) to Accelerate Farmers' Income

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ABSTRACT

Information and Communication Technology (ICT) is the resultant output of all modes of transmission like electronic devices, networks, mobiles, services and applications which help to disseminate information immediately and effectively. Timely availability and accurate information has proved very crucial in identifying and mitigating pest and disease prevalence, drought management and also knowing proper market for proper price. ICT has now become a reliable instrument to achieve this goal in India. Although ICT have escalated the living standard of Indian farmers and made them ICT-friendly which has resulted in increased penetration of useful information about crops husbandry as well as animal production, but rural India has yet to achieve full swing towards usage of ICT by the common farmers. The present study is an attempt to explore the status of access and usage of ICT, and perceived constraints towards utilisation of this new but challenging opportunity. The data from 100 farmers interviewed from selected villages of Dhenkanal district of Odisha through a structured schedule revealed that although they have access to the ICT tools but those tools are mostly used to get benefit of general communication and entertainment purpose and less for marketing and other productive purpose. The study suggests developing awareness and skill of the farmers to use ICT tools for their farming benefits.

Keywords: Information and communication technology, Access, Usage, Access-usage index

INTRODUCTION

Information and Communication Technology (ICT) is a modern technology tool which facilitate the creation, management, storage, retrieval, and dissemination of any relevant data, knowledge, and information that may have already been processed and adapted (Batchelor, 2002; Chapman and Slaymaker, 2002; Rao, 2007). In agriculture, ICTs have the potential to facilitate higher access to information that support knowledge sharing on different modern production technologies. It also makes the farmers aware about Govt. programmes and policies on agriculture. ICT technology opened up new opportunities for economic and social transformation and can act as a medium for poverty alleviation in the form of more income (Quibria, 2001), by providing powerful tool to rural farmers and other citizens by creating new opportunities and delivery of services (Nkwocha, *et al.*, 2009). The extension mechanism for purposeful farmer to farmer learning exchange was created through ICT in the form of WhatsApp group based social networking of innovative farmers (Nain *et al.,* 2019). However, despite rapid spread and potentiality, ICTs face challenges like affordability, ease of use, accessibility, scalability, and availability of relevant and localized content in an appropriate language (Keniston, 2002; Dossani, Misra, and Jhaveri 2005; Saravanan 2010). The personal sources still dominate the agricultural information system in the technologically and developmentally backward districts (Nain *et al.,* 2015). Various kind of social, technological and infrastructural barriers creating a digital divide and broadening the already existing gap for rural

Women as for as access, adoption and use of Information and communication technology (Sinha, 2018). In developing countries, 67 per cent of young people aged 15-24 use the Internet (Anonymous, 2017) so, ICT can be utilised in attracting rural youth in agriculture in present perspective of youth apathy in agriculture. Accessibility and usage of ICT tools may help in increasing the income

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of farmers. With this background, the present study was undertaken to explore the accessibility level and extent of usage of ICT tools of the farmers.

MATERIALS AND METHODS

The study was conducted in two villages of Dhenkanal district of Odisha. Villages were selected purposively considering that the villagers had exposure on ICT tools. 100 respondents from the villages were selected randomly as the respondents.

Access of ICT tools was operationalized as the scope to use of ICT tools and usage was assessed as the actual utilization of these tools for productive purposed.

A construct [Access-Usage Index (AUI)] was developed to compare among respondents and among the ICT tools regarding their level of utilization of these tools. AUI was calculated as:

$$AUI = \frac{A+2b}{3n}$$

Where, a= number of ICT tools having access by the respondent/frequency of farmers having access in a specific tool

b= number of ICT tools actually used by the respondent for productive purpose/frequency of farmers actually using the tool

n= total number of respondents or total number of ICT tools under comparison

Constrains towards usage of these tools were ranked based on the Rank Based Quotient (RBQ) as follows:

$$\text{RBQ} = \sum \frac{fi(n+1-i)}{N \times n} \times 100$$

Where, *fi* is the frequency of the informants for *i*th rank; *N* is the total number of respondents and *n* is the number of ranks.

RESULTS AND DISCUSSION

Data in the Table 1, indicated characteristics of the respondents in the study area. Most of the farmers were in middle age group with 36 years average age; medium level of education with nearly 11 years of average formal education; small level of land holding with 2.76 ha on average; majority (83%) of them having medium class level of annual income with nearly 3 lakh per year on an average; again a majority of the (67%) medium level of working knowledge on ICT with an average score; 47 per cent of them had medium level of access-usage index with 0.45 mean score, which indicates farmers were not utilizing ICT tools properly for development of their farming even though they had access of most of the ICT tools. This type of deviation in score of access-usage index occurred due to its complexity in many cases or lack of awareness about the utilization pattern or usage of ICT tools or anxiety about handling of ICTs in farming.

Table 2 represents ownership and access of ICT tools and the access usage index of the ICT tools. It is shown that all farmers having access to television from their own source. Most of the farmers (90%) having their own source of accessing the mobile phone and internet. Again for video calling and video recording (90%) farmers mainly depend on their own source; followed by 80 and 67 per cent for social Media (Facebook, Whatsapp etc.) and global positioning system, respectively. But, the percentage of respondents having access to radio, web camera and computer were less viz. 57, 54 and 47 per cent respectively in total.

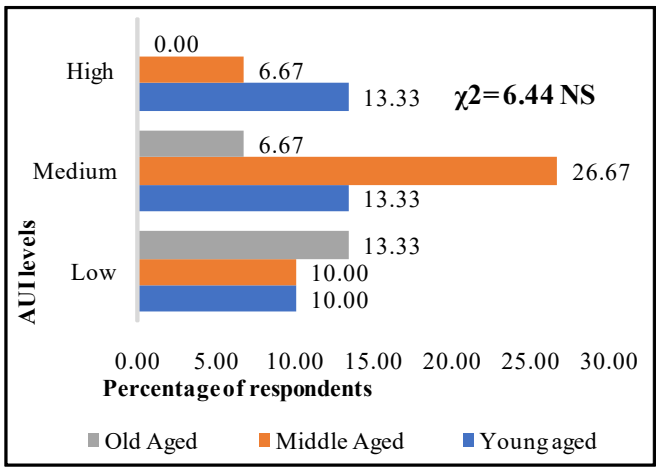
Data in the table also showed that most of the farmers (70%) were using mobile phone, internet, video calling, social media for production purpose like entertainment, online shopping, and online communication; followed by 60, 50 and 47 per cent for video recording television and computer, respectively. But, less number of farmers used global positioning system and web camera for production purposes due to the lack of knowledge and skill about advantages of uses of these tools. And, very negligible number of farmers (13% only) was using radio for production purpose might be due to gaining more popularity, easy access and uses of mobile phone and television. The access usage index (AUI) showed the comparing level of utilization of ICT tools i.e. highest for the social media and video calling (0.80) followed by 0.77 for mobile phone and internet each; 0.73 and 0.67 for video recording and television respectively. The AUI was less for computer, global positioning system, web camera and radio that was 0.47, 0.39, 0.36 and 0.28, respectively. As because lack of awareness, training and complexity of usage this unconventional ICT tools in Indian Agriculture prevails till date.

Table 1: Characteristics of ICT users in the study area (N=100)

Characteristic Class	Percentage of respondents	Statistical implication
Age (Scale: Chronological age rounded to nearer integer in yrs.)		
Young (Age < 30 yr.)	37.00	Mean age = 36.03 yr.
Middle (Age 30 to < 50 yr.)	43.00	Std. Dev. = 10.82
Old (Age 50 yr. & above)	20.00	Coef. Var. = 30.03 %
Education (Scale: Year of formal education undergone)		
Low (Up to Class-VIII)	07.00	Mean education = 11.80 yr.
Medium (Class IX to XII)	50.00	Std. Dev. = 1.34
High (Graduate & above)	43.00	Coef. Var. = 11.36 %
Land Holding (Scale: Possession of cultivable land expressed in ha)		
Marginal (Holding < 1 ha)	10.00	Mean land holding = 2.76 ha
Small (Holding 1 ha to <4ha)	60.00	Std. Dev. = 1.90 ha
Medium (Holding 4 ha to <10 ha)	30.00	Coef. Var. = 68.84 %
Large (Holding 10 ha & above)	00.00	
Annual Family Income (Scale: Total annual income per year in Lakh Rs.)		
Poor (Income <Rs.0.1L/year)	00.00	Mean score = 3.05 Lakh
Middle Class (Rs. 0.1L to <0.3L /year)	83.00	Std. Dev. = 0.88
Rich (0.3L & above)	17.00	Coef. Var. = 28.85 %
Working Knowledge (Scale: Level of knowledge on different aspects of ICT in score*)		
Low (Attained score <29)	10.00	Mean score = 33.50
Medium (Attained score 29 to 37)	67.00	Std. Dev. = 4.05
High (Attained score 38 & above)	23.00	Coef. Var. = 13.43 %
Access-Usage Index (Scale: Absolute unit-free value out of Index as mentioned*)		
Low (Value up to 0.33)	33.00	Mean score = 0.45
Medium (Value > 0.33 to 0.67)	47.00	Std. Dev. = 0.20
High (Value > 0.67)	20.00	Coef. Var. = 44.44 %

Table 2: Ownership and access of ICT (Expressed in percentage) N=100

ICT tools and procedures	Access			Used the tool on production purpose	Access-Usage Index (AUI)
	Own source	Out-source	Total		
Television	100.00	0.00	100.00	50.00	0.67
Radio	37.00	20.00	57.00	13.00	0.28
Computer	27.00	20.00	47.00	47.00	0.47
Mobile phone	90.00	0.00	90.00	70.00	0.77
Internet	90.00	0.00	90.00	70.00	0.77
Global Positioning System	67.00	17.00	84.00	17.00	0.39
Web camera	27.00	27.00	54.00	27.00	0.36
Video Calling	90.00	10.00	100.00	70.00	0.80
Video recording	90.00	10.00	100.00	60.00	0.73
Social Media (Facebook, Whatsapp etc.)	80.00	20.00	100.00	70.00	0.80



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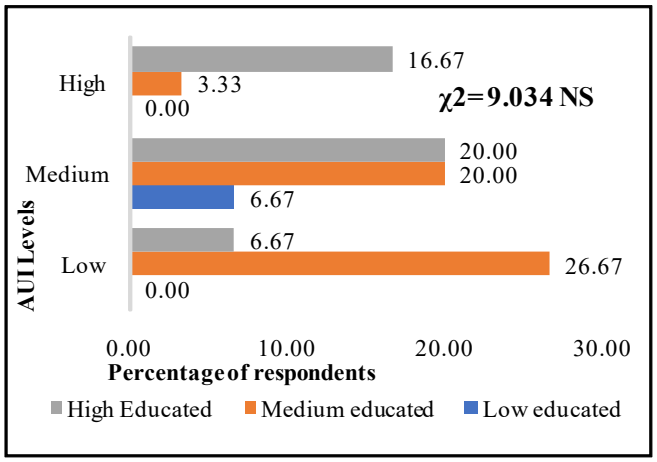

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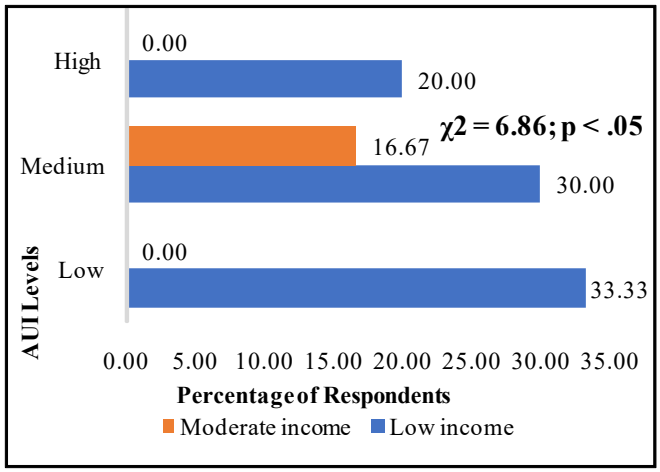

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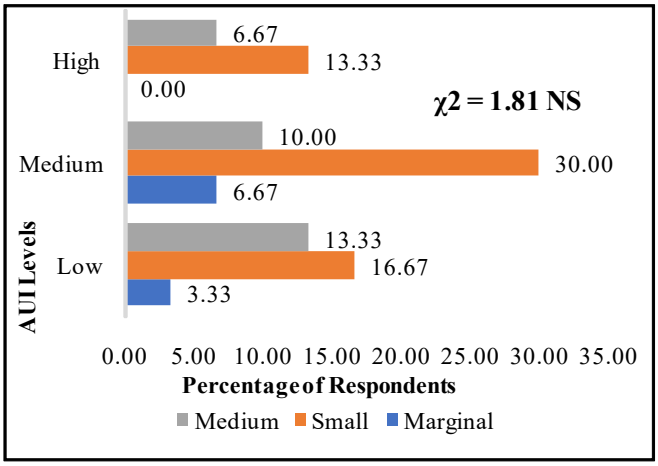

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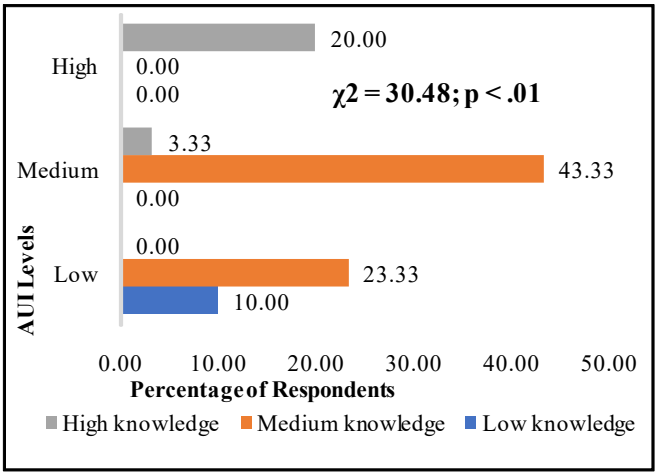

[E]

[A] Age vs. Access-Usage

[B] Education vs. Access-Usage

[C] Income vs. Access-Usage

[D] Land holding vs. Access-Usage

[E] Working knowledge on ICT vs. Access-Usage

Figure 1: Association between Socio-personal characters and Access & Usage of ICT

Figure 1, illustrated about association between Socio-personal characters and Access & Usage of ICT i.e., young aged farmers had higher access & usage of ICT tools [A]. The probable reason might be that due to social media addiction fascinate young age group of respondents to use ICT tools especially mobile phone and computer than old age group. Again, high educated group had higher access & usage of ICT [B] as because their formal education might be boost their confidence to access and usage of these technology oriented tools in their farming. And, the probable reason for low income group [C] having higher access & usage of ICT might be that such type of respondents desperate to improve their farming pattern, higher yield and better economic condition, so they believed to experiment with ICT tools to get better result. Farmers with small land holding had higher access & usage of ICT as because such types of farmer group are cosmopolites in nature and having higher social participation than other groups which might be influence their higher access and usage. Farmers with high working knowledge had higher access & usage of ICT as they had aware of how-to-do and also aware about benefits of ICTs in farming.

Data from Table 3 illustrated the benefits extracted by the farmers by using ICT tools i.e., most of the farmers (50%) high in using ICT tools or communication and 57 per cent for general information. To know about the new information and improved skill half of the respondents (50%) were using this technology, followed by 43 per cent for marketing of benefit. The benefits extracted to know the higher price of produce, health information and increase in production were very low and most of the farmers do not know that by using ICT tools the benefits can get by sitting in the home. The farmers should know about the benefits by improving the knowledge and skill of using ICT tools.

Table 3: Benefits extracted from ICT use (Expressed in percentage) (N=100)

Type of benefit	High	Moderate	Low	Total
Communication	50.00	40.00	10.00	100.00
Marketing	7.00	43.00	27.00	77.00
Higher Price of produce	0.00	13.00	10.00	23.00
New information	37.00	50.00	13.00	100.00
General information	56.00	37.00	07.00	100.00
Health information	0.00	0.00	30.00	30.00
Increased production	0.00	27.00	43.00	70.00
Improved skill	0.00	50.00	20.00	70.00

Pearson Chi-square test was used to assess the association between Row and Column variable, viz. association between Access-usage level and Benefit extracted (Table 4). It is seen that the relationship is significant at p=.001 level (Fisher Exact Test significance was also determined due to lower expected frequency in many cells where, p<.001). So, access and usage on ICT tools have significance to influence on benefit extraction, which indicated that if we could able to increase the awareness level than access and usage of ICT tools possibly increase.

Table 4: Relationship between Access-Usage Index (AUI) and Benefit extracted (Expressed in percentage)

Benefit extracted	Access-Usage Index (AUI)		
	Low	Medium	High
Low	10.00	0.00	0.00
Medium	17.00	43.00	17.00
High	0.00	0.00	13.00
Statistical implication	Pearson Chi-Square = 19.24 (p = .001) [Fisher Exact Test significance = .000]		

The respondents of the study areas had scope to use ICT tools for improvement of agriculture for doubling their income. But they were facing constraints to use these in full swing. From the Table 5, it was found that RBQ values for the perceived constraints ranged from 0.33 to 0.80. Low internet access found to be the most extreme constraints with an RBQ value of 0.80, followed by lack of training and skill development (0.70) and poor connectivity of network (0.69) and other ICT tools. Other constraints were inadequate infrastructural facilities (RBQ=0.60), lack of access to computers (RBQ=0.59), lack of knowledge (RBQ=0.45), high cost for service provisioning (RBQ=0.35), and literacy and language

Table 5: Constraints faced in accessing ICT

Constraints in using ICT tools	RBQ score	Rank
Inadequate infrastructural facilities (IIF)	0.60	IV
Lack of access to computers (LAC)	0.59	V
Low internet access (LIA)	0.80	I
Illiteracy and Language Problem (LLP)	0.33	VIII
Poor connectivity of network (PCN)	0.69	III
Lack of knowledge (LoK)	0.45	VI
Lack of training and skill development facilities (LTS)	0.70	II
High cost for service provisioning (HCS)	0.35	VII

problem (RBQ=0.33) in descending order according to RBQ values. Most of the ICTs require uninterrupted internet connectivity but people from rural areas were having low access due to poor connectivity and there were no systematic effort introduced to aware or train them about benefits and usage of GPS/Video calling and complex ICT tools to improve their farming.

CONCLUSION

This study indicated that farmers from the study mostly from middle age group with middle level of education, small land holding, middle class level of annual income; moderate level of working knowledge and medium level of access-usage index. Table 2 presents ownership and access of ICT tools and the access usage index of the ICT tools. All farmers had own their television; but user of radio, web camera and computer were less. Most of the farmers use mobile phone, internet, video calling, and social media for production purpose. The access usage index (AUI) showed that ICT tools utilized mostly for social media and video calling but less for computer, global positioning system, web camera and radio. The benefits extracted by the farmers by using ICT tools mostly for communication and for general information but very low to get higher price of produce with significance level of influence on benefit extraction. The respondents of the study were facing constraints to use ICT tools mostly due low internet access, lack of training and skill development and poor connectivity of network.

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Agri-entrepreneurial Innovations for Rural Prosperity and Sustainable Development

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ABSTRACT

Innovation is the key to human development. Innovations in the domain of agriculture is inevitable for an agrarian country like India, where agriculture is a primary mean of livelihoods for more than 70 per cent population. Further, recent Agriculture Census report (2015-16) of India indicates that prevailing traditional farming is no more sufficient and profitable venture for sustainable rural development and there is compelling need for innovative solutions to generate effective employment and self-employment opportunities to engage the rural youth in their own surroundings and create sustainable means to increase the income of the rural household. In this background, Agri-entrepreneurial innovations may serve as viable, sustainable solution to meet the pressing needs and aspirations of rural population and enable them to earn more and live a decent life. The aim of this review paper is to explore the various dimensions of the subject, which includes: concept of innovation and agri-entrepreneurship, attributes of an agri-entrepreneur, challenges of the agri-entrepreneurial sector, opportunities and support system available for agripreneurs.

Keywords: Agri-entrepreneurial, Gross domestic products, Innovations, Rural prosperity, Sustainable development

INTRODUCTION

India is agriculture based economy with more than 60 per cent population of country is dependent on agriculture. Amongst rural population more than 70 per cent of rural household depend on agriculture as their primary means of livelihood. On the other hand, agriculture along with fisheries and forestry sector accounts only for nearly 17 per cent of Gross Domestic Products (GDP) of the country (UNDP report, 2018) where more than 50 per cent of the total workforce of the country is employed in agriculture sector (India Economic Survey, 2018). The facts revealed by the latest Agriculture Census report (2015-16) are of high concern for the nation where agriculture is the crucial factor to contribute towards economy growth. The report estimated that 86.21 per cent of total farmers of India are small and marginal farmers (means with less than two hectares of land per family) and this percentage is higher as compared to earlier five-year block. The average land holding also decreased to 1.08 hectare in 2015-2016 as compared to 1.15 hectare in 2010-11, which is further declining steadily, with the increase in population. The total area under farming, fell from 159.6 million hectares (in 2010-11) to 157.14 million hectares in 2015-16. Increasing pressure of population and decreasing per capita land size has created serious concerns to rural people to earn well and lead a descent standard of living in limited resources. The country ranks 139th in per capita GDP (nominal) with $2,134 and 122nd in per capita GDP (PPP) with $7,783 as of 2018. Further, India ranks 130 in the latest Human Development Index (HDI) with HDI value of 0.640, which put the country in the medium human development category (UNDP, 2018).

Indian rural youth do not find any attraction in agriculture especially due to ever decreasing per capita vital natural resources, lack of infrastructure, limited facilities for health and education, and labour intensive age old agricultural practices. They perceived the situation as threat to their dreams and aspirations and felt compelled to move out of their villages and migrate to urban areas to find suitable livelihood for them and to support family. This has triggered a chain reaction to further imbalance the employment opportunities in urban areas also and unemployment emerged as a big issue both in rural as well as urban areas. All these factors contribute to high incidence of unemployment amongst rural youth and low level of income generation for livelihoods. This state of insecure future coupled with financial crisis and unhappy state of mind is further detrimental for the sustainable development of a nation.

Well known phrase **"Necessity is mother of invention"** implies here after analyzing the facts discussed above. It necessitates to explore viable, innovative solutions to meet the needs, aspirations and prosperity of rural India. Further, this challenging scenario establishes the fact that agri-entrepreneurial innovations are needed on a large scale. Various studies concluded that Agripreneurs play an imperative and decisive role in the agricultural value chain. Contributions made by them with the help of their innovative value addition processes are indispensable to increase the agricultural GDP. Also, agri-entrepreneurs actively engage in agriculture, use current technology to increase agricultural productivity, and adopt new systems of operations (Singh, 2014). In addition, agri-entrepreneurial innovations not only serve as the seed-bed for increasing living standards of rural India but also have great potential to strengthen the national economy and making country competitive at global level and feeding second largest population of the world.

Innovation, Entrepreneurship and Agri-entrepreneurship

Schumpeter (1934) viewed "the entrepreneurial function" and the "entrepreneurs" as keys to innovation and long-run economic change. He defined "innovation," as the process through which new ideas are generated and put into commercial practice. He emphasized on "New combinations" of new or existing knowledge, resources, equipment, and other factors. He also stated that innovation is different from invention and explained innovation as a specific social activity, with a commercial purpose within the economic sphere, while inventions are without commercial purpose and can be carried out everywhere. Peter Drucker (1985) in his book entitled "Innovation and Entrepreneurship" conceptualized "innovation" as: "Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service. Entrepreneurs need to search purposefully for the sources of innovation, the changes and their symptoms that indicate opportunities for successful innovation, and they need to know and apply the principles of successful innovation."

Dollinger (2003) defines entrepreneurship in agriculture as the creation of innovative economic organization for the purpose of growth or gain under conditions of risk and uncertainty in agriculture. Unlike general entrepreneurs, farming families are less driven by ideas of growth and profit maximization. Higher priority is given to survival, preserving family heritage, autonomy, rural lifestyle, and passing through a healthy farm on to the next generation (Jervell, 2011). Entrepreneurship is a viable strategy for upward mobility, as a 1% increase in entrepreneurial activities decreases the poverty rate by 2% (Singh, 2014). Also, entrepreneurship is a means of identifying value-added activities that increase efficiency and employment opportunities. Food and Agriculture Organisation of the United Nations (2014) in its report on sustainable development goals for zero hunger conceptualized agriculture innovation as context specific process which contribute to nutrition and food security, sustainable natural resource management and economic development by increasing resilience to shocks, effectiveness environmental sustainability, and competitiveness. Sarabu (2016) defined the concept as "Rural Entrepreneurship as entrepreneurship emerging at village level which can take place in a variety of fields of endeavor such as business, industry, agriculture and acts as a potent factor for economic development". Verma (2018) described Agri-entrepreneurship as the entrepreneurial process taken up in agriculture or the allied sectors by adopting new methods, processes, techniques for better output and economic earnings.

Agri-entrepreneurial Opportunities

Entrepreneurial opportunities differ from normal possibilities to optimize the efficiency of existing products in the sense that the former involves new means-ends relationships (Shane and Venkataraman, 2000). Opportunities in agriculture and allied sectors can be identified at different phases of agriculture process like Input stage, Farming stage, Value chain, Output processing and marketing stage and related services. There are very promising opportunities for entrepreneurial processes in the areas like organic farming, bio-pesticides, bio-fertilizers, vermi-composting, testing and amending soil, seed development etc. Besides, agri-enterprises like fisheries, sericulture, poultry, animal feed, mushroom, apiculture, machinery& farm equipments, Agro-tourism, Agri-clinic have enormous potential. After LPG (liberalization, privatization and globalization) reforms in 1991, Indian economy got affected by world economy and became free market economy, which instilled a new confidence in farmers and paved the way for enterprise rising trends in agriculture sector, which increased individual needs for

taking responsibility for running their own businesses (Alex, 2011). Government of India introduced many schemes to attract farmers and budding agriculture graduates to start their own enterprises. Agri-Clinics and Agri-Business Centre (ACABC) scheme was such a scheme, announced in 2002 which was propounded to provide motivation to agricultural graduates to take up their own entrepreneurial ventures.

Agri-entrepreneurial Behaviour

Studies have shown that socio-psychological factors like achievement motivation (Fraser, 1961), innovativeness (Kilby, 1971), etc. have a great bearing on agripreneurial behavior of farmers. Nandapurkar (1982) stated that entrepreneurial behaviour consists of different components like farm decision making, innovativeness, risk taking ability, achievement motivation, information seeking, knowledge of the farming, assistance of management service, co-ordination of farm activities, cosmo-politeness and leadership ability. Narayanaswamy (1996) described entrepreneurial behaviour as it is not necessarily doing new things but also doing things in a new way that has been already done. Nomesh Kumar and Narayanaswamy (2000) defined entrepreneurial behaviour as a combination of seven components viz., innovativeness, decision making ability, achievement motivation, information seeking ability, risk taking ability, coordinating ability and leadership ability. Narmatha *et al.* (2002) stated that innovativeness, achievement motivation and risk orientation were the most important components. Vijay Kumar *et al.* (2003) operationalised entrepreneurial behaviour as the cumulative outcome of information seeking behaviour, decision making, leadership ability, risk taking ability, innovativeness, achievement motivation and market orientation of respondent farmers. Hajong (2014) concluded that aspiration, pro-activeness and information processing behavior were the important predictors of agri-entrepreneurship behavior. Besides education, age, resource endowment, technological options, network and linkages, farmers' inner potential and drive are also critical.

Inhibiting Factors in Agri-entrepreneurship Development

What inhibits farmers to take up agri-entrepreneurial ventures, has been an important area of investigation. Seemaprakalpa (2014) in her study stated that agri-entrepreneurs lack awareness about various national and state level schemes and agencies which affected their entrepreneurial development. Beniwal (2017) concluded that district level institutions have a big role to play in supporting farmer innovations by providing technical, financial and other related support and private agencies should come up in commercialization of innovation. Verma (2018) expressed that rural entrepreneurs are suffering with various problems like fear of risk, lack of finance, illiteracy, lack of education and awareness and competition from the urban entrepreneurs.

Organisational Support for Agri-entrepreneurs

Uplaonkar and Biradar (2015) reported various government schemes for support to agri-entrepreneur like: Marketing Assistance Scheme, The National Institute of Agricultural Extension Management (MANAGE), Agri-clinics, and Agri-Business centers, NABARD for financial support for agri-business, small–scale and cottage industries and agro-based industries; Panchayat-mandi (Agri-Mandi), State Agricultural marketing banks (SAMB); The national council for state marketing board (NCOSAMB). State Trading Corporation (STC). Government of India launched a wide spectrum of schemes to boost-up innovations especially in agriculture and allied field and provide all types of support system, like technical, financial, marketing, training and extension to entrepreneurs and entrepreneurial processes.

Global Entrepreneurship Summit (2017) held in Hyderabad during 28-30 November, deliberated in detail on about fifty schemes initiated by government like:, Start-up India, Atal Innovation Mission (AIM), Atal Tinkering Labs (ATL) across India, Atal Incubation Centres, Stand-up India, Skill India, Pradhan Mantri Kaushal Vikas Yojna, Support to Training and Employment Programme for Women (STEP), Mahila E-Haat, National Rural Livelihood Mission (NRLM), INSPIRE programme, ARYA scheme, Gramin Bhandaran Yojana, Agriculture Marketing scheme, National Project on Organic Farming (NPOF), National Bamboo Mission, National Horticulture Mission, e-National Agriculture Market, Soil Health Card Scheme, Establishment of the Agri-clinics and Agri-business Centres (ACABC) etc.

Verma (2018) listed various Government Schemes for Rural Entrepreneurship in India: Entrepreneurship Development Institution Scheme, Rajiv Gandhi Udyami Mitra Yojana (RGUMY), Performance and Credit Rating

Scheme (Implemented through National Small Industries Corporation (NSIC), Product Development, Design Intervention and Packaging (PRODIP), Provision of Urban Amenities to Rural Areas (PURA), Khadi Karigar Janashree Bima Yojana for Khadi Artisans.

Impact of Agri-entrepreneurial Innovations on Rural Sustainable Development

Now the government priority is to double the income of the farmers by 2022. Many agri-preneur farmers have enhanced their income manifold. Some of the successful cases are given below.

Shri Samar Singh is a unique farmer from Kanpur district of Uttar Pradesh. He had always been a driven man, eager to experiment and strive for improvements that he could make on his 2 ha farm. He started marigold cultivation, when all surrounding farmers were growing wheat and paddy. During get-togethers, villagers used to advise him to give up flowers and take up routine crops. Even though it was a real struggle to make a profit from marketing of this crop but he never lost the hope. He used to sell the flowers in nearby local markets and gets meager profit out of it. Initially, he extracted little quantity of oil from plants of marigold which is of no use after harvesting of marigold during November month. Then he obtained 600 g oil out of 10 q plant of marigold. He visited the nearby KVK and consulted experts for verifying the extracted oil for testing its purity. After examination, the oil was found pure with no side effects, soon a team of scientists visited his field and after assessing his farm size, the scientists suggested to establish one-ton capacity of two processing units.

With the help of distillation unit, he extracted 25 kg oil in the first season and later he observed 50 kg marigold oil per year with additional yield of flowers. In the initial years, the major impediment was marketing of oil and he even distributed free samples in the neighbouring areas to make the people aware of medicinal value of oil. Gradually, he established linkages with retail outlets and also involved in direct marketing of oil. The oil was being sold at Rs 2500 per kg. Now he was earning a net profit of Rs 1.25 lakh per year from the extracted oil and additional yield of flowers worth Rs 2 lakh from 1 ha area. The results were phenomenal and he became an icon in his area. His income more than doubled and there was no looking back for Samar Singh. The success allowed him to take the initiative of utilizing the remaining processed material after oil extraction for Havan Samagri, mushroom production, organic manures and mulching material to other crops for eco-friendly environment. He feels that there was a need to tackle the elements of nature in a more productive and environmental friendly way.

Shri Ravinder Togodia is an excellent bee keeper and honey processor from Chulkana village of Panipat district in Haryana. He started his journey as farmer ion his land, which he got as ancestral property. His ancestors were sugarcane growers and he was also interested in it, because of its profitability. But due to some government policies his farming went into a big loss and he could not able to repay the loan taken for the sugarcane cultivation. He was in search of a job in different sectors than agriculture, but he could not find it. He started his life as beekeeper with few boxes and collected honey. But bees are migrating in different season and he could not able to handle all these things by himself. That time he came to understand the importance of group farming in beekeeping. By some years he could able to establish a group of well-trained farmers in bee keeping. Now 22 beekeepers are associated with him. He himself having 1500 bee boxes and group all together is having 1500 bee boxes. On an average 50-60 kilogram of honey he is getting from one box. He managed the problem of migration with well-trained members in his group. While migration stage they used to transport the bee hives from Haryana to Rajasthan. When the production increased and they find it was difficult to get good profit while selling to some processors. So he started processing plant of honey in his own place. All the group members were doing this processing and making good quality honey. They started outlet for the honey and selling it in brand name 'Sudh Sahad'. He also started processing of other important produce like pollen, polaris, bee wax and bee venom.

Smt. Krishna Yadav is a courageous and determined women entrepreneur who has has well established food processing unit in Nazafgarh, Delhi. She faced many problems and passed through many hail storms before reaching to this stage. Her story of success started from her migration along with her three children to Delhi in search of, a way of living; because of loss of her husband's job in 1996. Since they were not having any means of living and her husband was psychologically shattered, family whole together was transient through disheartening times.

But it was her bold and courageous decision which enabled the family to face hardships and migrate to Delhi with Rs. 500/- borrowed from friends. After reaching Delhi, they searched for a job and got an employment as caretaker in one farm (Tyagi Farms) in village Rewlala Khanpur. These farms were owned by Commdt. B.S. Tyagi. In that an orchard of *ber* and *karonda* was developed by him under guidance of scientists of Krishi Vigyan Kendra, Ujwa. This farm was not profitable because of low price and unsecured markets. Since it was on premises of KVK-Ujwa, they went to get some remedy. Home Scientist of KVK suggested value addition and processing activities as a probable solution to it. From that Smt. Yadav got an idea of entrepreneurship. Smt. Krishna Yadav underwent a training of three months' duration in food processing techniques in KVK, Ujwa in 2001. She prepared some *karonda* candy on a trial basis for few kg, just after training. The first value added products prepared for selling outside, after training were 100 kg *karonda* pickle and five kg chilly pickle with an initial investment of Rs. 3000. Her husband sold it out at roadside and fetched a net profit of Rs. 5250/- after sale. This success gave them courage to go ahead and produce diversified products and establishing a full-fledged value addition enterprise. In a short span of eleven years, she has expanded her enterprise tremendously with 152 different types of product (FPO approved) like pickles, *chutneys*, *murabbas*, candies, jam, jelly, aloe-vera gel, *Pusa* fruit drinks of *jamun*, litchi, mango, strawberry etc. At present, approximately 1500 quintals of fruits and vegetables are processed generating an annual turnover of more than Rs. 3 crores from the factory and providing employment to others. In her enterprise, presently 60 women are employed on regular basis and about 150 women are engaged on seasonal basis for cutting, grinding and mixing of processing of fruits. She is creating livelihood foe others also. She has provided on the job training to many young women for developing skills of food processing.

Shri Malook Singh is a progressive farmer and seed producer from Rasoolpur in Uttar Pradesh. He is known as 'Pea Man' of northern India, because of this enormous contribution in vegetable pea seed production. He learnt about the all aspects of soil, seeds, fertilizers, and interacted with experienced farmers and agricultural scientists. The most important and interesting thing that he noticed and realized through all over his study is that, he could further improve his harvest by sowing the different seeds. The most persuading information he got when he went to Delhi and met a senior agricultural scientist from the Indian Agricultural Research Institute (IARI) Pusa, Delhi. This scientist gave him seeds of the famous vegetable pea variety Arkel. He has started his agriculture occupation as seed producer with seed production of Arkel variety of pea under the guidance of IARI scientists. Today he is well known seed producer of this variety and other improved pea varieties.

He did not sit idle after the achievement of good seed production in pea. He started the seed production of other crops also and decided that he must share his growth and knowledge with other farmers. He has promoted high yielding varieties of pea, wheat, paddy, gram, lentil and vegetable among the farmers in his own districts and adjoining districts. Now he has set-up modern seed processing plant in his village. This processing plant is giving employment opportunities for many of the resources poor villagers. He has also started processing seed of palak, wheat, lentil, green gram, paddy and cowpea and marketing directly in various parts of the country. Organic products and seed is getting more acceptances in present day market and he is keeping this thing in mind he has started the cultivation of organic rice, wheat, pulses & vegetables and its seed production even. He has established '*Beej* India Farmers Producer Company" for direct marketing of farm produce.

CONCLUSION

Agri-entrepreneurial innovations have the potential to provide sustainable, viable solutions to the challenges, Indian agriculture and allied sector is facing in rural sector. The agri-entrepreneurial initiatives have multidimensional effects by playing a vital role to combat unemployment, generate more income for rural livelihoods, develop rural economy and bring prosperity and happiness to the people of the country. Role of various schemes and institutions is important in supporting agri-entrepreneurship by providing desired skills, finance, simple and transparent procedures for loans, technology, appropriate infrastructure, and marketing avenues including e-market platforms. Sayyer (2012) recommended that easy access to credits, granting low-interest loans to the students and graduates of agriculture field are of priority in government policies in order to accelerate and develop entrepreneurship in agriculture sector.

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