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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 1750 Life Members. The recognition of the Society in the efforts for strengthening the forum for scientific communication is growing among the related professionals and concerned agricultural stakeholders rapidly. The Society works on following objectives-

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

ABOUT THE JOURNAL

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

The aim and scope of the journal are:

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

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Editorial

The notion of a sustainable and circular bioeconomy holds enormous potential in transforming food systems towards greater resilience, efficiency, and environmental stewardship. By leveraging renewable biological resources, such as agricultural residues, food waste, and bio-based materials, a circular bioeconomy seeks to minimize waste, optimize resource use, and promote regenerative practices. This paradigm shift not only addresses pressing environmental challenges, such as climate change and biodiversity loss, but also fosters economic growth and social inclusivity. Through innovative approaches like bioenergy production from organic waste, sustainable agriculture practices, and the development of biodegradable packaging, the circular bioeconomy offers pathways to mitigate greenhouse gas emissions, conserve natural resources, and enhance food security. Moreover, by prioritizing the principles of sustainability and circularity, this transformative framework encourages collaboration across sectors and stakeholders, promoting a holistic approach to food production, distribution, and consumption. Embracing a sustainable and circular bioeconomy represents a vital step towards building resilient and equitable food systems that can meet the needs of present and future generations while safeguarding the health of the planet Society for Community Mobilization for Sustainable Development (MOBILIZATION Society) plays a crucial role in addressing current issues in agriculture by promoting dialogue, research, and collaboration to drive positive change and sustainable development through various initiatives aimed at fostering innovation, sustainability, and collaboration within the agricultural sector. In light of this, the organization has unveiled its 11th National Seminar titled "Transformative Agriculture and Sustainable Development: Rethinking Agriculture for a Changing World," in partnership with Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, scheduled from March 5th to 7th, 2024 at MPUAT, Udaipur. This seminar aims to delve into the intricacies of agricultural transformation amidst evolving global dynamics.

I am pleased to announce the publication of the newest edition of the MOBILIZATION Journal to our esteemed readers. The content of this issue presents a diverse array of research topics spanning agricultural, socioeconomic, and technological spheres, reflecting the multifaceted challenges and opportunities faced by stakeholders in contemporary agrarian society. From understanding the constraints encountered by members of Farmer Producer Organizations (FPOs) in Telangana and Andhra Pradesh to exploring the impact of the pandemic on agricultural activities in Haryana, each study offers valuable insights into pertinent issues affecting different regions and sectors. Additionally, the construction and validation of a farmer's attitude scale towards social networking sheds light on the evolving dynamics of farmer communication and engagement. Studies on women empowerment in self-help groups, financial inclusion among agricultural households, and the impact of occupational stress on working women underscore the importance of addressing gender disparities and promoting inclusive development. Furthermore, research on agricultural technology management, digital agricultural practices, and the significance of structured peer support systems highlights the transformative potential of innovation and collaboration in enhancing livelihoods and well-being. This issue provides a comprehensive overview of the current landscape of agricultural research and socio-economic analysis, inviting readers to explore and engage with the complexities of present-day issues in agriculture and rural development.

My sincere appreciation goes to the committed editorial team, devoted readers, and distinguished contributors who have all helped make our journal a success. Your steadfast dedication, knowledge, and efforts have been crucial in determining the calibre and relevance of our publication. I greatly appreciate the editorial team's unceasing efforts in maintaining the journal's high standards and seamless operation. I am grateful to our esteemed readers for their unwavering support and engagement with our content, which fuels our objective to advance scholarly conversation and the dissemination of knowledge. Finally, I would like to express my gratitude to our distinguished authors whose perceptive analysis, creative solutions, and academic contributions have enhanced our publication and expanded the frontiers of our disciplines. Your dedication and enthusiasm are truly commendable, and we are grateful for your invaluable contributions. Thank you all for your unwavering commitment to excellence, and we look forward to continued collaboration and success in the future.

> J.P. Sharma Chief Editor

Review Article

Impact of Agricultural Technology Management Agency (ATMA) on Livelihood of Farm Women: A Review

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ABSTRACT

Indian farm women perform triple roles and grow 60 to 80 per cent of food crops. They also face a number of issues in agriculture. Therefore, government has formulated and implemented many women welfare schemes to address those issues. But, in real sense, most of the schemes do not reach at women's door. Neither the women are aware of the schemes nor they availed any kind of benefits out of it. The study made on impact of ATMA on livelihood of rural women reveals that, all levels of stakeholders involved in ATMA system are not gender sensitive who unknowingly bypass the women in the process. Therefore, societal stereotypes towards women has to be changed through gender sensitization programmes and participatory action plan based on women needs and preferences.

Keywords: Farm women, Livelihood, Agricultural technology management agency, Impact

INTRODUCTION

As per Pingali et al. (2019), the ratio of women to men working in agricultural sector has increased over the time and made greater amount of contribution to GDP per capita. They are the momentous demographic group for sustainable food system (FAO, 2011). Some literature suggests that men in Africa work fewer hours than women, across all activities (Blackden and Wodon, 2006). The Economic Survey 2017-18, pointed at the 'feminisation' of the agriculture sector, noting that with growing rural to urban migration by men, an increasing number of women are assuming multiple roles as cultivators, entrepreneurs, and labourers. Rural women are responsible for the integrated management and use of diverse natural resources to meet the daily household needs (FAO, 2011). The farm women play triple roles like productive, reproductive & community management. In developing countries, between 60 and 80 per cent of food crops grow from seeds that are planted by a woman's hand (Gupta, 2009). But, the planners and policy makers always unintentionally ignored women while formulating developmental schemes and policies without realizing their contributions. As a result most of the schemes were

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unable to reach at women's door and failed to address their issues. But, the situation is changing over the period and the policy makers and planners quite becoming more sensitive towards developing and implementing women welfare schemes to address their issues. Here, the question arises that how effective are the schemes in empowering farm women? Whether they are aware of it? Whether they availed any kind of benefits from the schemes? Nawaz (2012) observed lack of awareness among women is a major obstacle for development of rural women entrepreneurship in Bangladesh. Harinarayan (1991) has revealed rural women were not aware of the programmes such as DWACRA, IRDP, TRYSEM, etc. Keeping this in view, a review was made to assess the impact of ATMA on livelihood of farm women.

ATMA scheme

Agricultural Technology Management Agency (ATMA) is a component of a World Bank-funded centrally sponsored scheme under Ministry of Agriculture, Government of India with Bottom – Up Approach. It is the new institutional arrangement for technology dissemination under National Agricultural Technology



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Project (NATP). Extension reforms were pilot tested from November, 1998 to June, 2005 in seven States in the country namely, Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand, Odisha, Maharashtra and Punjab through four project districts in each state (total 28). This model was pilot-tested through the Innovations for Technology Dissemination (ITD) component of a World Bank-funded, NATP that became effective in 1998 and concluded in June 2005 (World Bank, 2005a). It functions as a registered society at district level (Table 1).

Table 1: Details of piloting states and districts

Piloting States	Piloting Districts
Andhra Pradesh	Kurnool, Prakasham, Adilabad, Chittoor
Bihar	Muzaffarpur, Madhubani, Munger, Rural Patna
Himachal Pradesh	Shimla, Hamirpur, Kangra, Bilaspur
Maharashtra	Ahmednagar, Amaravati, Aurangabad, Ratnagiri
Odisha	Khordha, Koraput, Sambalpur, Ganjam
Punjab	Gurdaspur, Jalandhar, Sangrur, Faridkot
Jharkhand	Chaibasa, Dumka, Palamau, Jamtara

(Source: 07 December, 2021, PIB Delhi)

The successful pilot test served as a starting point to initiate the scheme "Support to State Extension Programmes for Extension Reforms" in the year 2005-06. The scheme was approved on 29th March, 2005 and now implemented in 691 districts of 28 states & 5 UTs in the country. The scheme promotes decentralized farmer-friendly extension system in the country. It supports state government to make available of latest agricultural technologies to farmers through different extension activities viz; farmers training, demonstrations, exposure visits, kisan mela, mobilization of farmers groups and organizing farm schools etc. The scheme was stretched and strengthened meticulously in the year 2010 and 2014 to integrate with Krishi Vigyan Kendras (KVKs), State Agriculture Universities (SAUs) and National Agriculture Research System (NARS) to strengthen district level planning.

Aims and objectives of ATMA scheme: It aims to support state extension programmes by introducing latest agricultural technologies through integration of research and extension activities. It aims to address the

key constraints faced by extension system in the country. ATMA is to decentralize decision-making to the district level, to increase farmer input into programme planning and resource allocation at the block level and to increase programme coordination and integration. It works with convergence mode with all the line departments, research organizations, NGOs and agencies associated with agricultural development in the district to provide an effective mechanism.

Features of ATMA scheme

- Convergence/ integrating stakeholders
- Integrating extension activities
- Focusing on small farmers including women
- Establishing rural employment
- Mobilizing farmers groups to markets
- Strengthening farmers income
- Extension from grass root level input to top
- In-service training to increase staff competence
- Validation and refining technologies through research units in the district
- Developing new Public-Private partnerships
- Formation and strengthening of farmer's interest group
- Farmer driven extension delivery
- Orientation for group approach
- location specific and need based technology
- Ample emphasis on gender concerns
- Farmer centric programmes in planning, execution and implementation

Funding: The scheme is supported by the central government. The funding pattern is 90 per cent by the central government while 10 per cent by the state government.

Institutional mechanism: ATMA is headed by the Project Director (PD) under the NATP, and reported directly to the GB as Member Secretary. The PD helps coordinate and integrate all agricultural research and extension activities carried out within the district (Singh *et al.*, 2005a and Singh, 2006).

State level

- The State Level Sanctioning Committee (SLSC) set up under Rashtriya Krishi Vikas Yojana (RKVY) to approve State Extension Work Plan (SEWP) which will form a part of the State Agriculture Plan (SAP).
- The SLSC for day-to-day coordination and management of the scheme activities within the state.
- The State Nodal Cell (SNC), consisting of State Nodal Officer, State Coordinator, State Gender Coordinator and supporting staff to ensure timely receipt of District Agriculture Action Plans (DAAPs), formulation of State Extension Work Plan (SEWP), incorporating farmers' feedback obtained through State Farmer Advisory Committee (SFAC).
- The SNC then convey the approval and monitor implementation of these work plans by State Agricultural Management & Extension Training Institutes (SAMETIs) and ATMAs. The SAMETIs to execute an annual training calendar for capacity building of the extension functionaries in the state.

District level

- ATMA is an autonomous institution set up at district level to ensure delivery of extension services to farmers.
- ATMA Governing Board is the apex body of ATMA to provide overall policy direction.
- ATMA Management Committee is the executive body looking after implementation of the scheme.
- District Farmers Advisory Committee is a body to provide farmers' feedback for district level planning and implementation.
- With ATMA staff, it will continue to be the district level Nodal Agency responsible for overall management of agriculture extension system within the district, including preparation of Strategic Research and Extension Plan (SREP).

Block level

• The block ATMA cell consisting of Block Technology Team (BTT) and Block Farmers' Advisory Committee (BFAC) will prepare the Block Action Plan (BAP) and provide necessary extension support within the block in its execution.

Village level

- The Farmers Friend (FF) will serve as a vital link between extension system and farmers at village level (one for every two villages).
- Agri-Entrepreneurs, Diploma Holders in Agricultural Extension Services for Input dealers (DAESI), Input Dealers and Extension Workers in Non-Governmental Sector will supplement the efforts of extension functionaries.
- Commodity Interest Groups (CIGs), Farmer Interest Groups (FIGs) and Food Security Groups (FSGs) will serve as a Nodal Point for information & technology dissemination among its members.
- Farm Schools will serve as a mechanism for Farmer-to-Farmer Extension at every block.

Women focus in ATMA functioning

- Resource allocation for women activities: 30%
- Women beneficiaries: 30 per cent
- Women farmers and female extension functionaries for decision making in Governing Board, Management Committee: 30 per cent reservation
- Women representation in FAC at state, district and block level
- More women as 'Farmers Friends' below block level for 'Farmer-to-Farmer extension'
- Farm Women's Food and Nutritional Security Groups at least 2 per block (Rs.10,000/-)
- Provision of credit for farm women
- Gender Coordinator at state level Nodal Cell
- One of the Secretaries from Inter Departmental Working Group (IDWG) should be from WCD Department.
- Encouragement for more Women Farmers Organizations.

The Government of India under "Support to State Extension Programs for Extension Reforms" made various provisions such as (i) 30 per cent of the fund exclusively for women farmers and women extension functionaries (ii) 30 per cent of women farmer representatives on the Governing Board (GB) and Block Farmer Advisory Committee (BFAC) of Agricultural Technology Management Agency (ATMA) etc. to address gender concerns and promote equity in agricultural extension (ATMA Guidelines, 2014). The detailed information about the benefitted farmers in the areas of exposure visit, training, demonstration, kisan mela and farm schools under ATMA scheme is reflected in the Table 2.

Overall impact of ATMA

• Average farm income in project districts increased 24%, in contrast with only 5% in non-project districts (Tyagi and Verma, 2004).

S.No.	States/Uts	Exposure visit	Training	Demonstration	Kisan mela	Farm schools	Total
1	Andhra Pradesh	2094	79905	1655	1113	0	84767
2	Bihar	26643	52436	0	5096	9700	93875
3	Chhattisgarh	448	901	7815	1280	225	10669
4	Goa	312	3775	542	0	193	4822
5	Gujarat	10568	65906	32156	20902	11500	141032
6	Haryana	9450	12360	1625	3450	2500	29385
7	Himachal Pradesh	95	4320	4365	800	1200	10780
8	J & K	0	9700	1890	3550	750	15890
9	Jharkhand	1390	1290	2222	12712	8150	25764
10	Karnataka	3676	25709	2332	2821	6450	40988
11	Kerala	0	1047	406	0	75	1528
12	Maharashtra	2936	44276	36969	27680	48025	159886
13	Madhya Pradesh	6050	2138	5955	0	23750	37893
14	Odisha	0	0	9905	768	0	10673
15	Punjab	933	15587	5091	5356	2900	29867
16	Rajasthan	1779	20198	40578	29041	15825	107421
17	Telangana	130	4875	276	754	25	6060
18	Tamil Nadu	32450	201320	1258	19625	5325	259978
19	Uttar Pradesh	7880	36388	13414	111016	48500	217198
20	Uttarakhand	1154	2126	2820	1994	4250	12344
21	West Bengal	440	16718	13952	3550	11300	45960
22	Assam	0	9076	0	846	0	9922
23	Arunachal Pradesh	0	500	0	0	500	1000
24	Manipur	1020	1650	900	0	120	3690
25	Meghalaya	187	882	119	75	50	1313
26	Mizoram	0	20	52	0	0	72
27	Nagaland	0	74	370	74	0	518
28	Tripura	0	2300	165	0	275	2740
29	Sikkim	0	0	0	0	0	0
30	Delhi	0	200	0	0	0	200
31	Puducherry	50	440	520	0	50	1060
32	Andaman & Nicobar	0	0	0	2068	0	2068
33	Ladakh	0	841	0	450	0	1291
	Total	109685	616958	187352	255021	201638	1370654

Table 2: Details of farmers benefited under ATMA scheme for the year 2021-22 (till October, 2021)

(Source: 07 December, 2021, PIB Delhi)

- ATMAs have promoted eco-friendly, sustainable agricultural technologies, such as integrated pest management (IPM); Integrated Nutrient Management (INM); organic farming; and the use of water conservation practices, including well recharging, converting from water-intensive crops, such as paddy and wheat, to water-extensive crops, such as vegetables, floriculture, maize, oilseeds and pulses. Also, all ATMAs have promoted the use of micro-irrigation systems (Singh *et al.*, 2005a and Singh, 2006).
- The need based training and exposure visits to the farmers and farmer-led extension have played a very effective tool for the technology dissemination (Singh, 2006).
- BTT officials are frequently deployed to other departmental works which results in poor performance. (Singh, 2006).

Impact of ATMA on women

- Since inception of ATMA in 2005-06, there are total 10102098 farm women (24.14%) of the total benefited farmers. Rs. 19500/-lakhs allocated and earmarked for women, but, utilized Rs. 9513.33 lakhs for women beneficiaries (DA & FW, 2017-18).
- Over 60263641 farmers including 14810130 farm women (24.58%) have participated in farmer oriented activities like Exposure Visits, Trainings, Demonstrations, Farm Schools & Kisan Melas (DA & FW, 2021-22). FAO survey showed that women farmers receive only five percent of all agricultural extension services worldwide and that only 15 per cent of the world's extension agents are women (FAO, 2004).
- The block-level FACs are operational in most project blocks, but rural women and other disadvantaged groups still need more representation. Approximately 700,000 farmers, including over 100,000 women farmers, directly benefited from these new extension programs through a combination of exposure visits, farmer training courses, on-farm trials, demonstrations and so forth (Singh *et al.*, 2012). Nayan and Borkakoty (2000) in a study conducted among the women entrepreneurs in Assam to find out the impact of EDP strongly argue that women can be the vital agents of change. Trained women can be able to

manage and reap the benefits of different schemes. Investing in women's capabilities and empowering them to achieve their 'choices' and 'opportunities' is the surest way to contribute to economic growth and overall development (Pattanaik, 2000).

- Over 10.00 lakh farmers including 2.98 lakh farm women (27%) have been benefited through farmer oriented extension activities since inception up to December, 2006 (Singh *et al.*, 2012).
- The beneficiary contribution in respect of SC, ST, women beneficiaries as well as for beneficiaries belonging to North Eastern and Hilly States has been reduced from 10 to 5% (Singh *et al.*, 2012).
- In village level programmes, the female participation in trainings was 19 per cent, exposure visits 19 per cent and demonstration 13 per cent in UP whereas it was 27, 29 and 20 per cent respectively in Haryana. The average number of participant per Farmer-Scientist Meet was 25 persons in UP and 22 persons in Haryana indicating low level of participation in such meets (Agricultural Finance Corporation Ltd).

Impact on women in Bihar

- Women involved in decision making in GB to FAC, quite encouraging participation in capacity building programmes, positions occupied at all levels, more active in food processing (Singh, 2006).
- Over 13,555 women farmers have been benefited with the new technologies through exposure visits, farmers training and demonstrations under the ATMA activities. More women groups have been developed in vermi-composting, dairy, bee keeping, floriculture, mushroom cultivation, vegetable cultivation, backyard poultry and more particularly women groups were more active in preparation of food processing (Singh, 2007).
- It is observed that majority of (84.2%) of the respondents were male while 15.8 per cent were female. Thus it can be concluded that involvement in ATMA programme and agriculture activities mostly dominated by men and least involved by females due to some factors that hinder female active participation in ATMA programme and agriculture (Pankaj and Jirli, 2018).

• In Bihar, under ATMA programme several strategies followed such as mobilization of farmers and farm women are organised into FIGs/SHGs, providing them training on new technology and promoting them to start their own agri-enterprise (Singh and Singh, 2014).

Impact on women in Andaman and Nicober Island

- The results clearly indicated that the involvement of all the small and women farmers in ATMA activities are benefitted. Still, there is much scope to involve women farmers in all the extension activities including FACs at different levels (Madhu *et al.*, 2018).
- Majority (47.54%) of the respondents opined that the participation of women farmers in ATMA activities is at medium level followed by low (43.19%) and high (9.27%). Enhanced participation of women in all the extension activities is the need of the hour. On the whole, the extent of reforms in extension system was low to medium only (Madhu *et al.*, 2018).

Impact on women in Mizoram

• The implementation of the ATMA scheme in Mizoram during the year 2016–2017 is observed to be satisfactory. With the implementation of this scheme, a number of farmers were found to practice better farming technology and many of them have abandoned their traditional humming practices. However, ATMA activities, at the present scale, are not adequate to change the whole scenario of farming practice in Mizoram, particularly, in the remote villages (SAMETI, Mizoram, 2016-17).

Impact on women in UP and Haryana

• The female participation at district level trainings is 15 per cent as compared to 19 per cent in village level programmes in UP whereas it was 27 per cent in Haryana in village level programmes and there was no district level programme. In the overall sample, SC farmers are about 22 per cent and women are 17 per cent where these percentages are 24 and 19 per cent in Uttar Pradesh (http://www.afcindia.org.in).

Impact on women in Karnataka

• ATMA has contributed much towards organising and motivating women to come together as a team

to achieve their immediate goals like small savings, pooling resources, conducting meetings, documentation, approach banks for financial support, record maintenance and thus empowering them to face the challenges. By pooling their resources and utilizing the financial support extended by ATMA in the form of seed money, the farmer's group and FSGs have been able to start income generating activities to supplement their resources. About 52.3 per cent of the beneficiary farmers have preferred ATMA to access the information related to agriculture sector and other sectors (Karnataka Evaluation Authority, 2022).

Impact on women in Odisha

- In Odisha, the district level budget allocation for women was - 0.43 per cent against expenditure -0.33 per cent under ATMA programme. The post of State Gender Coordinator in Nodal Cell was vacant. There was no women employee as BTM while only 11 per cent as ATM, 12 per cent as Farmers Friends and 17 per cent as Women Block Technology Convenor who perform the dual responsibility of ATMA as well as Agriculture programme. About 51 per cent of women and 44 per cent men had no awareness about ATMA. There was no significant positive impact on identified gender issues, no meeting by SFAC and no specific recommendation for gender, no gender training by ATMA for farmers/farm women and insufficient fund under HRD (Anonymous, 2020).
- In Odisha, the awareness of farm women towards eight selected government schemes was very negligible i.e. 9 to 21.5 per cent while the range of benefits they availed from the said schemes including Agricultural Technology Management Agency was 3 to 12.5 per cent (Author's own source 2017). This has conformity with the findings of Chinna and Hanamanthappa (2011) who highlighted in their study that, rural women entrepreneurs were unaware about policies and programmes of the central and state governments and also suggested to create awareness towards the programmes.
- ATM/BTM of Odisha state are over loaded with departmental activities specifically in KALIA Yojana and PM-KISAN Scheme and do not find

any time for ATMA work. The vehicles/other facilities under ATMA are being used for departmental works. More than 33 per cent women participate in training programme while it is only 5-10 per cent for demonstration. There is lack of gender sensitization among grass root ATMA functionaries for which they select the potential male farmers for demonstration ignoring women farmers (Author's own source 2022).

limitations with ATMA scheme

- Ministry of Finance has decided to stop the grant to Sub-Mission on Agriculture Extension from 2021-22 to fiscal 2025. But, Ministry of Agriculture is not able to provide fund. So, asked state government to reduce employee under scheme (Odisha Post, Bhubaneswar, November, 2021). State is not able to provide the same which is resulted in organizing less number of programmes for the farmers.
- Operationalization of BTT is a major problem before ATMAs, as most of the positions are vacant due to frequent transfers or non-filling of the positions all together; this has seriously hampered the ATMA mandate. BTT officials are frequently deployed to other departmental works which results in poor performance (Singh, 2006).
- According to Meeting Notes, No.103/ February 2022, AESA, the constraints under ATAM scheme are: delay in funds release, inadequate financial support, lack of technical employees, lack of field training facilities, lack of transportation facilities and poor infrastructure for conducting trainings.

Recommendations to make ATMA scheme more women friendly

- Orientation of upper level officers (AAO, BAO, CDAO) and grass root functionaries (ATM/ BTM) about ATMA and gender through sensitization programmes (trainings, seminars, workshops, etc.) to change their mindset.
- Exclusive monitoring of ATMA scheme by Non-Agriculture Department. A full time PD at district level for planning, implementation and evaluation of ATMA Scheme.
- Recruitment of more no of ATM, BTM and women functionaries and collect GDD to increase extension access of farm women.

- Identifying gender needs and priorities and development of participatory action plan in SFAC based on women needs and preferences.
- Support for handholding, critical inputs and market link for women to empower them.
- Considering women groups with lease plot as beneficiary to include in demonstration programmes.
- Organizing location specific need based capacity building programmes for farm women for enhancement of their livelihood. However, capacity building of farm women and women leaders is very much required.
- Stay facility for children near training place.
- Capacity building of ATMA staff to collect Gender Disaggregated Data (GDD) to create gender database for annual action plan and policy recommendation.
- Vehicle facility to all the officials working at the grass root level under ATMA.

CONCLUSION

Various developmental schemes designed and implemented for women welfare are not reaching to them and they are unable to avail maximum benefits out of it. Therefore, it is the need of the hour to change the societal stereotypes towards women and providing them equal opportunities to take part in development schemes. Government should take care for awareness creation among women, proper implementation, monitoring and evaluation of the developed welfare schemes for empowerment of rural women.

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Review Article

Empowering Farmers through Digital Agricultural Practices – A Review

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ABSTRACT

The Indian agricultural sector has long struggled with issues relating to input quality and supply, scientific management of farms, post-harvest storage, transport and processing, marketing, environmental degradation, and market and weather-related risks. Further, Climate Change affects the nature of farming operations and their overall outcome by decreasing water supply, degrading arable lands, increasing pest infestation and crop diseases, and diminishing yield quality and quantity. "Digital agriculture" is often seen as having the capacity to alleviate these prolonged issues faced by farmers. It enables the farmer to make better decisions and farmers can receive real-time feedback on the outcomes of their choices. Digital agriculture helps farmers to empower under four categories viz. Agronomical perspective, Technical perspective, Environmental perspective, and Economic perspective. Several technologies like IoT, Smart sensors, UAVs, Artificial Intelligence (AI), and Robotics provide highly relevant real-time data, data analytics can help farmers make sense of and make important predictions like harvest time, disease and infection risks, production volume, etc. The Ministry of Agriculture & Farmers Welfare has also announced the Digital Agriculture Mission 2021-2025 to forward digital agriculture. Several private partnership Agtech startups emerged with innovations that combat the issues of farmers and made an impact on the life of the farmers. Moreover, digital agriculture helps in advancing the United Nations Sustainable Development Goals (SDGs). But adoption of digital technology may not be a viable option for small farmers, due to higher investment and lack of operational skills. This calls for awareness and capacity-building programmes on digital agricultural practices to minimize the cost of operation and develop necessary skills among farmers. This study is an effort to define the role of digital agriculture and its significance in the empowerment of farmers.

Keywords: Digital agriculture, Empowerment, Innovations, Smart farming, Startups

INTRODUCTION

The agricultural sector in India has faced persistent challenges pertaining to factors such as input quality and availability, agronomic practices, post-harvest preservation, transportation and processing, marketability, consumer preferences, ecological deterioration, and exposure to the market and climatic uncertainties (Maurya *et al.*, 2022). The anticipated increase in the global population from 7.6 billion in 2018 to more than 9.6 billion by 2050 is expected to result in a substantial increase in the demand for food (Priscilla *et al.*, 2021). Moreover, amidst an already tumultuous course, the phenomenon of "Climate Change" is exerting a significant impact on agricultural practices and their ultimate consequences. This includes a reduction in water availability on an annual basis, degradation of cultivable lands, food insecurity, pest infestations, crop diseases, and a decline in both the quality and quantity of yields (Naik *et al.*, 2023). The range of challenges posed by this issue seems to be never-ending. Resolving obstacles encountered in the agricultural sector necessitates implementing a transformative approach firmly grounded in technological progress (Tinh *et al.*, 2019). Despite the pressing need to address the challenges outlined earlier, the agricultural industry has yet to fully embrace technological advancements. The implementation of digital agriculture has the potential to address a

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significant portion of these issues (Khudoynazarovich, 2021). The integration of contemporary technology with traceability, availability, and transparency principles holds promise as a viable solution for addressing the challenges confronting the agricultural sector (Balkrishna *et al.*, 2020).

The concept of "Digital Agriculture" refers to an ecosystem of information and communication technologies (ICT), that is designed to facilitate the provision of timely and tailored services to support profitable and sustainable farming practices (Shaheen et al., 2020). The ultimate goal of this approach is to ensure the production of safe, nutritious, and affordable food for all. The integration of big data in food production, coupled with the incorporation of various technological advancements such as the Internet of Things (IoT), blockchain technology, artificial intelligence (AI), machine learning, cloud computing, unmanned aerial vehicles (UAVs), and robotics, is commonly known as "digital agriculture." The digital economy, characterized by digital information technologies which include the internet, big data, and artificial intelligence, has undergone rapid development in recent years. This development has presented novel approaches for enhancing agricultural production efficiency (Klerkx et al., 2019).

Modern farmers must adopt digital agriculture to increase agricultural productivity, mitigate soil degradation, reduce chemical use in crop production, optimize water resource utilization, improve crop quality and quantity, and lower production costs (Chandra and Collis, 2021). Currently, farmers use inaccurate estimates, practical experience, and professional guidance to establish fertilizer and input amounts. The results of their decision are usually not visible until harvest. Digital agriculture allows farmers to use more frequent and precise data, including meteorological data, to make better decisions. The data is analyzed using advanced software and machinery to help implement educated judgments quickly and accurately. Farmers also receive immediate feedback on their decisions. Moreover, adoption or practicing digital technologies in agriculture helps in achieving the following United Nations Sustainable Development Goals (SDGs): digital technologies increase yield per acre and reduce production loss (SDG 02 - Zero hunger), the adoption of digital technologies can provide only as much water to the plants as needed & reduce chemical use and run-off into local water (SDG 06 - Clean water and sanitation), it also provide farmers with up-to-date pricing and trading & facilitate trade without using intermediaries (SDG 08 - Decent work and economic growth), through better-integrated systems and information sharing using the digital technologies, it improved the food supply chains (SDG 09 - Industry, Innovation, and Infrastructure), digital technologies enable more sustainable city growth through better waste management (SDG 11 -Sustainable cities and communities), it helps in reduce waste, through improved planning and by linking agricultural sensors to reduce food spoilage (SDG 12 - Responsible consumption and production), it helps to reduce chemical run-off contaminating oceans (SDG 14 – Life below water), it helps to promote more sustainable land ecosystems through a more considered use of land and approach to forestry (SDG 15 – Life on land), and it allow companies to partner to increase the impact through improved availability of information (SDG 17 - Partnership for the goals) (Anonymous, 2020). Keeping these points in view, the study was conducted with the objectives of studying the role of digital technologies in empowering farmers, getting an insight into major digital technologies used in agriculture, and finding out the implications of different initiatives for digital agriculture in India.

MATERIALS AND METHODS

The study was conducted based on the review of past literature and scientific documents, delving into the subject area of digital technology and its significance in modern agriculture. The secondary data used in this study were collected from a range of sources, such as journals, periodicals, articles, books, reports, websites, etc. A thorough review of more than thirty published works was conducted to understand the role of digital technologies in empowering farmers, major digital technologies used in agriculture, and the implications of different initiatives for digital agriculture in India. The paper is an attempt at a theoretical review of the previous studies in order to get an insight into the role of digital technologies in agriculture.

RESULTS AND DISCUSSION

The fundamental prerequisites for the transformation of agriculture into a digital domain encompass a range of factors, including but not limited to the provision of adequate facilities and networks, accessibility of technology, education, and training, and institutional support (Trendov et al., 2019). Digital agriculture helps farmers to understand the various aspects of farming practices and aids farmers in maintaining the ideal conditions with the least amount of work and highest return on investment to achieve more competent, extremely productive, efficient, and economically viable farming enterprises (Upendra et al., 2020). Farmers in the 21st century are equipped with advanced technologies such as GPS, soil scanning, handling information, and the Internet of Things, which aid in their agricultural practices. Through meticulous measurement of fluctuations within a given agricultural domain and subsequent adjustment of corresponding strategies, farmers can significantly enhance the efficacy of fertilizers and pesticides, while also employing them in a more discerning manner (Dayioðlu, and Turker, 2021). Digital technologies help them in four different categories with respect to their empowerment.

In general, farmers decide how to manage their farms based on an evaluation of the local environment, past performance, and intended results. They can be empowered by digital technologies to handle their farming demands, particularly those pertaining to irrigation systems, soil health, and crop management. Farmers can utilize digital technology to determine the specific agronomical practices to be used for the crops. Example: Choosing micro irrigation practices over flood irrigation will help in reducing soil degradation and efficient utilization of water resources.

Farmers can use digital technology in the production of crops and save precious time. The technologies can be used to quickly evaluate the growing conditions of crops and offer insightful conclusions and operational information to boost production efficiency. It offers fresh insights into agroecological observations through the combined use of global sensing capability, remote monitoring, and real-time data processing. Additionally, these advancements are helping farmers to create new chances for inclusivity and sustainable development. Examples: using GPS and remote sensing technology for pest or disease surveillance.

The contribution of excessive use of chemical fertilizers and pesticides, along with ineffective irrigation

management, leads to severe drought, pesticide pollution, and agroecosystem disturbance. In this case, by using digital technology it is possible to reduce the pollution of the environment and preserve precious natural resources – land, soil, and water. It fosters the responsible utilization of the necessary resources that benefit biodiversity and farmers instead of the chemical industry and generates a stable combination of society, the environment, and capital. Examples: Controlled use of chemicals, and water resources based on advanced assessment of crop health using digital technology.

The adoption of technology in crop cultivation is aided by data on input costs, crop water requirements, farm yields, and net profits. This helps in improving the economic and environmental performance of farm management practices (Gangwar *et al.*, 2022). By practicing digital technology in farm operations, farmers can reduce the cost of production and increase the output and quality of output. Examples: Using digital technology to get accurate weather forecasts related to rainfall can save input and reduce the cost of production.

Pasupuleti (2015) observed that, for farmers who hire seasonal workers, the implementation of digital technologies could potentially yield a positive outcome. The adoption of digital tools to measure the work, time, and output of laborers on farms results in increased efficiency and reduced costs.

Digital agriculture is expected to enhance agricultural productivity to meet the growing food demands of farmers in the future. The utilization of agricultural technologies enables the acquisition of vast amounts of agricultural data at a reduced cost, thereby promoting insight-driven, productive, and efficient agricultural practices (Sarker *et al.*, 2019). Many types of digital technologies available in the market are proving to be a game changers in the field of agriculture. This paper focuses on popular digital technologies currently being used in agriculture such as smart sensors, AI, robotics, and drones.

The Internet of Things (IoT) can assist farmers in understanding and making critical forecasts about harvest time, disease and infection risks, crop volume, etc. Internet of Things and smart sensors are useful in managing real-time data. The farmer installs a gadget with numerous sensors incorporated into it for various tasks and data collecting, including measuring and forecasting wind speed and direction, rain gauge, lux meter, leaf wetness, temperature, humidity, and air pressure. These sensors are connected to a central system that processes the incoming data and generates suitable responses for carrying out various operations like irrigation. This allows farmers to optimize the use of various resources in their farms and reduce input costs. Some commonly used smart censors in agriculture are optical sensors, used for the collection and analysis of soil reflection and plant color data.; electrochemical sensors, used for soil nutrient detection by analyzing the presence of nitrate, potassium, hydrogen, and other ions; dielectric soil moisture sensors, used for monitoring soil moisture level; and electronic sensors, installed upon machinery to monitor operational status. Adusumali (2018) reported that the regular utilization of smart sensors has resulted in the acquisition of new skills and the enhancement of knowledge related to soil & plant health among farmers. Shruti et al. (2018) too observed that smart sensors are quite useful in precision agriculture as it allows farmers to apply variable rates of inputs across the field depending on soil condition and also help them in determining the optimum time of harvesting based on fruit color and size.

Unmanned aerial vehicles (UAVs), commonly referred to as drones, are aircraft without pilots that are flown remotely by people or automatically utilizing embedded systems that regulate their operations (Kulbacki *et al.*, 2018). Drones are used in several agricultural tasks, including tree and crop planting, spraying chemicals, crop monitoring, weed detection, crop health examination, crop insurance, geo-fencing, animal management, soil and field analysis, mapping of drainage, weed pressure, canopy cover, and more. The use of drones has several advantages in agriculture. It helps in optimizing inputs like seeds, fertilizers, and water. Using drones, it is possible to spray a precise number of fertilizers by automatically changing the rate of the application using real-time mapping. Farmers can early detect the outbreak of weeds, pests, and diseases and take necessary action. Rani et al. (2019) observed that drones enable farmers to predict the estimated yield by precisely calculating the field characteristics. Moreover, she also revealed that drones are far more effective in mapping and monitoring entire fields, in comparison to manual monitoring of fields by farmers.

Artificial Intelligence (AI) is a broad field within computer science that focuses on the development of intelligent machines that can perform tasks that typically necessitate human intelligence. Artificial intelligence (AI) based agricultural systems have been found to enhance the general efficacy and precision of crop production. The utilization of this technology aids in the identification of plant ailments, infestations, and inadequate nourishment. The system can identify and localize weeds and determine the appropriate herbicidal treatment for the affected region (Beriya, 2020). There are several AI-based applications currently used in agriculture such as Agri-crop mobile application, diagnostic mobile application, calculative mobile application, etc. (Table 1).

S.No.	AI-based Application	Functions
1	Agri-crop mobile application	Provides all the information about any particular crop like major disease attacks of the crop and its preventive measures.
2	Multi-informative mobile application	Provides whole information or cultivation tips for the whole crop cycle from sowing to harvesting and marketing
3	Calculative mobile application	Facilitates farmers to do the fertilizer calculator for their crop and plot area.
4	Diagnostic mobile application	Enables farmers to detect diseases and provide them with preventive advice instantly.
5	Agri- academic mobile application	Helps farmers in understanding the terms related to agriculture and improve their knowledge of complex agricultural terms in use
6	Agri- professional mobile application	Enables farmers to communicate and interact with the agriculture subject experts to make clear their doubts and for sharing their observations with the largely agricultural community

Table 1: Effect of AI-based Application and Functions

Barh and Balakrishnan (2018) found that the implementation of artificial intelligence (AI) in the agricultural sector has resulted in the creation of various tools and apps that aid farmers in the management of crucial aspects such as water usage, crop rotation, timely harvesting, crop selection, optimal planting, pest control, and nutrient management. This not just helps farmers in making scientific decisions but also saves them time and money.

Agricultural robots have been developed to mechanize the monotonous and time-consuming tasks of farmers, thereby enabling them to concentrate on enhancing the overall productivity of their operations. Innovation in terms of robotics applications in agriculture has advanced considerably in the last 5 years. The objective of agricultural robotics is to help the sector in its efficiency and the profitability of the processes. In other words, mobile robotics works in the agricultural sector to improve productivity, specialization, and environmental sustainability (Lytridis et al., 2021). Lately, the agriculture sector has been plagued with labour shortages, increased consumer demand, and high production costs. Robotics have enabled farmers to counter these challenges. The agricultural practices where robots can be used are crop condition identification, chemical application, mobile manipulation through collaborative arms, collection of field data, and selective application of pesticides.

Hajjaj and Sahari (2016) found that while the adoption of robotics technology can be challenging for farmers in the initial stages, it does have the potential to perform a range of tasks efficiently and effectively, thereby reducing the cost of cultivation significantly. Further, they argued for institutional support and capacity building among young farmers for greater adoption of robotics in agriculture.

The utilization of various technological devices such as computers, sensors, drones, mobile devices, and decision support systems has witnessed a surge in recent times, thereby facilitating farmers in the collection and analysis of on-farm data. According to Soma and Nuckchady (2021), farmers have different perspectives on the adoption of digital agricultural practices. While digital agriculture is often portrayed in a positive light there exist certain limitations and impediments to its adoption. Farmers are worried about sharing their data (collected through digital technologies) with external agencies, like the government and multinational corporations. Additionally, there is a concern that the adoption of digital agricultural practices might end up utilizing significantly more resources to generate greater profits on investments. Another significant challenge is economic risk, notably debt, among small-scale farmers. Adoption of digital technologies requires high initial investments and these investments may not generate enough returns to overcome the costs incurred on its adoption. Also, family-owned farms are less likely to adopt digital agriculture as compared to commercial farms due to the availability of family labour and limited returns from agriculture (Jiang *et al.*, 2022).

Ivanova *et al.* (2020) found that the adoption of newer technologies in agriculture by individual farmers has not resulted in any significant changes in terms of production and profits. This was attributed to the lack of proper planning, institutional support, and skills required for operating new technologies.

The government of India has launched Digital Agriculture Mission 2021-2025 with the objective to increase the adoption of digital technology in agriculture. It was assumed (under the mission) that the growth and implementation of digital agriculture in India will be fostered through the Public-Private Partnership (PPP) model (Anonymous, 2021). The government signed a Memorandum of Understanding (MoU) with CISCO, Jio Platforms Limited, and ITC Limited in September 2021 to advance digital agriculture through pilot projects under the mission. Some of the initiatives under Digital Agriculture Mission 2021-25 are as follows:

Agricultural digital infrastructure (ADI) solution: It was developed by Cisco in August 2019 and focuses on enhancing farming practices and knowledge sharing among different stakeholders. Under this initiative, the Department of Agriculture has established a National Agri Stack, for creating a comprehensive data pool. This initiative was implemented as a pilot project in Kaithal (Haryana) and Morena (Madhya Pradesh) and was expected to play a crucial role in Digital Agriculture Mission 2021-25.

Jio Agri (JioKrishi): It was launched in February 2020 by Reliance Jio as a platform with a focus to digitize the agricultural ecosystem across the entire agricultural value chain, and empowering farmers. Additionally, it

also provides agro-advisory services. Jio Agri utilizes data from multiple sources to offer personalized and accurate advice. This was initiated as a pilot project in Jalna and Nashik districts of Maharashtra.

Site specific crop advisory: This was initiated by the Indian Tobacco Company (ITC) with the objective to transform traditional crop-level general guidance into customized site-specific crop advisory services for the farmers, through the utilization of a digital crop monitoring platform. This platform was hosted on ITC's e-Choupal 4.0 digital platform and implemented in the Sehore and Vidisha districts of Madhya Pradesh.

Unified farmer services interface: This was implemented by Microsoft as a pilot programme in 100 villages of six states. This project was initiated as a crucial component of the Ministry of Agriculture and Farmers Welfare's vision to establish AgriStack. This platform aims to offer comprehensive services to farmers throughout the agriculture food value chain by generating distinctive identification numbers for farmers nationwide using cloud computing service.

Digital Agriculture: Case Study

The adoption of digital agriculture can have a significant impact on the life of a farmer and it can be proved with the following case studies:

Case-I Mr. Ravi Kumar (Region: Badepally, Telangana)

Mr. Ravi Kumar is a resident of Badepally, Telangana who has adopted an automated grain analyser, NEBULLA-MATT. MATT employs advanced techniques such as artificial intelligence (AI) along with image analysis to reduce the need for human involvement and introduce a more impartial approach to the process of assessing grain quality (FAO and ICRISAT, 2022). Generally, the quality assessment of the farmers' produce was performed manually, through physical inspection, and grades were allocated to lots after manual assessment. This is used to create quality-related issues for both farmers and consumers. Nowadays, consumers have become quality conscious. The adoption of MATT has allowed Mr. Ravi Kumar to expand his network and ensured higher prices for his product by obtaining a universal testing report that certifies the quality of the product. NEBULLA-MATT has equipped farmers with knowledge regarding the standards of their products, which allows them to negotiate for more favorable prices from buyers.

Case-II Mr. Sangamesh Tallikoti (Region: Bagalkot, Karnataka)

Mr. Sangamesh Tallikoti is a tomato grower from Bagalkot, Karnataka, who has adopted FASAL, an intelligence platform that operates at the farm level and is designed to provide crop-specific insights to farmers (FAO and ICRISAT, 2022). FASAL makes use of artificial intelligence (AI) models that are powered by FASAL's Internet of Things (IoT) devices. These devices are equipped with a set of sensors that are installed on the farm and are capable of capturing localized environmental parameters. Adoption of FASAL has allowed Mr. Sangamesh Tallikoti to reduce irrigation requirements by 60 per cent, prevent outbreaks of diseases like powdery mildew and fruit rot by precise timings of sprays & also prevented the outbreak of pests like aphids, thrips, and leafhoppers. Additionally, he was able to save Rs. 90000 in disease management by reducing the number of sprays and optimum utilization of inputs. Further, he also obtained 25 tones more yield from 3 acres of a tomato farm, in comparison to the previous season.

The increasing demand for digital technology in the future may lead to a rise in production and the potential availability of low-cost technologies for small landholders (Sheng et al., 2021). The utilization of portable hardware is deemed suitable for small landholders, who constitute the majority of farmers, owing to its user-friendly plug-and-play feature that allows for easy adaptability. In addition, they also engage in leasing arrangements whereby they transition from one parcel of land to another in accordance with seasonal changes. The portable hardware is expected to be readily adaptable. The concept of "Renting and Sharing" involves the formation of groups, such as Farmer Producer Organizations (FPOs), to collectively purchase and utilize technology rather than individual ownership. This approach allows for the sharing and renting of technology among members of the group. Consequently, the expense incurred by each farmer will decrease. The provision of academic support entails fostering collaboration between agricultural organizations and academic institutions to engage with farmers through government initiatives, training programs, result demonstrations, and experiential learning opportunities. These measures are expected to facilitate greater digital adoption among farmers. So, the need of the future is to develop better, faster, and cheaper products or services that will increase the smallholders' productivity, providing gains in poverty reduction, nutrition, education, and income (ICRISAT, 2016).

CONCLUSION

The utilization of digital technology at the farm level has a positive impact on income and is significant in terms of policy implications. It is recommended that farmers be guided through scientific fertilization and information dissemination to reduce the use of chemical fertilizers and promote sustainable agricultural development. Small landholders are responsible for producing over 80% of the food supply in developing nations. Digital agricultural tools have been developed to address the difficulties encountered by small-scale farmers, such as poor crop yields and results. The agricultural ecosystem has the potential to undergo a significant transformation. Ultimately, the utilization of technology confers advantages on farmers by enhancing efficiency and diminishing expenses associated with agriculture. One of the challenges faced by farmers is the high capital cost associated with acquiring digital technology for their field operations, which necessitates a significant investment of capital. The issue of limited resources for funding has resulted in a significant challenge concerning purchasing power. As a result, a considerable number of individuals have been unable to acquire the necessary technology required for their field operations. The lack of skills in operating modern technologies is another hindrance to the effective utilization of digital technology. This calls for greater institutional support for enabling farmers to adopt and acculturate digital technologies. Government and policymakers need to prioritize their credit policy for greater penetration of digital technology and initiate capacity-building programmes on digital agricultural practices to minimize the cost of operation and maintenance.

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Review Article

Wound Healing with *Lucilia sericata* Maggot in Diabetes Mellitus-A Review

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ABSTRACT

Maggot in the treatment of wound is very old therapy before discovery of antibiotics. The therapies become remerge in the field of therapeutics once antibiotic resistance developed. The potential of maggot therapy has become explored and the candidate species for this biotherapy have been categorized for various molecules and for simulating properties of excretory and secretary product of maggot. Recent report of maggot debridement therapy on its reduction of bacterial bioburden in chronic wound, diabetic wound and reduction of oxidative stress get much attention to take this biotherapy on hand again. Evidence of maggot induced tissue growth or wound healing is observed both at laboratory and clinical studies and suggested both mechanical and biochemical pathways. Thus the review highlighted the properties of maggot therapy in bionolecular basis in controlling bacterial bioburden in wound of human and animal origin.

Keywords: Diabetes, Lucilia, Wound healing

INTRODUCTION

Diabetes mellitus (DM) is probably the fastest growing metabolic disorder in the world and it is a major source of morbidity in the developed countries. DM is commonly referred as diabetes, and it is now regarded as heterogeneous group of disease characterized by a state of chronic hyperglycaemia, which causes a number of secondary complications like cardiovascular, renal, neurological and ocular (Thornalley et al., 1996). Diabetes, sometimes called as- "Mother of diseases" as it starts with pancreas and spread towards all other essential organs such as heart, liver, brain, eye and kidney (Mohiuddin et al., 2016). The prevalence of the disease is increasing at a very fast and alarming rate and epidemiological study showed that the number of patients with DM increased from about 30 million cases in 1985 to 177million in 2000 and 285 million in the year 2010 and it is expected that around 592 million people will be diabetic worldwide by the year 2035 (Kumar and Agarwal, 2016). India is predicted to have

the most number of people with DM in the world (Sridhar, 2000). People with DM showed common complications of lower extremity diseases and negatively influences the healing process in injuries. Almost 50% of nontraumatic lower extremity amputations worldwide occur in people with DM (Global Lower Extremity Amputation Study, 2000). People with diabetes undergo some structural changes i.e. the thickening of basement membrane and diabetic wounds do not follow the precisely orchestrated course of events observed in normal healing (Falanga, 2005). Studies have demonstrated that in early diabetes, micro vascular blood flow is increased with prolonged exposure to hyperglycemia (Pober and Cotran, 1990). This is explained by increased production of nitric oxide by the endothelial cells as a result of vessel wall damage and high viscosity of the blood due to glycosylation of haemoglobin leading to reduced precapillary resistance and further vasodilatation occurs in response to increased metabolic demand and oxygen

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requirements of damaged tissue. In turn, stress on the vascular wall increases resulting in accumulation of extra cellular matrix and the protein fibronectin in response to its chronic injury. Further basement membrane thickening occurs, altering membrane charge and as a result affecting capillary permeability (Christopherson, 2003). Persistent hyperglycemia encourages the conversion within the endothelial cells of glucose to sorbitol, as sorbitol cannot diffuse across the cell membrane resulting in basement membrane thickening due to cellular oedema. The absence or deficiency of insulin in DM causes impaired metabolism of carbohydrates, fat and proteins which are necessary for cellular activities and tissue synthesis in wound healing (Terranova, 1991). When the wound is open and unhealed, bacteria move in. Even when this doesn't result in an overt infection, a thin layer of bacteria can create a biofilm that covers the sore. Large groups of biofilm producing bacteria coat themselves in sugars and other barriers that keep antibiotics from killing them off. Biofilms, along with dead tissues, mean that even the most advanced wound treatments won't work. Debridement is necessary for removal of devitalized tissues in order to create a healthier wound bed. Removal of nonviable tissue permits better visualization of the wound base, removes a growth medium for bacteria and stimulates release of growth factors. The maggots go in there as God's miniature little surgeon and they can see what the surgeon can't see, and they can eat the bacteria and the dead tissue, and they might even do a better job than sharp debridement and also hastened growth of granulation tissue (Sherman, 2003).

Wound healing process

Loss of the integrity of a large area of the skin as a result of injury or illness may lead to major disability or even death (Adam *et al.*, 1999). Normal wound healing is a dynamic and complex process involving a series of coordinated events, including bleeding, coagulation, initiation of an acute inflammatory response to the initial injury, regeneration, migration and proliferation of connective tissue and parenchyma cells, as well as synthesis of extracellular matrix (ECM) proteins, remodeling of new parenchyma and connective tissue and collagen deposition regulated by cytokines and growth factors (Rivera and Spencer, 2007). Four well defined phases can be recognized during a healing process – haemostasis (coagulation), inflammation, repair (cell migration, proliferation, matrix repair, and epithelization), remodeling and maturation of the scar tissue (Lawrence, 1998). Clinically, wound can be categorized as either acute or chronic non-healing wound depending upon the timescale of healing or the tendency to relapse. The abnormal presence of bacteria in wound prolongs the wound healing inflammatory phase. The majority of wounds are polymicrobial, involving both aerobes and anaerobes. The aerobic pathogens such as Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Klebsiellae, Proteus spp. and â- haemolytic Streptococci have been most frequently cited as the cause of delayed wound healing and infection (Madsen et al., 1996). The most common anaerobes present in the chronic wounds are Peptostreptococcus spp., Serratia spp., Bacteroides, Peptoniphilus, Fingoldia, Anaerococcus, and Peptostreptococcus spp. isolates (Dowd et al., 2008). Chronic wound do not pass through the normal stages of healing. They are characterised by prolonged inflammation, inhibited cell proliferation, incomplete restructuring of extracellular matrix and lack of epithelisation. Wound takes prolonged healing period because of excess production of extracellular matrix and ineffective cleansing of the wound of fibrin and fibronectin (Kruglikova and Chernysh, 2013). Chronic wound fluid contains elevated protease level (Linda et al., 2013). These increased levels have deleterious effects on wound healing, degrading de novo granulation tissue and endogenous, biologically active proteins such as growth factors and cytokines. Prolonged inflammation or infection and imbalance of moisture and/or deleterious composition of wound fluid can lead to impaired healing. As a result of these disturbances, chronic wounds are often characterized by slough and necrosis (debris) on the wound bed. Persistent influx of neutrophils into the wound bed associated with an elevated level of proteolytic activity and unbalanced oxidant/ antioxidant level causes damage of the surrounding tissues rather than repair (Eming et al., 2007). Effective debridement, e.g.by larvae and their secretions, is thus essential to facilitate and continue the process of wound healing. In addition, larvae and their secretions affect the inflammatory and the wound healing processes (van der Plas et al., 2009; Zhang et al., 2010). Diabetic wounds are slow, non-healing wounds that can persist for weeks despite adequate and

appropriate care. Such wounds are difficult and frustrating to manage. Intense inflammation is associated with diabetic wound and it is evident that high glucose environment enhanced oxidative stress and increased IL8 secretion from keratinocytes impaired diabetic wound healing (Lan et al., 2013). L. sericata maggot plays a tremendous role in healing of diabetic wound. Maggot's digestive system and characterization of the digestive process requires special attention, because digestion plays a crucial role for maggot therapy (Mumcuoglu et al., 2001). One pair of salivary gland continuously produces digestive and proteolytic enzymes that are secreted into the surroundings. In particular, there were found proteases such as collagenases, amylases, peptidases and antibacterial factor called lucifensin (Cerovsky et al., 2010). The midgut in L. sericata maggot consists of three parts anterior, middle and posterior segments with different characters. The maggots feed by dipping their front end into the liquid nutritive substrate, while breathing through their posterior respiratory apertures. During feeding, they form feeding communities and secrete digestive enzymes together. They produce a cocktail of proteolytic and antimicrobial substances called ES products of the gut as well as salivary gland origin. The ingestion of bacteria by maggots during debridement of necrotic tissue leaving wound bed clean and healthy (Sherman, 2014). Overproduction of reactive oxygen species (ROS) results in oxidative stress thereby causing cytotoxicity and delayed wound healing. Effective free radical scavenging activity of ES of blowfly maggot, Lucilia spp. was studied recently by Omalu and Colleges (2016). Maggots' ES can also inhibits multiple neutrophil pro-inflammatory responses thereby reducing prolonged inflammation and reduce elevated level of ROS in chronic wound (Cazander et al., 2013), which might be the cause of early reduction of oxidative stress in maggot treated groups of diabetic wound. Maggot therapy helps in increased collagen concentration and stabilization of fibre due to increase tissue oxygenation, fibroblast proliferation and angiogenesis and formation of granulation tissues. There is evidence to suggest that maggots not only debride wounds effectively but also stimulate the growth of granulation tissue from diabetic wound. It is believed that the movement of the maggots across the wound bed acts as a stimulant to promoting the growth of granulation tissue (Rayner, 1999). However,

Thomas (1998) suggested that the stimulation of granulation tissue was more likely to be as a result of macrophage activity being enhanced by maggots' secretions, which in turn stimulates the production of growth stimulating hormones. The organized formation of collagen with well developed matrix and reepithelization reported in study of diabetic groups (Borkataki, 2017) respectively, clearly showed effect of maggot responsible in promoting quick healing of wound in diabetes.

CONCLUSION

Diabetic wound infection continues to be a challenging problem and represents a considerable healthcare burden. The healing of a chronic wound has been shown to be impaired by the presence of a bacterial infection. The level of infection affects the balance between healing and chronicity. Maggot therapy is more effective and efficient in controlling septic contaminated wound than routine antibiotic treatment in diabetic cases. The review contribute to further acceptance of this efficient and successful maggot therapy for the treatment of chronic diabetic wounds in animals.

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Review Article

A Significance of a Structured Peer Support System for University Students: A Review

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ABSTRACT

A structured peer support system is a novel intervention recently adopted in university students' mental health and well-being worldwide. A diverse number of definitions and classifications for a structured peer support system have been provided in the literature and numerous reports have included and supported the service provided by peer support volunteers. It may not be a replacement for professional mental health services. It may be a valuable complement to today's student support system on university campuses. In this general review, we aimed to examine the literature, exploring the origin, change the concept of informal to formal type structured peer support system, challenges to implement for structured peer support system and provide guidelines for structured peer support at university level.

Keyword: Peer support system, Informal, Formal, Youth and mental health

INTRODUCTION

The general review sheds light on peers, experiences, benefits, and challenges to expanding access to addiction and mental health care using peer support systems. The review was done through a general search of the literature on Medline, Google Scholar, EMBASE, Scopus, Chemical Abstracts, and PsyInfo. Search terms included peer support, peer support in mental health, social support, family support, and integrated care. We began the review with an examination of the definitions, origins, and types of structured peer support contribution within different clinical contexts, aiming at deepening the view of the diverse effects of such a workforce. Peer support is a system of giving and receiving help founded

on key principles of respect, shared responsibility and a mutual agreement of what is helpful (Mead *et al.*, 2001). Formal peer support system bring together people with similar perceptive to share knowledge for mutual benefit, building social connection and reducing

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isolation (Schubert and Borkman, 1994; Solomon, 2004). While the term, peer support, includes a variety of approaches, from one-to one mentoring to self-help groups. Such self-help groups are formed by peers who come together for mutual assistance. By bringing people with common experiences together, self-help groups set the foundations for social support, widely recognised to be protective against the development of depression (Berkman and Glass, 2000; Cohen, 2004; Hefner and Eisenberg, 2009; Hunt and Eisenberg, 2010; Smith and Christakis, 2008). We concluded the review by purposing to generate effective guidelines for a structured peer support system at the university level.

RESULTS

Definitions: A Structured peer support has diverse meanings in the literature for example, Peer support is support provided by and for people with similar experiences. As students turn to peers for support with their mental health, peer support may provide an

opportunity to engage students at an informal level and avoid some barriers to help-seeking (Byrom, 2018). The mental health foundation in India defined peer support in mental health as "the help and support that people with lived experience of a mental illness. In 1976, authors defined self-help groups as "voluntary small group structure for mutual aid in the accomplishment of a specific purpose usually formed by peers who have come together for mutual assistance in satisfying a common need, overcoming a common handicap or life-disrupting problem and bringing about desired social and personal change" (Solomon, 2004). Although the mutual relationship was sometimes overlooked and rather described as an asymmetric or nearly one-directional relationship (Davidson et al., 2006), it is emphasized as one and four main tasks for peer support accomplishment, which are mutual, connection, worldwide and moving toward rather than moving away (Mead, 2014). A Peer support system mainly for mental illness may have particular value among university students. Those who suffered from severe depression among university students have been estimated at 30.6 per cent (Ibrahim et al., 2013). Barriers to professional help-seeking include perceiving problems as unsuitable for professional help, negative expectations of professional help, and believing informal strategies are sufficient (Brown et al., 2014). Thus, when students experience difficulties, they tend to turn first to their same-age mate for support and most students experiencing mental health difficulties talk to their same-age mate about their mental health. Peer support groups may have most important for higher education, supporting a necessary expansion in service provision. Most students avoid seeking the professional support system in educational institutions just because of the stigma of labeling mental illness.

Beginning and development of structured peer support system

Davidson *et al.* (2006) have expressed the paradigm that calls for new models of community-based practice which turned away from case management and from conceptualizing old practices under new terms. In the 1990s' peer support was formally introduced as a service in community mental health care. However, there is evidence of its practice throughout history, including during the moral treatment era in France at the end of the 18th century (Weiner, 1979). Recently peer support has been rapidly growing in many countries and could attract a considerable amount of research (Davidson *et al.*, 2012). Although the Lunatic friend society is known as the earliest peer support group in mental health, which was founded in England in the middle of the 19th century (Sunderland *et al.*, 2013), self-help groups were described as the oldest and most pervasive peer support types (Solomon,2004). Some peer-run groups also formed in Germany in the late 19th century, which protested involuntary confinement laws in the united states, the start of legitimacy for peer support was ignited in 2007 by considering the conditions under which Peer Support Service could be reimbursed by Medicaid (Ostrow *et al.*, 2017).

Change the concept of peer support system: Informal to formal peer support evolution

Intentional peer support (IPS) is described as a philosophical descendant of the informal peer support of the ex-patients' movement in the 1970s (Penney, 2018). It depends on a way of communication that immerses the provider into the recipient experience by stepping back from one's story and being eagerly open to others' stories (Mead, 2014). In the field of psychiatry, trauma is blamed for playing a pivotal role in the experience, diagnosis and treatment. Peer support is described as the logical environment for disseminating trauma-informed care (TIC) or service, which enables building relationships based on mutuality, shared power and respect (Mead, 2001). In the same context, trauma-informed peer support usually begin with the main question. "What is happened to you?" instead of "what is wrong with you?" (Mead, 2014). TIC is an explanatory model that identifies peer support services sharing lived experiences, ensuring safety and functioning as an advocate and a liaison to patient management plans, where empowerment and intervention models are strongly emphasized upon (Wilson et al., 2017; Goetz and Taylor-Trujillo, 2012). The shift from a traditional biomedical model to recovery-oriented practice is meant to perceive trauma as a coping mechanism rather than a pathology (Wilson et al., 2017; Ashmore 2013). Peer support systems have long played a crucial role in providing individuals with emotional, social, and practical assistance. These systems have traditionally operated in an informal manner, relying on personal relationships and informal

networks. However, with the evolving needs and demands of modern society, there has been a shift towards the formalization of peer support systems. This evolution aims to enhance the effectiveness, reach, and sustainability of peer support, while ensuring accountability and professional standards. In this article, we will explore the concept of peer support system evolution from an informal to a formal structure. Understanding Informal Peer Support Systems: Definition and characteristics of informal peer support systems. Examples of informal peer support networks in various contexts (e.g., mental health, addiction recovery, parenting, etc.).

Challenges to structured peer support in India

There are number of challenges to implementing structured peer support system in routine mental health and educational institutions in India. The absence of policy support makes it difficult to convince policy makers to allocate funds to establishing a structured peer support system. India is a hierarchal society and mental health services, like other health services in India (Fochsen et al., 2006). The role of structured peer support system vis-à-vis other mental health care professionals and the absence of a structure for professional growth for peer supporters add further barriers to integrate a recovery-oriented approach. We should start an active service user movement that can catalyze the growth of structured peer support system to implement structured peer support within clinical and educational-based education.

Preparation of guidelines for a structured peer support system at university level

To make the guidelines for a structured peer support system at university level: The guidelines for a structured peer support system at university level have been formed. These guidelines are especially designed after probing into the overall results which reflect that university students of Punjab require a structured peer support system and also this system contribute towards adjustment and well-being of university students.

Structured peer support system: Structured peer support consist of a formal group of senior students who are empathetic and willing to serve their fellow beings, a training in the field of guidance and counseling

will better serve the purpose.

Purpose of a structured peer support system: Mostly universities prefer structured peer support group to deliver their services rather than unstructured peer support.

- The main objective of structured peer support is to encourage new students to interact with senior and successful students.
- The first year students face more problems than those in later years and are more likely to struggle with academic and social adjustments. This suggests that students may need structured peer support more at the beginning of their university life and less as they progress.
- It aims to support students in their academic and social adjustment in college life.
- It acts as a mutual aid model as it provides an opportunity to connect with others who have similar experiences and learn from them directly, ultimately improving quality of life through social, emotional, mental adjustment and well-being.
- It can help fresher students to develop proper identity.



Administrative Body and its Working

• One coordinator at university level under the authority of Directorate of student welfare can be selected to help the peer support committee to

plan, implement and evaluate the working of the system and give proper guidance and direction to convener who work at college level.

- Coordinator can organize different trainings like guidance and counseling skills for the executives and active members of the student body.
- Class in-charges of all the classes of bachelor programmes play a vital role in structured peer support system as they can easily assess the problems of the students due to more frequent contact with them.
- In-charges and advisors can help in nominating the students which they think might be good volunteers.

Student body			
Executive committee	President Vice-President Secretary Joint Secretary		
Active members	Class Representatives Volunteers		

Working of student body

- The president and vice-president can be chosen from final year students of college. The candidate who have formally applied can be interviewed.
- Some of the qualities to be judged in an interview for the selection of executive body are empathetic attitude, leadership quality, emotional maturity and social maturity, which they must possess to act as a positive ambassador for university students.
- The secretary and joint secretary can be selected from third year students of college.
- One class representative (CR) and two to four volunteers can be selected from each class. Class representative is a student who represents the views of his/ her class on academic matters.
- Volunteers along with class representatives can help in forwarding the concerned issues to executive body of the students.
- The role of peer support group may be more beneficial to enhance well-being and adjustment

of the first and second year students at university level as they need high support in emotional, academic and social sphere.

• During orientation program, in the college as well as in hostel, the president of the students' executive committee can give the introduction of the peer support system existing in the university and can also explain how it works for the adjustment and well-being of the students especially the new entrants.

Role of a structured peer support group

- In the semester a few ice-breaker sessions may be conducted so that students can openly talk about their issues without reluctance.
- Highlighting previous work including case studies (with changed names) can develop faith of fresher students and can boom the importance of such support system.
- A day in a week can be fixed for the students to share their personal and academic issues.

CONCLUSION

Not only is structured peer support an effective way to combat the stress and depression that can accompany the transition from high school to university, but it can also be useful throughout a student's undergraduate career. Moreover, those who perceived more structured peer support may benefit because peer supporters can help identify disconcerting thoughts and behaviors and urge those without a perceived need to receive professional help. In this case, structured peer support can be a beneficial addition to student campuses alongside professional services. It would be also helpful for parents, counselors, psychologists, and human development professionals to understand the level of college students. This study will be useful for the youth to understand the importance of mental health, adjustment and well-being of university students.

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Review Article

Cultivating Tomorrow: The Synergy of India's Population Growth, Agriculture, and Agri- Entrepreneurship

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ABSTRACT

India's population has always been a significant driver of its agricultural sector. As the country grapples with the challenges of feeding its ever-growing population, agri-startups have emerged as a crucial element in the agriculture ecosystem. The intricate relationship between India's population, agricultural products, and agri-startups is immense while addressing future agricultural trends and challenges. On the other, there is a greater number of agricultural undergraduates coming out of agricultural universities every year. This rich human resource can be motivated towards agripreneurship. This paper delves into the connections between India's population, agricultural production, and the role of agriculture undergraduates in agristartups, offering insights into their future implications.

Keywords: Agricultural education, Agripreneurship, Agri-startups, Population growth, Sustainable agriculture

INTRODUCTION

India has achieved self-sufficiency in food grain production over decades (Figure 1). India, with its burgeoning population exceeding 1.3 billion, faces a unique set of challenges in the agricultural sector. The need to produce enough food to feed this growing populace is a pressing concern. Simultaneously, the agricultural industry is undergoing a transformation driven by technology and innovation, primarily through the rise of agri-startups.

India's population is projected to continue growing for the foreseeable future. This demographic trend puts enormous pressure on the agricultural sector to increase food production. The correlation between population growth and the demand for agricultural products is evident, especially for staples like rice, wheat, and pulses. On the other hand, the escalating population also has led to land fragmentation, resulting in smaller landholdings. This diminishes the per capita availability of arable land and intensifies the need for increased agricultural productivity through modern techniques and technologies. Besides, India's agricultural landscape is diverse, with a wide variety of crops grown across different regions. However, the demand for staple crops has sometimes led to monoculture practices, which can lead to soil



Figure 1: Population and food grain production in India

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degradation, pest infestations, and reduced crop resilience. Sustainable practices are essential to address these challenges. Despite increased agricultural production, India faces significant post-harvest losses due to inadequate infrastructure, lack of modern storage facilities, and inefficient supply chains. These losses have substantial economic and food security implications.

Agri-Startups: Catalysts for Change

Agri-Startups are interventions by innovative minds acting as catalysts for change. They are businesses that use innovative technology to solve problems in the agriculture industry. There has been increasing dominance of agri-startups in areas like Precision agriculture, Agtech and Farm management software, Vertical farming and controlled environment agriculture, Agrobotics, Sustainable agriculture, Supply chain management, Market access and agri-market places, Agri-fintech, Data analytics and predictive modelling, Agri-biotechnology. Agri-startups are at the forefront of precision agriculture, using data analytics, IoT (Internet of Things) sensors, drones, and satellite imagery to optimize farming practices. They enable farmers to make data-driven decisions about planting, irrigation, fertilization, and pest control, leading to higher yields and reduced resource wastage. Agristartups offer farm management software and apps that help farmers with tasks like crop planning, inventory management, and resource allocation. These tools streamline operations, improve communication, and enhance productivity on the farm. Some agri-startups are pioneering vertical farming and controlled environment agriculture solutions. They use advanced technology to grow crops indoors, allowing for yearround production in urban areas and reducing the environmental impact associated with traditional agriculture. Robotics and automation are becoming increasingly important in agriculture. Agri-startups are developing robots and autonomous vehicles for tasks such as planting, harvesting, weeding, and monitoring crop health. These technologies reduce labour costs and make farming more efficient. Many agri-startups focus on sustainable practices, including organic farming, regenerative agriculture, and soil health management. They offer innovative solutions to reduce chemical inputs, enhance soil fertility, and promote environmental stewardship. Startups are developing blockchain-based systems and other technologies to

improve transparency and traceability in the agricultural supply chain. This helps reduce food fraud, improve food safety, and ensure fair compensation for farmers.

Agri-startups are creating online marketplaces that connect farmers directly with consumers, restaurants, and retailers. This cuts out middlemen, improves market access for farmers, and ensures fresher produce for consumers. Some startups offer financial solutions tailored to the agriculture sector, such as microloans, insurance products, and credit scoring services. These tools help farmers manage risk and invest in their operations. Agri-startups analyse vast amounts of data to provide farmers with insights into weather patterns, pest and disease threats, and crop performance. This information helps farmers make proactive decisions to protect their crops and maximize yields. Startups in the biotechnology sector are working on innovations like genetically modified crops and gene editing techniques to enhance crop resilience, nutritional value, and pest resistance. Agri-startups are playing a crucial role in modernizing the agriculture industry, making it more efficient, sustainable, and resilient. Their innovative solutions have the potential to address the global challenges of food security, climate change, and resource scarcity, while also providing economic opportunities for farmers and entrepreneurs.

The Startup India is a flagship initiative by Govt of India from 2015 onwards which was aimed to build a strong eco-system for nurturing innovation and Startups in the country that will drive sustainable economic growth and generate large-scale employment opportunities. The initiative has provided agri-startups with access to a number of benefits, including Funding, Mentorship, Regulatory support and Infrastructure, etc. It provides agri-startups with access to funding through a variety of schemes, such as the Startup India Seed Fund and the Fund of Funds for Startups. It provides agri-startups with access to mentorship from experienced entrepreneurs and investors. It has simplified the regulatory process for agri-startups, making it easier for them to start and operate their businesses. It has created a number of incubators and accelerators that provide agri-startups with access to shared workspaces, equipment, and other resources. The Startup India initiative has helped to create a more supportive ecosystem for agri-startups in India. As a result of these benefits, the number of agri-startups in India has grown rapidly in recent years.

Substantial progress has been made under the Startup India initiative, which has stirred entrepreneurial spirit across the country. As of Jan 2023, there are 80,000 start-ups in all sectors including 2000 agri-startups (https://dpiit.gov.in/) in India. The Indian startup ecosystem is the third largest ecosystem after USA and UK with investment by India amounting to USD 200 million. The Department for Promotion of Industry and Internal Trade (DPIIT) is mandated to coordinate the implementation of Startup India initiative with other Government Departments. The government launched the Scheme for Promotion of Innovation, Rural Industry and Entrepreneurship (ASPIRE), which aims to create jobs and businesses in the agricultural sector (Lahmo and Parihar, 2022). Apart from DPIIT, the initiatives under Startup India are driven primarily by five Government Departments viz. Department of Science and Technology (DST), Department of Bio-technology (DBT), Ministry of Human Resource Development (MHRD), Ministry of Labour and Employment and Ministry of Corporate Affairs (MCA) and NITI Aayog (www.startupindia.gov.in). Factors like land holding size and social/political involvement are affecting the farmers' decision to become members of the FPOs (Sharma et al., 2022).

Agri-startups are playing a significant role in creating jobs, especially in rural areas where agriculture is a primary source of employment. These jobs span various sectors, including farm management, data analysis, logistics, and technology development. It's impressive to note that over 9 lakh direct jobs have been created by the DPIIT-recognised startups, with a notable 64 per cent increase in 2022 over the average number of new jobs created in the last three years. (Economic Survey, GoI, 2023). The top fund raisers in the agriculture sector are Waycool, Ninjacart, Dehaat, Absolute, Agro Star, Arya.org, etc. (www.startupindia.gov.in.).

According to the Economic Survey (2019-20), 3.80 per cent of startups in India are Agri startups. Every 9th Agritech startup in the world is from India. During 2013-17, Karnataka had the highest percentage (27.00%) of agri-startups in the country followed by Maharashtra

(22.00%), NCT (9.00%), Haryana (9.00%), Tamil Nadu (8.00%), Telangana (7.00%), Gujarat (7.00%) and others (11.00%). Karnataka and Maharashtra together account for fifty per cent of the total Agritech startups opened in India. Further, Karnataka receives 67.00 per cent funding for Agritech startups among all the states of India followed by Maharashtra (7.00%), NCT (11.00%), Telangana (7.00%) and others (8.00%). Agristartups are also increasingly looking to corporate partners for funding and support. There are a number of different sources of funding available to agristartups, like venture capital firms, angel investors, government grants, and crowdfunding platforms. Strategic partnerships with established agriculture companies, retailers, and food processors can provide agri-startups with not only funding but also valuable industry expertise and distribution channels.

Agripreneurship: Linking Agricultural Education to Innovation

India has the world's largest agriculture education network by having facilities for education in 12 disciplines at the undergraduate level and 96 disciplines at the postgraduate level. Currently, there are 74 Agricultural Universities, comprising 63 State Agricultural Universities (SAUs), 4 Deemed-to-be-Universities, 3 Central Agricultural Universities and 4 Central Universities with agriculture faculty, in the country under the National Agricultural Research Extension System with numerous colleges under them. The intake capacity of students in these institutions, which was less than 5,000 in 1960, has now gone up to > 45,000 (Soam, 2021). Linking these agricultural undergraduates to entrepreneurship in agriculture, often referred to as agripreneurship, is crucial for promoting innovation, sustainable farming practices, and economic growth in the agricultural sector. Entrepreneurship education encourages students to consider starting their own agricultural businesses, which can lead to job creation not only for themselves but also for others in their communities. This can have a positive impact on local employment rates.

Even though youth are expected to play a central role in the evolving agricultural sector, the younger generations are hesitant to pursue careers in the field because of a variety of misconceptions about the industry, as well as a lack of information and awareness of opportunities (Aphunu and Atoma, 2010; Rana et al., 2020). The youth are looking for professional growth opportunities that are concentrated in nonagricultural sectors due to the lack of clear connections between the agricultural sector and the hyperbole surrounding the fourth industrial revolution. According to earlier research, some young people have also avoided the field because of its low pay and demanding physical requirements (Mibey, 2015). Given that young people are the link between the present and the future, it is feared that the decreased youth participation in agriculture will likely jeopardise the agricultural sector's long-term viability (Okeowo et al., 1999; Thammi Raju et al., 2020). Through a systematic educational approach, the teaching of creative thinking and innovative problem-solving for the recognition and development of agricultural prospects could ensure food security at the household, sectoral, and national levels (Uneze, 2013). It also facilitates smallholder farmers' productivity gains, fosters growth, diversifies and increases income, and their integration into regional, national, and global markets (Sah, 2009).

The following measures can be taken to foster agripreneurship among undergraduates:

- Integrate entrepreneurship courses or modules into the undergraduate agricultural curriculum. These courses should cover topics such as business planning, market analysis, financial management, and entrepreneurship skills.
- Set up dedicated agripreneurship centres or incubators within agricultural universities and colleges. These centres can provide students with resources, mentorship, and a supportive environment for developing their agricultural business ideas.
- Invite successful agripreneurs and industry experts as guest lecturers or mentors. Their real-world experience can inspire students and provide valuable insights into the challenges and opportunities in agri-business.
- Promote research and innovation projects among agricultural undergraduates. Encourage them to work on projects that address real-world agricultural challenges, and provide funding and guidance for these initiatives.

- Facilitate internships and practical training opportunities with agripreneurs, agricultural startups, and established farming operations. Hands-on experience can help students gain a better understanding of the industry.
- Organize networking events, pitch competitions, and hackathons related to agriculture and agripreneurship. These events can help students connect with like-minded peers and potential collaborators.
- Provide information about funding opportunities, grants, and subsidies available for aspiring agripreneurs. Offer support in preparing business plans and applications for financial assistance.
- Establish mentorship programs where experienced agripreneurs or alumni guide and support undergraduate students in developing their business ideas.
- Collaborate with agricultural industry stakeholders, organizations, and companies to create opportunities for students to engage with the sector. This can include joint research projects, field visits, and industry-sponsored challenges.
- Foster a culture of innovation and entrepreneurship within the agricultural institutions. Encourage students to think creatively and explore entrepreneurship as a viable career path.
- Connect agricultural undergraduates with the broader entrepreneurial ecosystem, including local incubators, accelerators, and government programs that support startups in the agricultural sector, thus providing them supportive ecosystem.
- Provide ongoing guidance and counselling services to students interested in agripreneurship. Help them navigate the challenges and uncertainties of starting and running their own agricultural businesses.

There is a significant gap between agribusiness and agriculture, and young people in rural India can gain immensely from agripreneurship, which will enhance their standard of living and the prosperity of rural areas (Narendran and Ranganathan, 2015). Agripreneurship contributes in different ways to the growth and expansion of the national economy by fostering entrepreneurship, which raises income levels and employment prospects both in urban and rural regions (Bairwa and Kushwaha, 2012). Incorporating agriculture into the educational curriculum for young people would be beneficial because it will make it more likely that they will grow to be ambitious about agribusiness. Initiatives aimed at increasing youth participation should be designed to offer some seed financing as well as training on how to curb risks as providing such services can encourage the younger generation to start agricultural businesses. In order to encourage more young people to engage in agripreneurship, more should be done to raise public awareness of the profitable business opportunities and well-paying jobs that the agricultural sector has to offer (Magagula and Tsvakirai, 2020).

Governments around the world are recognizing the importance of agri-startups in driving innovation and growth in the agricultural sector. As a result, many governments are implementing policy measures, incentives, and regulatory reforms to support agristartups. Here are some examples of how governments are supporting agri-startups:

Policy measures

Creating dedicated funds and programs to invest in agri-startups. This could include providing grants, loans, or equity investments. For example, the Indian government has launched a \$500 million agritech accelerator program to support early-stage startups.

Providing tax breaks and other incentives to agri-startups. This could include reducing the tax rate for agri-startups, providing tax credits for research and development, or exempting agri-startups from certain taxes altogether. For example, the Kenyan government offers a five-year tax holiday to agri-startups.

Streamlining regulations to make it easier for agri-startups to operate. This could include reducing the number of permits and licenses required, simplifying the application process, or creating a single point of contact for regulatory issues. For example, the US government has created a website that provides agri-startups with information on all of the federal regulations that apply to them.

Incentives

Providing access to land and other resources. This could include providing below-market rates for land, access to government-owned facilities, or preferential treatment in the allocation of water resources. For example, the Chilean government has a program that provides agristartups with access to land at below-market rates.

Offering training and mentorship programs. This could include providing training on business development, marketing, and finance, or connecting agri-startups with experienced mentors. For example, the Australian government has a program that connects agri-startups with mentors who can provide them with advice and support.

Promoting agri-startups to potential investors and partners. This could include hosting events, creating online directories, or providing marketing support. For example, the UK government has a website that lists all of the agri-startups in the country.

Regulatory reforms

Creating a regulatory sandbox that allows agri-startups to test new products and services without having to comply with all of the traditional regulations. This could be a particularly valuable tool for agri-startups that are developing new technologies.

Streamlining the approval process for new agricultural products and technologies. This could involve reducing the amount of data required, simplifying the application process, or creating a faster track for approval.

Harmonizing regulations across different jurisdictions. This could make it easier for agri-startups to operate in multiple markets.

By implementing these types of policy measures, incentives, and regulatory reforms, governments can create an environment that is conducive to the growth and success of agri-startups. This will help to drive innovation in the agricultural sector and contribute to food security and economic development.

LOOKING FORWARD

India's agricultural future is firmly based on the interdependence of population growth, agri-startups, and agricultural education. Understanding this symbiotic relationship is essential; agri-startups and agricultural education will be key drivers of sustainable growth as our population grows. Envisioning the future, our focus should be on a sustainable, innovative, and
thriving agricultural sector. The pressing need to address environmental concerns and mitigate climate change will drive agri-startups to develop and promote sustainable agricultural practices. Sustainable practices, driven by agri-startups, are key, which guarantee productivity without endangering the environment. Sustained backing from the government, educational institutions, and industry stakeholders is imperative. Government programmes must evolve to provide targeted funding, streamlined policies, and infrastructure development. The government's role in supporting agri-startups through policy measures, incentives, and regulatory reforms will be crucial in shaping and accelerating the future of agriculture in India, thereby meeting the challenges of reaching out to billions of populations in future. In order to foster future agripreneurs, educational institutions must embrace innovation and incorporate entrepreneurship into agricultural curricula. Stakeholders in the industry, both new and established, should work together to support this revolutionary journey by pooling resources and expertise. With the appropriate level of commitment, collaboration, and an innovative outlook, India's agricultural landscape has the potential to genuinely evolve and become a global model of sustainable, agripreneur-driven growth.

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Research Article

A Study of Farmers Perception About Agricultural Mobile Apps

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ABSTRACT

One such piece of technology that can be immediately applied to the expansion of agriculture is the mobile application. Additionally, the current research was carried out in four districts of the Haryana state, namely Rewari, Jhajjar, Karnal, and Kurukshetra, in the year 2022 to investigate how farmers perceive agricultural mobile apps. Additionally, two blocks from each of the four districts were randomly chosen, as were two villages from each of the eight blocks. This gave a total of sixteen villages, with fifteen respondents from each village being chosen for the data gathering. As a result, 240 respondents were chosen in total, and the researcher directly interviewed them at their farms and homes. According to the current study, most farmers had a medium degree of perception of mobile technology. The majority of respondents classified their view of agriculture mobile apps as medium level. Overall, respondents' perceptions of agricultural mobile applications were satisfactory.

Keywords: Perception, Mobile Apps, Respondents, Majority and agriculture

INTRODUCTION

Information is essential for improving output and lowering cultivation costs (Birthal et al., 2015; Ake, 2003). Extension systems for public sector have lessened their effect due to information failures (Anderson and Feder, 2004). Compared to the conventional techniques used in public extension systems, using information and communication technology (ICT) has many benefits (Park, 2004; Lomas, 2000; Ake, 2003; Mangina, 2005; Gandhi et al., 2008). Utilizing mobile-enabled information services reduces information asymmetry, enhances the function of extension services, and boosts farmer output (Mittal et al., 2010; Jensen, 2007). Additionally, it assisted in reducing physical activity. Farmers are increasingly using mobile applications now-a days. Mobile apps are pieces of software created to make the most of mobile technology, allowing the transmission and gathering of data for social and economic activities (McNamara, 2009). The number

of mobile applications created for the agriculture industry by the public sector, the private sector, and organisations based on farmers is on the rise. The potential for mobile use and mobile-enabled services for farms expands with this rise in rural mobile penetration. When Qiang et al. (2011) studied 92 mobile apps from developing nations in Africa, Asia, Latin America, and the Caribbean, they found that the majority of the apps were focused on enhancing the integration of the agriculture supply chain and served a variety of purposes, including facilitating market links, supplying market information, and expanding access to extension services. For mobile app content to be useful to rural users in developing nations, it must be extremely localized. According to Luna-Nevarez and McGovern (2018), a major part of adapting the traditional educational method to contemporary educational methods in the 21st century was played by mobile phones with rapidly expanding educational applications that were used as instructional resources.

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This study will have a significant practical effect on agricultural production and extension in the current environment. More than 48Percent of Indians work in agriculture either directly or tangentially. It is crucial that the agricultural sector be connected and embrace modern technologies in order to make it productive, easy, lucrative, and respectable. One such piece of technology that can be immediately applied to the expansion of agriculture is the mobile application. The study's findings will be used to create an effective "ICT" plan for agricultural development. Mobile apps for agriculture are a crucial instrument for bridging the gap between scientific advice and farmers' implementation of it. The study's conclusions will be very helpful to agricultural institutions, scientists, and managers engaged in designing and creating mobile applications that meet farmers' needs. Evaluating how mobile app users perceive their effect will also be helpful (Upali Kisku, 2022). The research also assesses the effect of farmers' personal, socioeconomic, communication, and perception factors on agricultural mobile apps. The results will therefore be extremely helpful for farming app developers and their use.

METHODS AND MATERIALS

The current research was carried out in the state of Haryana. Four districts were chosen for this study: Kurukshetra, Karnal, Rewari, and Jhajjar in the southwestern and north-east regions, respectively, of Haryana. Two blocks from each of the four districts were chosen at random. Additionally, two villages were randomly chosen from each of these eight blocks, making a total of 16 villages chosen for data gathering. Sixteen villages from four districts were thus randomly chosen, and 15 farmers who were using agricultural mobile applications were randomly chosen from each of the 16 villages. Thus, 240 farmers in total were chosen, and the researcher directly interviewed them in their homes or fields. To gather data for this research, a well-structured and pre-tested interview schedule was created. The researcher conducted in-person interviews with each of the chosen respondents.

RESULTS AND DISCUSSION

According to the data in Table 1, the vast majority of farmers (92.91%) ranked first and fully agreed that they could access information with 2.91 WMS at any moment (24 hours/day). Weather forecasting access came in second with 2.90 WMS, followed by

information accessed from anywhere in the world with 2.86 WMS, potential agricultural problems solutions with 2.83 WMS, best cropping pattern adoption with 2.77 WMS, information reaching farmers in the shortest amount of time with 2.70 WMS and access to updated information with 2.47 WMS, respectively. The findings of this research are consistent with those of Rupender (2017).

According to Table 1's findings, the majority of farmers (89.58%) agreed that mobile apps were essential for providing information about the needed nursery size (2.88 WMS), ranking first. While soil treatment came in at 2.80 WMS, followed by soil and water testing at 2.77 WMS, knowledge was useful for field preparation and monsoon prediction at 2.72 WMS, which came in at 2nd, 3rd, and 4th, respectively, with those rankings. The findings of this research are consistent with those of Jeevan Ram Jat (2021).

According to the data in Table 1, the majority of farmers (86.67%) ranked first and completely agreed with that mobile apps help in recommended fertilizers dose of 2.81 WMS. Information about the proper time to sow was rated second with 2.67 WMS, followed by seed treatment with 2.50 WMS, high-quality varieties with 2.49 WMS, an appropriate method of sowing seeds with 2.45 WMS, and information about intercropping with 2.08 WMS. These results might be due to mobile apps provided guidance in sowing practices.

According to the data in Table 1, the majority of farmers (87.92%) completely agreed that mobile apps help in pest management, with 2.83 WMS coming in first place. It was followed by the right number of pesticides (2.80 WMS), various crop pests and effective weedicides (2.79 WMS), the right timing of irrigation (2.75WMS), assistance in planning the irrigation and fertilizer application (2.56 WMS), various weeding techniques (2.48 WMS), the number of irrigations (2.46 WMS), the best irrigation technique for the crop (2.36 WMS), the source of fertilizers availability (2.34 WMS), the need for micronutrients. The results are conferred by the study of Wason (2009).

The information through mobile apps regarding the method of storages with 2.56 WMS and rated first was completely accepted by the majority of farmers (68.75%), according to the data in Table 1. Information about the best methods and timing for harvesting came

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Table 1: Perception of farmers about agricultural mobile apps service (n=240)

S.	Statements	Response under each category		WMS	Rank	
No.		Undecided	Disagree	Agree		
1.	Information reaches the farmers in minimum time period	14 (05.83)	44 (18.33)	182 (75.83)	2.70	VI
2.	Farmers getting possible solution for the agricultural problems	04 (01.67)	31 (12.92)	205 (85.41)	2.83	IV
3.	Access to weather forecasting	06 (02.50)	11 (04.58)	223 (92.92)	2.90	Π
4.	Farmers can get information at any time (24 hrs/7 days)	04 (01.67)	13 (05.42)	223 (92.91)	2.91	Ι
5.	Information can be accessed from any part of the globe/world	10 (04.17)	12 (05.00)	218 (90.83)	2.86	III
6.	Information helps in adopting best cropping pattern	16 (06.67)	21 (08.75)	203 (84.58)	2.77	V
7.	Access to updated information (price, inputs availability)	30 (12.50)	65 (27.08)	145 (60.42)	2.47	VII
1.	Predicts date of onset and withdrawal of monsoon	15 (06.25)	35 (14.58)	190 (79.17)	2.72	IV
2.	Information helps in field preparations	13 (05.42)	39 (16.25)	188 (78.33)	2.72	IV
3.	Information regarding the size of nursery required	03 (01.25)	22 (09.17)	215 (89.58)	2.88	Ι
4.	Information about soil and water testing	15 (06.25)	23 (09.58)	202 (84.17)	2.77	III
5.	Mobile apps provide information regarding the soil treatment	12 (05.00)	22 (09.17)	206 (85.83)	2.80	Π
1.	Information regarding correct time of sowing	22 (09.17)	35 (14.58)	183 (76.25)	2.67	Π
2.	Information of suitable method of seed sowing	42 (17.50)	48 (20.00)	150 (62.50)	2.45	V
3.	Information about high quality varieties	49 (20.42)	24 (10.00)	167 (69.58)	2.49	IV
4.	Information regarding seed treatment	32 (13.33)	55 (22.92)	153 (63.75)	2.50	III
5.	Information regarding intercropping	67 (27.92)	86 (35.83)	87 (36.25)	2.08	VI
6.	Information of recommended fertilizer dose	12 (05.00)	20 (08.33)	208 (86.67)	2.81	Ι
1.	Requirement of micro nutrients	54(22.50)	75 (31.25)	111 (46.25)	2.23	Х
2.	No. of irrigation	31 (12.92)	67 (27.92)	142 (59.16)	2.46	VII
3.	Best irrigation method according to crop	28 (11.66)	97 (40.42)	115 (47.92)	2.36	VIII
4.	Information of correct timing of irrigation	14 (05.82)	31 (12.92)	195 (81.25)	2.75	IV
5.	Source of availability of fertilizers	48 (20.00)	62 (25.84)	130 (54.16)	2.34	IX
6.	Scheduling the irrigation and fertilizer application	16 (06.66)	73 (30.42)	151 (62.92)	2.56	V
7.	Weed management	17 (07.10)	46 (19.15)	177 (73.75)	1.83	XI
8.	Different methods of weeding	23 (09.58)	78 (32.50)	139 (57.92)	2.48	VI
9.	Effective weedicide	15 (06.25)	20 (08.33)	205 (85.42)	2.79	III
10.	Various pests of crop	13 (05.41)	24 (10.00)	203 (84.59)	2.79	III
11.	Pest management	10 (04.16)	19 (07.92)	211 (87.92)	2.83	Ι
12.	Correct dose of pesticides	11 (04.58)	24 (10.00)	205 (85.42)	2.80	II
1.	Timing of harvesting	30 (12.50)	51 (21.25)	159 (66.25)	2.53	II
2.	It gives proper precautions and method of harvesting	12 (05.00)	93 (38.75)	135 (56.25)	2.51	III
3.	Helps in booking transport vehicle for taking produce to market	42 (17.50)	73 (30.42)	125 (52.08)	2.34	V
4.	Helps in minimizing the post-harvest loss	73 (30.42)	50 (20.83)	117 (48.75)	2.18	VIII
5.	Method of storages	30 (12.50)	45 (18.75)	165 (68.75)	2.56	Ι
6.	Storage facilities provided by Govt.	47 (19.58)	48 (20.00)	145 (60.42)	2.40	IV
7.	Treatment before the storage	51 (21.25)	91 (37.92)	98 (40.83)	2.19	VII
8.	Increased connectivity with stakeholders (consumers, traders, etc.)	56 (23.34)	65 (27.08)	119 (49.58)	2.26	VI

in second with a score of 2.53 WMS, followed by information about the government's storage facilities with a score of 2.40 WMS, assistance in scheduling a transport vehicle to deliver produce to market with a score of 2.34 WMS, improved connectivity with stakeholders (consumers, traders, etc.), treatment prior to storage, and access to up-to-date information with a score of 2.26 WMS, and assistance in reducing postharvest losses. These results are due to mobile apps provide govt. schemes to store agriculture produce and help in managing the transport facilities. The results are conferred by the study of Ayush (2021).

Table 2 findings show that 32.92 per cent of respondents had a high level of perception about agricultural mobile apps, followed by 17.91 per cent of respondents with a low level of perception, and nearly half of the respondents (49.17%) had a medium level of perception. The majority of respondents responded favourable to agricultural mobile applications.

Table 2: Overall perception of farmers aboutagricultural mobile apps service

Category	Frequency	Percentage
Low (< 90)	43	17.91
Medium (90-102)	118	49.17
High (> 102)	79	32.92

According to this, respondents were more likely to favour agricultural mobile applications than conventional methods of getting weather information. These conclusions concur with those of Vernon (1994) and Madison (2006).

Table 3 shows that four variables-mass media exposure, extension contacts, innovativeness, and use of mobile apps-showed positive and significant relationships at the 1.00 percent level of probability out of the 18 independent variables chosen for the research. A significant negative association between age and two variables, cosmopoliteness and education, was found at a 5.00 percent level of probability.

According to the data in Table 4, a multiple regression analysis of a few variables and the perception level of mobile app users revealed that all 18 independent variables together were responsible for 51.20 per cent of the variance in the respondents'

Table 3: Relationship between selected independent variables and perception of the respondents towards agricultural mobile apps

Independent variables	Correlation coefficient (r)
Age	-0.139*
Education	0.157*
Caste	0.024^{NS}
Land holding	0.065^{NS}
Annual income	0.102^{NS}
Source of irrigation	0.082^{NS}
Mass media exposure	0.188**
Method of irrigation	0.076^{NS}
Farm machinery	0.109 ^{NS}
Implements available at custom hiring centers	0.042 ^{NS}
Extension contacts	0.174**
Innovativeness	0.191**
Farming system	0.112 ^{NS}
Crop rotation	0.014^{NS}
Cosmopoliteness	0.137*
Soil Health Card (SHC)	0.030^{NS}
Kisan Credit Card (KCC)	0.072^{NS}
Apps using	0.187**

** Significant at 1%, * at 5% respectively and NS= non-Significant

perceptions of agricultural mobile apps. At a 5.00 per cent level of probability, the regression coefficient of education, extension contact, innovativeness, farming system, cosmopoliteness, and using mobile applications was significant. Exposure to the media and age were significant at the 1.00 per cent threshold of probability. Therefore, it can be inferred that a change of one unit in the independent variables can cause a corresponding change in the respondents' perception of agricultural mobile applications.

The majority of respondents were young and middle-aged, which could be the cause of these findings. Respondents in this category were more educated, eager to embrace new technologies at a risk, and active online. The findings of this research are consistent with those of Savithramma (2011) and Rupender (2017).

These respondents were aware of digital information and mobile apps. The above findings are

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Independent variables	'B' value	't' value	'P' value (Significant value)
Age	-0.117	-2.398	0.017*
Education	0.144	2.855	0.005**
Caste	0.095	1.873	0.062^{NS}
Land holding	0.090	1.729	0.085^{NS}
Annual income	0.087	1.708	0.089 ^{NS}
Source of irrigation	0.084	1.664	0.098^{NS}
Mass media exposure	0.145	2.589	0.010*
Method of irrigation	0.090	1.830	0.069 ^{NS}
Farm machinery	0.099	1.882	0.061 ^{NS}
Implements available at custom hiring centres	0.099	1.881	0.061 ^{NS}
Extension contacts	0.171	3.275	0.001**
Innovativeness	0.167	3.070	0.002**
Farming system	0.129	2.396	0.017**
Crop rotation	0.102	1.968	0.051 ^{NS}
Cosmopoliteness	0.193	3.742	0.001**
Soil Health Card (SHC)	0.092	1.850	0.066 ^{NS}
Kisan Credit Card (KCC)	0.085	1.728	0.085 ^{NS}
Apps using	0.237	4.478	0.002**
R ² value		0.512	
Constant		58.358	

Table 4: Multiple reg	ression between selected	d independent variables	and perception of t	he Respondents at	out mobile
apps					

** Significant at 1%, * at 5% respectively and NS= non-Significant

in line with the findings of Nimbalkar and Pawar (1990) and Padmaiah (1995).

CONCLUSION

Poor agricultural development has been caused, in large part, by limited access to knowledge and input resources, which widened the gap in the adoption of new technology. An information-based, decisionmaking agricultural system is necessary to take a major step towards increased agricultural productivity. Farmers are well-versed in agricultural mobile apps, it is determined, but they should follow the advice provided by these apps. The research found that respondents knew a lot about agricultural mobile applications. According to the research, respondents' perceptions of agricultural mobile apps ranged from high to medium. This is encouraging, but there is still room for improvement by offering more training sessions on how to use these applications effectively. The research found that the majority of respondents responded favourable to agricultural mobile apps and made extensive use of the various services offered by mobile apps.

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Research Article

Exploring Audience Sentiment towards Popular Farming YouTube Videos through Analysis of Associated Comments

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ABSTRACT

YouTubers use the potential of videos in various subjects, including finance, education, farming, brand promotion, etc. In the current internet and social media era, farmers are also using social media and digital platforms to learn about farming tools and techniques rather than only relying on conventional methods. They also provide feedback in the form of comments and likes, which gives YouTubers the crucial data they need to create engaging content for their audience. This study examines the users' feedback on the most viewed YouTube farming videos by performing the sentiment analysis of the comments on the selected videos. The sentiment analysis was conducted by using the R software program in which the analysis was done by using sentiment lexicons which assign sentiment scores to the texts. By the word frequency data, data trends of commonly used words and lesser used words were comprehended. According to the overall sentiment scores, the study's result revealed that most viewers have positive sentiments about the chosen videos. The result also showed that the viewers want to make personal contact with the experts and are more interested in the video if some machinery is involved in the agricultural process.

Keywords: Comments, Farming videos, Feedback, Sentiment analysis, YouTube

INTRODUCTION

YouTube is an American online video-sharing and social media platform owned by Google. It was founded in February, 2005, and has been of great use since then. In India, it was launched in 2008. The current times are witnessing a digital era in which video is one of the most accessible means used in mass media, significantly impacting people. YouTube is becoming the most popular and most extensive online platform worldwide. In social media, YouTube is one where there is a lot of traffic these days. As of 2022, there was an estimated 2.1 billion YouTube users worldwide, and it is the second most popular social media platform in terms of the number of searches performed daily (Ceci, 2022). YouTubers harness the potential of YouTube to provide quality content to viewers in different domains like finance, education, farming, etc. In 2022, the total internet connections in India stood at 824.89 million. Although the population of the rural area is higher than the urban area in our country, the internet connections in the urban area are higher compared to rural areas, i.e. 493.08 million connections in the urban area and 331.81 million connections in rural areas (TRAI, 2022). Internet users have been increasing in rural areas along with urban areas. Nowadays, farming people are also very much interested in using social media platforms like YouTube to get farming-related information and exchange their ideas.

In the current age of the internet and social media, they use social media and digital tools to get information and knowledge regarding tools and techniques of farming rather than solely depending on conventional methods and also give feedback in terms of comments and likes that provide essential information to the YouTubers for content creation for the satisfaction of the audience. There are many farm influencers on YouTube whose videos are helping millions of farmers

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(Afroz *et al.*, 2014; Sinha and Basu, 2020). Different people interpret agricultural information differently and also get benefits accordingly. Sentiment analysis of the comments on the videos is the technique to get the subjective information to know the people's opinions, attitudes, and emotions towards the content of that video. To understand how people interpret agricultural information and sentiments associated with the comments on the selected YouTube farming videos were analyzed in this research.

MATERIALS AND METHODS

The study sample was the most viewed videos posted by popular farming YouTubers in India. The ten YouTubers were selected purposively following the ten best YouTube channels for Indian farmers (Tractor Junction, 2021). The list of the most popular YouTubers is updated annually on the website. The detail of the selected channels is mentioned in Table 1. There are different categories of videos on YouTube with different content and video length, like promotional videos, subject matter-related videos, shorts, etc. In this study, only those videos were purposively chosen on the basis of inclusion criteria: videos above one minute in duration, videos in English and Hindi language and videos based on the subject matter. Five videos with the most views were selected from the YouTube channel of each YouTuber. Thus, the total sample size of videos was 50.

The sentiment analysis was conducted using the R software program, a free, open-source software program in which the analysis is performed using sentiment lexicons which assign sentiment scores to the texts. The NRC lexicon was used for this study since

apart from estimating the polarity, i.e. reporting of positive and negative words, it also provides eight additional categories, which are trust, surprise, sadness, joy, fear, disgust, anticipation, and anger.

The comments of Selected YouTube videos were extracted using YouTube API. The extracted comments were pre-processed before the analysis because they had many things other than the required text, like punctuation, emojis, stop words, and some irrelevant words. The extracted comments were translated into English language for analysis. Finally, the text was extracted from the comments and used for analysis. R studio and R programming languages were used to write a script for text mining and pre-processing (de Micheaux *et al.*, 2013) (Figure 1).

Sentiment analysis is analysing subjective information to know people's opinions, attitudes, and emotions toward an entity that can represent individuals, events, or topics (Medhat *et al.*, 2014). The expression we know by sentiment analysis may be positive,



Figure 1: Steps involved in Text mining and Pre-Processing

S.No.	YouTube channel	No. of subscribers	YouTuber/ Owner
1.	Farming Leader	3.67 million	Mr. Darshan Singh
2.	My kisan dost	1.09 million	Mr. Yash Jat
3.	Hello Kisaan	1.04 million	Mr. Robin Tyagi
4.	Technical Farming	773 thousand	Mr. Kuldeep Singh
5.	Indian Farmer	749 thousand	Mr. Santosh Jadhav
6.	Ravizone Farming Leader	603 thousand	Mr. Ravi Tyagi
7.	Crops Information	338 thousand	Mr. Pargat Singh
8.	Indian Farming Management	340 thousand	Mr. Satyender Kumar
9.	Tractor Junction	211 thousand	Mr. Rajat Gupta
10.	Kheti Ki Shaan	154 thousand	Mr. Kamal Jat

Table 1: Selected top 10 farming YouTube channels

negative, or neutral. The extracted text was analysed to identify and extract subjective information related to the emotional intent, attitude, and emotions of the piece of text or comment. The processed texts were then analysed using a sentiment lexicon which assigns sentiment scores to the processed texts. The NRC lexicon is used for this study since, apart from estimating and reporting positive and negative words, it also provides ten additional categories: negative, positive, trust, surprise, sadness, joy, fear, disgust, anticipation, and anger. Text classification is based on their polarity, whether positive, negative, neutral, or other emotions.

RESULTS AND DISCUSSION

In this research, a total of 49608 comments were imported, with a total of 2228108 raw words from the selected farming YouTube videos. After preprocessing, there were 1886895 rectified characters for the analysis. The result showed that the word "contact" and "machine" were the most frequently words used in the text with a frequency of 2946, followed by the word "number", asking for information about the contact of the experts with a frequency of 2754. It was followed by the word "price" with frequency 1493. The next word, "great", was most frequent with the frequency of 1475 to show gladness and gratitude to the experts in the video and so on. The word frequency of all words can be understood by the word cloud, shown in Figure 2.

NRC lexicon was used for the sentiment analysis, which provides ten categories of basic emotions and sentiments, i.e. anger, fear, anticipation, trust, surprise, sadness, joy, disgust, negative and positive. The sentiment lexicon assigned sentiment scores to the



Figure 2: Word cloud of words used in the comments



Figure 3: Overall Sentiment score

processed texts. The overall sentiment score of the ten basic emotions and sentiments is shown in Figure 3. The overall sentiment score of basic emotions and sentiments are: Positive (score: 769) and Negative words (score: 130); Trust (score: 439); Fear (score:146); Anticipation (score:185); Sadness (score:219); Anger (score:171); Joy (score:254) and Disgust (score:90).

The most frequently occurring word in the category of trust are "sir, machine, good, brother, found, money, share, provide, formula, show, excellent, calf", category surprise are "good, money, veer, advance, tree, wonderful, leave, vote, luck, hoax, greeting", category joy are "good, found, money, advance, share, beautiful, excellent, calf, tree, love", category anger are "subsidy, money, fraud, cutting, bad, chaff, tree, ram, mob, vote", category anticipation are "good, delivery, mobile, money, time, mill, advance, share, watch, coming", category disgust are "subsidy, cutting, bad, tree, fat, hoax, lie, fool, rubbish, pregnancy, nose, interested, dislike", category fear are "cutter, veer, advance, cutting, watch, bad, chaff, government, problem, hospital", category sadness are "cutting, bad, problem, hospital, fat, blue, leave, vote, mother, hoax", category negative are "cutter, subsidy, fraud, cutting, bad, fake, chaff, small, government, payment", category and positive are "sir, good, brother, contact, information, delivery, found, money, worth, advance".

It was found that the types of video posted by the influencers depend on the need, demand and likeness of the audience, which is in line with the study of Banmeke *et al.* (2021) and Thomas *et al.* (2021). The videos were found to help assist in decision-making by the farmers (Sharma *et al.*, 2021). Audience response is the ultimate objective of any communication, which may be positive, negative, or no response, and this plays a very important role in the best content creation by the influencers. Following pre-processing of the extracted comments, the word frequency data gives an overview of the commonly occurring words in the text mass. For basic knowledge, it is essential to comprehend the data trends relating to keywords, commonly used words, and lesser-used words in the corpus. The emotional and sentiment scores, i.e. Positive (score: 769), Negative (score: 130), Trust (score: 439), Fear (score: 146), Anticipation (score: 185), Sadness (score: 219), Anger (score: 171), Joy (score: 254), Disgust (score: 90) demonstrate that the text mass contains a range of viewer emotional reactions. For ease of comprehension, the most frequent words in each category of the emotional score and sentiment score are also studied. According to the overall sentiment scores, the majority of viewers have positive sentiments about the chosen videos, which is in accordance with the study of Mostafa (2019). The findings are also similar to the findings of the study done by Neogi et al. (2021).

CONCLUSION

The influencers have gained high subscriber counts that generate revenue through advertisements and brand partnerships. In addition, the influencers create relationships with their subscribers, leading to loyalty through video views and likes. Now more than ever, customers are seeking videos and social media as sources of product information. The study's methodology could be a reference guide for educating current and rising farming YouTubers aspiring to grow their channels through subscribers and video views. The quick analysis of the audience's comments will help the YouTubers create content according to the audience's need, demand, and liking. Incorporating these techniques in their videos could assist in their journey to success on YouTube.

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Research Article



Farmer's Participatory Evaluation of Yield and Economic Analysis of Rice (*Oryza sativa* L.) Varieties under Different Establishment Methods in Punjab, North-Western India

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ABSTRACT

Rice (Oryza sativa L.) is an important kharif crop established either as direct seeded rice (DSR) and/or as puddled transplanted rice (PTR) in north-western India. We compared the performance of short duration (PR-126, n=63) and medium duration (PR-128; n=41 and PR-129; n=31) varieties under DSR and PTR methods at farmers' fields during *kharif*-2021. Mean rice grain yield did not differ significantly (p<0.05) among different establishment methods. The yield difference from average yield potential varied between 0.11 and 0.51 Mg ha⁻¹ for DSR and between 0.19 and 0.42 Mg ha⁻¹ for PTR. As compared with the district average, the rice grain yield was higher by 0.24-0.58 Mg ha⁻¹ under DSR and by 0.27-0.50 Mg ha⁻¹ under PTR. The technology gap of 1.52 Mg ha⁻¹ for PR-126 was lower by ~ 2.97 and ~ 2.86 -times than PR-128 and PR-129, respectively, and the extension gap of 1.32, 1.37 and 0.97 Mg ha⁻¹ for PR-126, PR-128 and PR-129, respectively was observed. As compared with PTR, the irrigation water use was significantly lower in DSR (by ~15.9-20.1%) in three rice varieties. Per cent increase in irrigation water use efficiency in DSR method varied between 17.9-24.7%; the lowest for PR-128 and the highest for PR-129, while PR-126 in-between. These results revealed higher B-C ratio of 4.07-4.16 for DRS, as compared with between 3.25-3.33 for PTR method. The production efficiency was higher for DSR than the PTR method, regardless of the rice variety. The production efficiency was for PR-126 was higher by ~18.4% than PR-128 and by ~15.8% than PR-129 under DSR method.

Keywords: Direct seeded rice, Economic efficiency, Production efficiency, Returns over variable cost, Rice establishment methods

INTRODUCTION

Rice (*Oryza sativa* L.) is important cereal grain crop cultivated extensively in north-western India extending between Punjab in northwest and West Bengal in east (Singh *et al.*, 2005; Singh *et al.*, 2019). Its cultivation after wheat (*Triticum aestivum* L.) in rice-wheat cropping system (RWCS) covers ~13.5 million ha (Mha) in South Asia (Bhatt *et al.*, 2021). RWCS provide food for a large majority of human population and have been the lifeline for the food security and livelihoods of burgeoning South Asian population (Nawaz *et al.*, 2019). The sustainability of RWCS has been questioned with either stagnated or decreased yields due to declining groundwater tables (Bhatt *et al.*, 2019), open field residue burning (Singh *et al.*, 2021a; Sharma *et al.*, 2021), large emission of greenhouse gases emission causes decreased ecosystems' sustainability (Singh *et al.*, 2020a). Of all aforementioned sustainability issues threatening the sustainability of rice based ecosystems, rapidly declining underground water table in entire northwestern Indian states has been most debatable issues (Hira *et al.*, 2004; Bhatt *et al.*, 2021). Despite of these

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sustainability issues, rice production has been expected to increase by $\sim 40\%$ by the end of 2030 to meet the rising demand from the ever increasing human population (FAO, 2009).

Farmers in north-western India follow conventional agricultural practices i.e. wet tillage for puddle transplanted rice (PTR), which is water, capital and energy intensive (Bhatt et al., 2019; Singh et al., 2019; Singh et al., 2021b). In north-western India, irrigation in rice is applied 5-6 times to facilitate land preparation and puddling (wet-tillage in standing water) before rice seedling transplanting under PTR (Bhatt et al., 2021). During previous three decades several site-specific water efficient technologies viz. laser land leveling, alternate wetting and drying, direct seeded rice (DSR), cultivation on permanent raised beds, soil matric potential based irrigation scheduling, selection of early maturity short duration varieties etc. have been recommended in north-western India with variable impact on crop and irrigation water productivity (Bagchi et al., 2012; Campbell et al., 2016; Bhatt et al., 2021; Bhatt and Singh, 2021).

In north-western India, timely rice establishment under PTR which depends on migratory labor for seedling transplanting has faced difficulties particularly during the lockdown period imposed amid COVID-19 pandemics (Bhatt and Singh, 2021). Labor shortage and huge increase in seedling transplanting charges amid COVID-19 restrictions has largely increased area under DSR in north-western India. The DSR technology being time-, energy- and capital-efficient has largely benefitted the farmers in north-western India. In addition, cultivation of early maturing short duration varieties are considered important for water saving (Hasan, 2014; Ohno et al., 2018). Therefore, there was need to study the performance of rice varieties of diverse duration under different establishment methods. The present study was therefore, conducted to investigate the yield, water use efficiency and economics of three different varieties viz. short duration (PR-126) and medium duration (PR-128 and PR-129) under DSR and PTR treatments at farmer's fields during kharif-2021.

MATERIALS AND METHODS

The study area (south-western alluvial plain agroecosub region; longitudes of 29° 33' to 30° 36' N and latitude of 74° 38′ to 75° 46′E) in Bathinda district falls in a south-western Punjab, in north-western India. The study region is characterized by hot, typic arid with hot and dry summers and cold winters. The normal annual rainfall is ~408 mm is received in ~20 days, and has been highly unevenly distributed. The southwest *monsoon* sets in last week of June and withdrawn towards end of September, and contributes ~82% of annual rainfall, while remaining ~18% occurs during non-*monsoon* months. Soils are generally coarse loamy to fine loamy, and are classified as *Ustic Haplocambids*, *Ustic Torripsamments*, and *Ustic Haplocambids*.

A total of 135 farmers field demonstrations were conducted with three short and medium duration rice varieties viz. PR-126 (n=63), PR-128 (n=41) and PR-129 (n=31) during kharif-2021. The crop was established through seedling transplanting in puddle (wet-tillage) fields (i.e. PTR) and DSR. In PTR treatment, ~25-30 days old rice seedlings were manually transplanted in the field. Weeds in rice crops were mainly controlled by the application of herbicides. All other soil management and crop production practices were same in both the treatments. For plant protection measures, chemical insecticides were used by the farmers. The canal and the under-groundwater used for irrigation to crop were extracted by the farmers using electric motors. The harvesting of rice was done mechanically with combine harvesters at physiological maturity.

RESULTS AND DISCUSSION

Rice grain yield of PR-126 in DSR varied between $7.25 \text{ and } 7.47 \text{ Mg ha}^{-1}$ (mean = 7.39 Mg ha^{-1} , compared with between 7.25 and 7.45 Mg ha⁻¹ (mean = 7.31 Mg ha-1) in PTR (Table 1). The grain yield of PR-128 in DSR varied between 6.98 and 7.37 Mg ha⁻¹ (mean = 7.12 Mg ha⁻¹), while between 7.12 and 7.37 Mg ha⁻¹ $(mean = 7.22 \text{ Mg ha}^{-1})$ in PTR. For PR-129, rice grain yield varied between 6.95 and 7.29 Mg ha⁻¹ (mean = 7.05 Mg ha⁻¹) in DSR and between 6.85 and 7.19 Mg ha^{-1} (mean = 7.08 Mg ha^{-1}) in PTR. Mean yield of rice varieties in DSR and PTR did not differ significantly (p < 0.05). The mean yield of PR-126 was highest, while the lowest for PR-129 in both DSR and PTR. Earlier, Singh et al., (2020b) reported that mean grain yield of PR-126 varied between 5.50 and 7.60 Mg ha-1 (mean $= 6.70 \pm 0.22$ Mg ha⁻¹) at farmers' field in south-western Punjab. Bhatt and Singh (2021) reported rice grain yield

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Rice variety	r	Percent change						
	Direct seeded rice (DSR)			Puddled transplanted rice (PTR)			in grain yield	
	Lowest	Highest	Mean	Lowest	Highest	Mean	over PTR	
PR-126	7.25	7.47	7.39a±0.7†	7.25	7.45	7.31a±0.6	1.09	
PR-128	6.98	7.37	7.12a±0.6	7.12	7.37	7.22a±0.9	-1.39	
PR-129	6.95	7.29	7.05a±0.8	6.85	7.19	7.08a±0.7	-0.42	

Table 1: Range and mean of rice (*Oryza sativa* L.) grain yield of different varieties under direct seeded rice (DSR) and puddled transplanted rice (PTR) at farmer's field in south-western Punjab, India

[†]Values indicate mean \pm standard error from mean (S.E._M)

Mean values for compared treatments viz. DSR vs. PTR for each rice variety with different letters are statistically significant at p < 0.05.

Table 2: Grain yield (Mg ha⁻¹) difference from average yield potential and national, state and district average yields, and technology gap, technology index and extension gap for different varieties under direct seeded rice (DSR) and puddled transplanted rice (PTR) at farmer's field in south-western Punjab, India.

Rice variety	Rice grain yield difference (Mg ha ⁻¹)								
	Average yield potential [†]		National average yield [¶]		State average yield [∆]		District average yield ⁰		
	DSR	PTR	DSR	PTR	DSR	PTR	DSR	PTR	
PR-126	0.11	0.19	-4.81	-4.73	-1.22	-1.14	-0.58	-0.50	
PR-128	0.51	0.41	-4.54	-4.64	-0.95	-1.05	-0.31	-0.41	
PR-129	0.45	0.42	-4.47	-4.50	-0.88	-0.91	-0.24	-0.27	
	Techno	ology gap	Techno	ology index	Exter	nsion gap			
PR-126	1	.52		1.52	1.32				
PR-128	4.55		6.62		1.37				
PR-129	4	4.35		6.00	0.97				

[†]Average yield potential is 7.50, 7.63 and 7.50 Mg ha⁻¹, respectively for PR-126, PR-128 and PR-129 (Source: Handbook of Agriculture, P.A.U., Ludhiana).

[¶]National average yield is 2.576 Mg ha⁻¹ (Source: Singh et al., 2020b)

^AState average yield is 6.167 Mg ha⁻¹ (Source: Handbook of Agriculture, P.A.U., Ludhiana)

^θDistrict average yield is 6.806 Mg ha⁻¹ (Source: Handbook of Agriculture, P.A.U., Ludhiana)

of 6.61 Mg ha⁻¹ under DSR and 7.36 Mg ha⁻¹ under PTR; ~10.2% yield increment under PTR.

The yield difference from average yield potential varied between 0.11 and 0.51 Mg ha⁻¹ for DSR, and between 0.19 and 0.42 Mg ha⁻¹ for PTR (Table 2). This difference was lowest for PR-126, compared with other two varieties. As compared with the national average, the grain yield of different rice varieties evaluated in the present study was higher by 4.47-4.81 Mg ha⁻¹ in DSR, compared with 4.50-4.73 Mg ha⁻¹ in PTR. However, the corresponding values were higher by 0.88-1.22 Mg ha⁻¹ for DSR and 0.91-1.14 Mg ha⁻¹ for PTR than the state average yield. As compared with the district average, the rice grain yield of different varieties was higher by 0.24-0.58 Mg ha⁻¹ in DSR, and

by 0.27-0.50 Mg ha⁻¹ for PTR. These results revealed higher yield benefit of PR-126 than the other two compared varieties. The technology gap of 1.52 Mg ha⁻¹ for PR-126 variety was lower by \sim 2.97 and \sim 2.86times than PR-128 and PR-129, respectively. Similarly, the technology index were 1.52, 6.62 and 6.00 Mg ha-¹ for PR-126, PR-128 and PR-129 respectively; which was ~4.35 and ~3.95-times lower for PR-126 than the others. These results revealed extension gap of 1.32, 1.37 and 0.97 Mg ha-1 for PR-126, PR-128 and PR-129, respectively. The extension gap varying between -0.59 and -1.21 Mg ha-1 for three rice genotypes with short to medium duration; with highest gap for PR-126 and the lowest for PR-124 has been reported earlier (Singh et al., 2020b). The extension gap of 1.3-1.8 Mg ha-1 in rice production has been reported in West Bengal (Sagar and Chandra, 2003). The technology gaps for rice cultivation varied between -0.44 and -1.13 Mg ha⁻¹; with the highest gap for PR-124 and the lowest for PR-122 and the technology index varied between 5.6 and 14.8%, and was the highest for PR-124 and the lowest for PR-122 (Singh *et al.*, 2020b). Sagar and Chandra (2003) reported that technology index range of 2-10%, and described technology index as feasibility of technology for the reason.

The volume of irrigation water used varied between 174.0 and 194.3 cm in DSR as compared with between 207.0 and 243.0 cm in PTR (Table 3). As compared with PTR, the irrigation water use in DSR was significantly (p < 0.05) lower in DSR (by ~ 15.9-20.1%) in three different varieties. Bhatt and Singh (2021) reported total volume of irrigation water of 174.9 cm under DSR and 214.6 cm under PTR in Kapurthala district of Punjab, India. The volume of irrigation water use in PR-126 variety established under DSR methods was lower by ~8.3-10.4% than the other two varieties. However, the corresponding value under PTR method was ~8.9-14.8% lower water use in PR-126, compare with other two varieties. These results revealed significantly lower irrigation water use efficiency in PTR, compared with the DSR method of rice establishment.

The water use efficiency of 42.4 kg ha⁻¹ cm⁻¹ in DSR and 35.1 kg ha⁻¹ cm⁻¹ in PTR for PR-126 was higher, compared with PR-128 and PR-129. The water use efficiency of 49.1, 32.5 and 46.4 kg ha⁻¹ cm⁻¹, respectively for PR-126, PR-124 and PR-122 has been reported earlier (Singh *et al.*, 2020b). Sarkar *et al.*, (2017) reported a water use efficiency of 36 kg ha⁻¹ cm⁻¹ for rice under continuously flooded field conditions,

compared with 226 kg ha⁻¹ cm⁻¹ under alternate wetting and drying regimes. The per cent increase in irrigation water use efficiency in DSR method of rice establishment varied between 17.9-24.7%; the lowest for PR-128, highest for PR-129, while PR-126 inbetween. The irrigation water productivity varying between 3.6 and 4.4 kg ha⁻¹ mm⁻¹ in DSR, compared with 3.3 and 3.6 kg ha⁻¹ mm⁻¹ under PTR has been reported (Bhatt and Singh, 2021). Basha and Sarma (2016) reported significantly higher water use efficiency of aerobic rice (81.3 kg ha⁻¹ cm⁻¹) as compared to transplanted rice (36.1 kg ha⁻¹ cm⁻¹) due to higher water requirement of transplanted rice.

The ACC for different rice varieties varied between Rs. 31900 and 33200 ha-1 under DSR, compared with between Rs. 39750 and 41450 ha-1 under PTR method (Table 4). These calculations showed that additional cost incurred under PTR varied between Rs. 7850 and 8750 ha-1 over DSR method for three rice varieties. The AGRs varied between Rs. 131694 and 137970 ha-¹ for rice establishment under DSR, and between Rs. 132254 and 136551 ha-1 under PTR method, with additional gross returns of Rs. 1420 ha-1 for PR-126 and the loss in AGRs of Rs. 1568 and Rs. 560 ha⁻¹, respectively for PR-128 and PR-129 varieties. These results revealed higher B-C ratio of 4.07-4.16 for DRS, as compared with between 3.25-3.33 for PTR. However, the highest B-C ratio was observed for PR-126, compared with the other two rice varieties. The returns of variable cost (Rs. 92504-95101 ha-1 for PTR and Rs. 99794-104770 ha-1 for DSR) were higher for DSR, compared with PTR method of rice establishment. The production efficiency was higher for DSR than the PTR method, regardless of the rice variety. The production efficiency was for PR-126 was

Table 3: Irrigation water use, water use efficiency and per cent saving in irrigation water use for different varieties under direct seeded rice (DSR) and puddled transplanted rice (PTR) at farmer's field in south-western Punjab, India

Rice variety	Irrigation water use (mm)		Water use efficiency (kg ha ⁻¹ cm ⁻¹)		Percent water saving over	Percent increase in water use efficiency	
	DSR	PTR	DSR	PTR	PTR	over PTR	
PR-126	174.0a	207.0b	42.4b	35.3a	15.9	20.1	
PR-128	189.8a	227.3b	37.5b	31.8a	16.5	17.9	
PR-129	194.3a	243.0b	36.3b	29.1a	20.1	24.7	

Mean values for compared treatments viz. DSR vs. PTR for each rice variety with different letters are statistically significant at p < 0.05.

Table 4: Average cost of cultivation (ACC), average gross returns (AGRs), average net returns (ANRs), benefit-cost ratio (B-C), additional cost incurred, additional gross returns, and production and economic efficiency of different varieties under direct seeded rice (DSR) and puddled transplanted rice (PTR) at farmer's field in south-western Punjab, India

Particular	Rice variety						
	PR-126		PR-128		PR-129		
	DSR	PTR	DSR	PTR	DSR	PTR	
Average cost of cultivation (ACC; Rs. ha ⁻¹)	33200	41450	32700	41450	31900	39750	
Additional cost incurred	8250	8750	7850				
Average gross returns (AGRs; Rs. ha ⁻¹)	137970	136551	133002	134870	131694	132254	
Additional gross returns	1420	-1868	-560				
Average net returns (ANRs; Rs. ha ⁻¹)	104770	95101	100302	93420	99794	92504	
Benefit-cost ratio (B-C)	4.16	3.29	4.07	3.25	4.13	3.33	
Production efficiency (kg ha ⁻¹ d ⁻¹)	59.3a	58.7a	50.1a	50.8a	51.2a	51.4a	
Economic efficiency (Rs. ha ⁻¹ d ⁻¹)	1108a	1097a	935a	948a	956a	960a	

Mean values for compared treatments viz. DSR vs. PTR for each rice variety with different letters are statistically significant at p < 0.05.

higher by ~18.4% than PR-128 and by ~15.8% than PR-129 under DSR method. However, under PTR method of rice establishment, the production efficiency of PR-126 was higher by ~14.2-15.6% than the other two varieties. The economic efficiency was also higher for PR-126, compared with the other two varieties, regardless of the establishment method. The production efficiency of 54.5 kg ha⁻¹ day⁻¹ was higher for PR-126, compared with PR-124 (50.0 kg ha⁻¹ day⁻¹) and PR-122 (50.6 kg ha⁻¹ day⁻¹) (Singh *et al.*, 2020b). They reported that higher production efficiency of PR-126 was due to its short duration of only 123 days, while for PR-122 was due to its higher productivity under poor quality irrigation water conditions (Singh *et al.*, 2020b).

CONCLUSION

These results revealed that mean rice grain yield did not differ significantly (p<0.05) among different establishment methods. The production efficiency, economic efficiency and water use efficiency were higher for PR-126, compared with other two varieties under both establishment methods. The technology gap for PR-126 variety was lower than PR-128 and PR-129. The technology index was 1.52, 6.62 and 6.00 Mg ha⁻¹ for PR-126, PR-128 and PR-129 respectively; which was ~4.35 and ~3.95-times lower for PR-126 than the others. The extension gap was 1.32, 1.37 and 0.97 Mg ha⁻¹ for PR-126, PR-128 and PR-129, respectively. These results suggested that more intensified extension efforts are required to create awareness among the farmers for the wide spread adoption of short duration PR-126 to conserve underground irrigation water. Further, there is a need to create awareness on dissemination of component technologies e.g. efficient nutrient management, weed management and maintenance of optimum plant population for increased crop productivity and economic returns.

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Research Article

Socio-economic Characteristics of Farmers and their Feedback About the Castor Cultivar GCH–10 Variety

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ABSTRACT

Castor (*Ricinus communis*) is an important non-edible oil seed crop of the arid and semi-arid regions of the world. India in general and Gujarat in particular, hold top rank not only in production and productivity but also in oil export. As a concern, the study has attempted to know the socio-economic characteristics of farmers and their feedback about the Castor Cultivar GCH–10 variety. The study revealed that the majority of the farmers belonged to the old age group, educated up to higher secondary level and had above 21 years farming experience, 1 year experience in castor cultivation GCH-10 variety, large to medium size of land holding, up to 1 hectare land under castor cultivation, annual income above Rs. 2,00000/-, membership in more than one organization and medium extension contact and mass media exposure. With regard to about feedback of farmers about the Castor Cultivar GCH-10 variety; harvesting of first raceme is 89 to 125 days (92.00%), raceme of castor has longer than other local variety (90.00%). GCH-10 variety has enough plant height (89.00%) and GCH-10 variety is resistant against wilt disease (87.00%). The feedback of farmers about the technological traits of castor cultivar GCH-10, it is triable (96.00%), acceptable is (92.00%), it is practicable (88.00%), profitable (83.00%), the result of the variety is visible (81.00%), relative advantage than other local variety is visible (81.00%), relative advantage than other local variety (79.00%) and cost effectiveness (76.00%).

Keywords: Castor cultivar, Feedback, Socio-economic characteristics

INTRODUCTION

The castor plant (*Ricinus communis* L.) is a member of the Euphorbiaceous family and plays an important role in the country's vegetable oil economy. Castor is a nonedible oilseed crop used in industry. Gujarat produces over 80 per cent of India's total production of castor. The castor seeds are used for the production of castor oil, which in our childhood; we had to consume this distasteful liquid as a purgative. Castor is cultivated in almost all the districts of Gujarat state. Amongst these Gandhinagar, Ahmedabad Mahisagar, Panchmahals, Banaskantha, Sabarkantha, Kutch, Mehsana, Patan, and Surendranagar are the major castor-producing districts.

A variety GCH-10 (Hybrid SCH 53: SP 1 X SI 14) released in 2019, resistant to wilt diseases and low infestation of sucking pests viz., thrips, leaf hopper and white fly. The proposed hybrid SCH 53 gave 3980

kg/seed yield which is 15.73 higher than GCH 7 under irrigation conditions of middle Gujarat. This variety was grown among farmers for the last two years. Sodhi *et al.* (2013) reported that knowledge level, education, source of information, social participation, scientific orientation, innovativeness and extension contact characteristics of the hybrid castor growing farmers had a direct bearing in the extent of adoption of recommended castor production technologies by the farmers of Gujarat. So, the present investigation was planned to know "socio-economic characteristics of the farmers and their feedback the Castor Cultivar GCH-10 variety" with the following objectives.

- 1. To study the profile of the castor cultivar GCH-10 growers
- 2. To study the feedback of farmers about the castor cultivar GCH-10



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MATERIALS AND METHODS

A comprehensive list was obtained from Agriculture Research Centre Sansoli, KVK Devataj and beneficiaries of Anubhav brand seed and from that 100 beneficiaries were selected purposively with ex post facto research design. The data was collected and analyzed in light of the objectives by using appropriate statistical tools.

A survey method of inquiry was used for data collection. The data was collected through a wellstructured interview schedule. The data were collected and recorded in a free and frank atmosphere where the interviewer and interviewee may have a good rapport. Pretested Gujarati version questionnaire was prepared in light of the objectives for the collection of data. The data were statistically analyzed and presented as percentages, frequency and mean.

The data collected were tabulated and presented in the form of tables as necessary. The data collected was qualitative as well as quantitative. The quantitative data were interpreted in terms of percentage and qualitative data were tabulated based on categorization methods. After tabulation, appropriate statistical tools like frequency, percentage were used.

RESULTS AND DISCUSSION

Results deal with the presentation, analysis, interpretation and discussion of the data collected through the interview schedule. The data were tabulated, classified, presented and interpreted systemically as per the objectives of the study.

Table 1: Distribution of respondents according to age groups (n=100)

Age	Frequency	Percentage
Young (Up to 35 years)	05	05.00
Middle (36 to 50 years)	23	23.00
Old (above 51 years)	72	72.00
Total	100	100.00

As is evident from Table 1 that slightly less than three-fifth (72.00%) of the respondents belonged to the old age group, followed by middle age and young age group with 23.00 per cent and 5.00 per cent, respectively. These findings are in consonance with the findings of Kakkad *et al.* (2021).

Table	2:	Distribution	of	respondents	according
educat	ion	n (n=100)			

Education	Frequency	Percentage
Illiterate	01	01.00
Primary	09	09.00
Secondary	31	31.00
Higher secondary	35	35.00
College and above	24	24.00
Total	100	100.00

The data presented in Table 2 indicate that majority i.e. 35.00 per cent of the respondents had higher secondary level of education, followed by secondary level and college and above level with 31.00 per cent and 24.00 per cent, receptively. Whereas, 9.00 per cent of them were primary level of education. Only, 1.00 per cent of them had illiterate.

Table 3: Distribution of the respondents according to Experience in Farming (n=100)

Experience in Farming	Frequency	Percentage
Very low (Up to 5 Years)	04	04.00
Low (6 to 10 Years)	07	07.00
Medium (11 to 15 Years)	16	16.00
High (16 to 20 Years)	17	17.00
Very high (Above 21 years)	56	56.00
Total	100	100.00

As it is clear from the data presented in Table 3 shows that more than half (56.00%) of the respondent had above 21 years of farming experience, followed by 16 to 20 years (17.00%), 11 to 15 years (16.00%), 6 to 10 years (7.00%) and up to 5 years (i.e. 4.00%) of experience, respectively. The results are in line with the findings of Kakkad *et al.* (2021).

Table 4: Distribution of the respondents according to Experience in Farming in castor cultivar GCH-10 (n=100)

Category	Frequency	Percentage
1 Years	79	79.00
2 Years	21	21.00
Total	100	100.00

As far as experience in farming regarding cultivation of castor cultivar GCH-10 variety, nearly fourth-fifth of the respondents (79.00%) had 1 years of experience, followed by 2 year i.e. 21.00 per cent had experience in cultivation of castor cultivar GCH-10.

Table 5: Distribution of the respondents according to land holding (n=100)

Category	Frequency	Percentage
Marginal (up to 1.0 ha)	09	09.00
Small (1.1 to 2.0 ha)	23	23.00
Medium (2.1 to 4.0 ha)	25	25.00
Large (above 4.1 ha)	43	43.00
Total	100	100.00

The data depicted in Table 5 indicate that majority of the respondent (i.e. 43.00%) had large farm size, followed by medium (25.00%), small (23.00%) and marginal (9.00%), respectively. The results are in conformity with the findings of Kakkad *et al.* (2021).

Table 6: Distribution of the respondents according to total land under GCH-10 (n=100)

Category	Frequency	Percentage
Up to 1.0 ha	65	65.00
1.1 to 2.0 ha	14	14.00
2.1 to 4.0 ha	08	8.00
above 4.1 ha	13	13.00
Total	100	100.00

It is apparent form the Table 6 reveals that majority (65.00%) of the respondents had up to 1.0 ha of land under GCH-10 cultivation, followed by 1.1 to 2.0 ha (14.00%) and above 4.1 ha (13.00%), respectively. Only, 8.00 per cent of them had 2.1 to 4.0 ha of land under GCH-10 cultivation.

Table 7: Distribution of the respondents according to annual income (n=100)

Category	Frequency	Percentage
Very low (up to 50,000)	03	03.00
Low (50,001 to 1,00,000)	04	04.00
Medium (1,00,001 to 1,50,000)	06	06.00
High (1,50,001 to 2,00,000)	04	04.00
Very high (above 2,00,000)	83	83.00
Total	100	100.00

The perusal of data presented in Table 7 clearly reveals that more than four-fifth (83.00%) of the respondents had a very high level of annual income, followed by 17.00 of them had very low to high level of annual income. The results are in conformity with the findings of Kakkad *et al.* (2021).

Table 8: Distribution of the respondents according to their social participation (n=100)

Category	Frequency	Percentage
No membership	06	6.00
Membership in one organization	44	44.00
Membership in more than one	49	49.00
organization		
Position holder	01	01.00
Total	100	100.00

Table 8 indicates that nearly half per cent (49.00%) of the respondents had a membership in more than one organization, followed by membership in one organization (44.00%) and no membership in any Organization (6.00%), respectively. Only, 1.00 per cent of them had position holder in organization.

Table 9: Distribution of the respondents according to extension contact (n=100)

Category	Frequency	Percentage
Very low (up to 2.4)	16	16.00
Low (2.41 to 4.80)	13	13.00
Medium (4.81 to 7.20)	54	54.00
High (7.21 to 9.60)	16	16.00
Very high (above 9.60)	01	01.00
Total	100	100.00

It could be seen from the Table 9, that more than half (54.00%) of them had medium level of extension contact, followed by very low and high (equal per cent i.e. 16.00%), low (13.00%), respectively. Only 1 per cent had a very high level of extension contact.

Table 10: Distribution of the respondents according to mass media exposure (n=100)

Category	Frequency	Percentage
Very low (Up to 3.60)	05	05.00
Low (3.70 to 7.20)	40	40.00
Medium (7.21 to 10.80)	46	46.00
High (10.81 to 14.40)	09	09.00
Very high (above 14.40)	00	00.00
Total	100	100.00

Feedback	Frequency	Percentage
GCH-10 variety has enough plant height	89	89.00
GCH-10 is a early maturing variety as compared to local verities	75	75.00
GCH-10 variety has low incidence of sucking pest	69	69.00
GCH-10 variety is resistant against wilt disease	87	87.00
GCH-10 is a high yielding variety as compared to local verities	85	85.00
GCH-10 variety has more market demands	72	72.00
GCH-10 fetch more price in comparison with other variety	67	67.00
Harvesting of first raceme is 89 to 125 days	92	92.00
GCH-10 variety has a bigger and bold seed size then other variety	80	80.00
Raceme of castor has longer than other local variety	90	90.00
More number of capsule in raceme than other local variety	83	83.00

Table: II Feedback of Farmers about the Castor Cultivar GCH-10 (n=100

It is evident from Table 10 that nearly half (46.00%) of the respondents had medium level of mass media exposure, followed by low, high, and very low level of mass media exposure with 40.00 per cent, 9.00 per cent and 5.00 per cent, respectively. The results are in conformity with the findings of Kakkad *et al.* (2021).

As data presented in Table 11 about feedback of farmers about the Castor Cultivar GCH-10 variety clearly indicates that harvesting of first raceme is 89 to 125 days (92.00%), raceme of castor has longer than other local variety (90.00%), GCH-10 variety has enough plant height (89.00%), GCH-10 variety is resistant against wilt disease (87.00%), GCH-10 is a high yielding variety as compared to local verities (85.00%), more no. of capsule in raceme than other local variety (83.00%), GCH-10 variety has a bigger and bold seed size then other variety (80.00%), GCH-10 is a early maturing variety as compared to local verities (75.00%), GCH-10 variety has more market demands (72.00%), GCH-10 variety has low incidence

 Table 12: Feedback of farmers about different

 technological traits of castor cultivar GCH-10 (n=100)

Name of Traits	Frequency	Percentage
Triable	96	96.00
Practical	88	88.00
Visible	81	81.00
Cost effectiveness	76	76.00
Acceptable	92	92.00
Profitable	83	83.00
Relative advantage	79	79.00

of sucking pest (69.00%), GCH-10 fetch more price in comparison with other variety (67.00%). The results are in conformity with the findings of Murugan and Akila (2020).

The data in Table 12 narrated the feedback of farmers about the technological traits of castor cultivar GCH-10 indicates that GCH-10 is triable (96.00%), acceptable is (92.00%), it is practicable (88.00%), profitable (83.00%), the result of the variety is visible (81.00%), relative advantage than other local variety (79.00%) and cost effectiveness (76.00%).

CONCLUSION

Gujarat Castor Hybrid 10 (Charutar Gold) hybrid gave 9.12 per cent higher yield over check GCH 7. It is medium duration hybrid having profuse branching habit with medium plant stature and higher 100 seed weight. This hybrid is resistance to wilt disease and show low incidence of sucking pests. It gives 3898 kg/ha yields. Feedback of farmers about the technological traits of castor cultivar GCH-10 is triable, acceptable, practicable, profitable, the result of the variety is visible, relative advantage than other local variety and cost effectiveness. It could be better for charutar area of Gujarat.

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Research Article

Ergonomic Assessment of Maize Shelling Activity Using Traditional and Modern Tool

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ABSTRACT

Women play an important role in agriculture making up 43 per cent of the total agriculture workforce. Farm women are involved in plethora of agricultural activities from sowing to harvesting including post harvesting activities. But unfortunately majority of farmwomen utilize traditional tools and implements that involve lot of drudgery, leading to their exploitation as an agricultural worker. Traditionally farm women accomplish shelling of maize cob manually through finger nails, sickle or beating of cob by wooden sticks. They perform this activity either in sitting cum bending or in squatting posture for long time which leads to fatigue and drudgery. So, the present study was undertaken to investigate the existing practices of maize shelling and ergonomic assessment of maize shelling using traditional and modern tools. Study was conducted in district Hoshiarpur, Punjab where 40 farm women in this activity. The data was collected with help of self-structured interview schedule. For ergonomic analysis data was collected on objective and subjective parameters. Results revealed that cardiovascular, physiological and muscular cost of work decreased significantly while working with modern tool. Further, musculoskeletal disorders were also reduced significantly with modern tool. Further increase in output was from 14 kg/hr (Traditional tool) to 26 kg/hr (Modern tool) when we compare the traditional and modern tools.

Keywords: Musculoskeletal problems, Total cardiac cost of work (TCCW), Physiological cost of work (PCW), Drudgery reducing tools, Maize shelling tool

INTRODUCTION

Agriculture in India is labour-intensive in nature and thus requires manpower wherein farmwomen contribute as majority of the workforce. There is huge contribution of women in agriculture. The daily routine of farm women is extremely monotonous and time consuming. They work for almost 8-10 hours every day in the agriculture field especially during peak season. Especially, post harvesting activities are primarily performed by farm women. Maize (*Zea mays*) is world's largest resourceful seed crop. The processing of maize is sequentially performed as: harvesting, drying, dehusking, shelling, storing and milling. Shelling of maize is one of the important post-harvest activity which is predominantly performed by farmwomen. Traditionally, shelling of maize cob was performed manually through finger nails, sickle or beating of cob by wooden sticks. Studies have shown that women in agriculture are typically employed in agricultural operations that are either not mechanised or are just slightly mechanised and involve lot of drudgery (Singh et al., 2010). The postures used by farmwomen while performing maize shelling are sitting, squatting and bending which leads to drudgery and serious health issues such as back, shoulder and knee pain. Due to these factors there is considerable increase in cardiovascular and physiological problems. They perform maize shelling activity in awkward postures which are major cause of fatigue and drudgery. Engberg (1993) reported that farm women have anatomical and physiological differences that place them

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at higher risk of injuries. According to various studies, anthropometric data surveys in India are limited to male agricultural labourers. Due to which male anthropometric data was widely used for women at work due to a shortage of female anthropometric data, with the expectation that it would be advantageous to female workers as well (Dewangana et al., 2008). But since women have different ergonomic and anthropometric characteristics than men these tools and equipment leads to drudgery while operating them. These factors significantly reduce work efficiency, causing women to lag behind in the use of improved technology and tools at farm (Khadatkar et al., 2014). These factors significantly reduce their work efficiency, causing women to lag behind in the use of improved technology and tools. Thus in order to ease the problem of marginal farm women, it is extremely important to extensively analyze traditional practices adopted by farmwomen in maize shelling activity and then to evaluate the performance of traditional and modern tools considering ergonomic evaluation. Therefore, the present study was undertaken with objective to study the existing practices adopted by farmwomen and to compare ergonomic assessment of maize shelling using both traditional and modern tools.

MATERIALS AND METHODS

The study was conducted in district Hoshiarpur wherein one block i.e. Garshankar was selected purposively as it has major area of maize production. Further, two villages (Talwara and Mahilpur) were randomly selected and from each village 40 farmwomen were taken making total sample of 80 farm women. For ergonomic analysis, data was collected on objective and subjective parameters. The data was collected with the help of pre-tested interview schedule. The study was conducted in the actual working environment under maize cultivation from harvesting to post harvesting. Further, assessment of the drudgery, posture and work related physiological and muscular problems were analyzed while performing maize shelling activity with traditional and modern tool. Ergonomic assessment of Traditional and Modern tool was done by using Anthropometer, Weighing Scale, Blood pressure monitor, Heart Rate Monitor and Grip Dynamometer. Various work related risk factors such as musculoskeletal problems, postural discomfort and physiological cost of performing the activity were ergonomically evaluated using subjective assessment techniques.

RESULTS AND DISCUSSION

The personal profile of the selected respondents included their socio-personal characteristics like age, religion, education, marital status, family type, family size, monthly income and monthly family income. It also included physical profile of the respondents such as height, weight and Body mass index (BMI). The results of the same are presented from Table 1 to 3.

Table 1: Socio- personal characteristics of the respondents (n=80)

Age (years)	Frequency	Percentage
20-30	42	52.50
30-40	24	30.00
40-50	14	17.50
Average age \pm SD	31.10	± 7.22
Education		
Illiterate	36	45.00
Literate	35	43.75
Primary	9	11.25
Marital status		
Unmarried	19	23.75
Married	55	68.75
Widow	6	7.50
Family type		
Nuclear	59	73.75
Joint	21	26.25
Family size		
Small (up to 4 member)	9	11.25
Medium (5 to 8 member)	54	58.75
Large (above 8 member)	17	21.25
Monthly income of responde	ents (Rs)	
4000-6000	23	28.75
6000-8000	44	55.00
8000-10000	13	16.25
Average monthly income \pm SD	6731.25	± 1391.53
Monthly income of family (I	Rs)	
10000-15000	35	43.75
15000-20000	37	46.25
20000-25000	8	10.00
Average family income \pm SD	15950.00	± 2769.18

The results from Table 1 revealed that 52.50 per cent of respondents were from age group of 20-30 years and 45 percent were illiterate. 68.75 percent of farmwomen were married whereas majority of the respondents (73.75%) were having nuclear family and 58.75 per cent of respondents had medium sized family with 5 to 8 member. Further it was found that 55 per cent of respondent had income from Rs. 6000-8000 per month and 46.25 percent of the population of respondents belonged to the family income group of the Rs. 15000- 20000 per month. Therefore it could be stated that the respondents were having low socio-economic level.

Data from Table 2 shows that more than half of respondents (56.25%) have height from 150 cm to 160 cm and 41.25 per cent of the respondents had weight from 40 kg to 50 kg. Seventy per cent of the respondents had BMI in the range of 20-25 kg/m² with mesomorph body type. Thus, the results showed that respondents were physically fit.

This section provides information regarding job profile of the respondents wherein job profile includes type of job, working experience, working duration, distance from home to workplace, mode of transport, number of working days in a week and satisfaction from wages.

Physical characteristics	Frequency	Percentage	
Height (cm)			
140-150	23	28.75	
150-160	45	56.25	
160-170	12	15.00	
Average height ± SD	153.79	0 ± 5.74	
Weight (kg)			
40-50	33	41.25	
50-60	32	40.00	
60-70	15	18.75	
Average weight \pm SD	52.60 ± 7.99		
Body mass index			
Below 20 (Ectomorph)	13	16.25	
20-25 (Mesomorph)	56	70.00	
Above 25 (Endomorph)	11	13.75	
Average BMI ± SD	22.18	± 2.63	

Results from Table 3 depicted that 67.50 per cent of the respondents were working as permanent labour and 43.75 per cent of population of the respondents had an experience of five years. More than half of respondents (51.25%) were working for 6 to 8 hours daily and 60 percent of the respondents were travelling 1 to 3 km daily to workplace. 61.25 per cent of the respondents reach to the workplace by walking and all the farmwomen where working in the farm fields for 6 days per week. On an average respondents were working for 7 hours per day i.e. 42 hours per week. Moreover, maximum numbers of respondents (85%) were not satisfied with the wages paid to them. Therefore, it can be concluded that women workers were engaged for long hours while performing maize

Fable 3: Job	profile of	the res	pondents ((N=80)	,
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Job profile	Frequency	Percentage
Type of job		
Permanent labour	54	67.50
Contractual labour	26	32.50
Working experience (years)		
0-5	35	43.75
5-10	33	41.25
10-15	12	15.00
Average working experience \pm	SD 5.95	5 ± 2.95
Working duration (hours)		
4-6	24	30.00
6-8	41	51.25
8-10	15	18.75
Average daily working duration	$h \pm SD = 7.05$	5 ± 1.07
Distance from the home to	workplace (k	m)
Below 1	17	21.25
1-3	48	60.00
Above 3	15	18.75
Average Distance ± SD	2.08	3 ± 1.34
Mode of transport		
Own vehicle	12	15.00
Public transport	19	23.75
Walking	49	61.25
Number of working days in	a week	
1-7	6	days
Satisfaction with wages		
Yes	12	15
No	68	85

shelling activity. This section provides information regarding traditional practices adopted by the farmwomen, extent of involvement, posture adopted and drudgery experienced while performing maize shelling activity.

Data from the Figure 1 depicts that majority of respondents (60%) were performing maize shelling manually either through finger nails or pressing thumb on the grains followed by beating cobs with wooden sticks (25%) while only 15 per cent were using traditional maize sheller for maize shelling.



Figure 1: Existing Practices of Maize Shelling



Shelling by Hands



Shelling by Traditional Maize sheller

Results from Table 4 explained that highest number of man per season was observed for shelling activity where farmwomen were involved for 6 hours a day with 4 number of labour employed for 5 days, thus the number of man days required per season for shelling activity was 21 which was highest among all activities followed by dehusking where man days required per season were 12. Man days per season required for reaping, drying, stocking and storage were 9, 8, 6 and 2 respectively. Thus, it could be concluded that maize shelling is one of most time consuming and monotonous activity

Results from Figure 2 revealed that respondents perform the maize shelling activity by sitting posture (55%) followed by squatting (47.5%) and bending posture (35%). Thus it could be concluded that

Table 4: Extent of involvement of Farm women in harvesting and post- harvesting activities of maize shelling (1 acre land) (N=80)

Farm activities	rm activities Hours/ No. of day labour employed		No. of days	*No. of man days/ season
Harvesting				
Reaping	06	04	03	09
Stocking	06	04	02	06
Post harvesting				
Drying	04	02	08	08
Dehusking	06	04	04	12
Shelling	06	04	07	21
Storage	04	02	02	02

*Number of man days: 8 hour=1 man day



Figure 2: Posture adopted while performing Maize Shelling Activity with Traditional tool

uncomfortable posture if attained for longer time may lead to musculoskeletal disorder. Musculoskeletal problem mainly arise due to repetitive and overuse of certain muscles, tendons and soft tissues that leads to fatigue and strain in tissues. Singh and Nigam (2007) also reported that forward bending posture is extremely undesirable to be attained for longer hours as it increases the load on musculature and produces muscular pain in neck and back of the respondents.

Table 5 showed that maize shelling was one of most demanding and exhausting activity since postures adopted were awkward and uncomfortable with total mean score of 19.30. Mean scores for work demand (4.40), feeling of exhaustion (4.30), posture adopted (3.95), difficulty perception (3.25) and workload perception (3.40) were also highest for maize shelling activity followed by Dehusking where total mean score was 16.95. Mean score obtained for reaping, drying, storage and stocking were 14.40, 13.45, 13.00 and 11.40 respectively. Therefore it could be concluded that maize shelling was one of most strenuous and drudgery prone activity with uncomfortable posture.

This section included comparison of traditional and modern tool in terms of cardiovascular responses, physiological responses, grip strength, intensity of pain and drudgery experienced while performing maize shelling activity.

Cardiovascular responses of the respondents were measured with Heart Rate Monitor before and while performing maize shelling activity with traditional and modern tool. Results of cardiovascular responses from Table 6 shows that average heart rate and energy expenditure while working with modern tool was 107.64 beats/ min and 7.24 kJ/ min in comparison to traditional tool (112.40 beats/ min and 6.18 kJ/ min). Further results reveals that Total Cardiac Cost of Work (TCCW) and Physiological Cost of Work (PCW) while performing maize shelling activity with the help of traditional tool was 1262.85 beats and 24.75 beats/ min whereas with modern tool was 1029.10 beats and 20.39 beats/min. Thus it could be stated that cardiovascular and physiological cost of work decreases significantly with the modern tool since tool was more comfortable and easy to use. The observed results were also justified as per classification given by the Verghese (1995) which states that on the basis of heart rate and energy expenditure manual maize shelling (or maize shelling performed with the help of traditional tool) is considered to be moderately heavy activity while if done through maize sheller it is light.

Results from Table 7 showed that grip strength for right hand after working with modern tool was 21.60 kg in comparison to traditional tool with 20.79 kg whereas grip strength for left hand after working from modern tool was 18.50 kg in comparison to traditional tool with 17.57 kg. Per cent increase in grip strength was found to be 3.89 per cent for right hand and 5.29 per cent for left hand. Thus, results show that there is significant increase in grip strength while working with modern tool due to rubberized handle which helped in providing proper grip during activity. Awasthi *et al* (2015) also stated that reduced grip strength indicates that manual maize shelling often leads to musculoskeletal disorders in wrist, upper arm, shoulder and elbow.

Activities	Rating on work demand	Rating on feeling of exhaustion	Rating on posture assumed in the work	Rating on difficulty perception	Rating on workload perception	Total score
Harvesting						
Reaping	3.25±0.71	2.90±0.64	2.70 ± 0.73	$2.85 {\pm}~0.36$	2.70 ± 0.47	14.40±1.46
Stocking	3.10±0.97	2.65 ± 0.61	2.80 ± 0.95	2.85 ± 0.74	2.60 ± 0.82	11.40±1.60
Post harvesting						
Drying	2.95 ± 1.09	2.65 ± 0.67	2.45±0.69	2.7±0.66	2.85 ± 0.67	13.45±1.35
Dehusking	3.85 ± 0.93	3.45±0.76	3.70±0.47	2.95 ± 0.75	3.00 ± 0.45	16.95±1.35
Shelling	4.40 ± 0.75	4.30±0.47	3.95 ± 0.89	3.25 ± 0.79	3.40 ± 0.50	19.30±1.75
Storage	2.55±0.51	2.45±0.69	2.15 ± 0.37	3.00±0.34	2.85 ± 0.37	13.00 ± 1.00

Table 5: Drudgery experienced in harvesting and post harvesting activities of maize shelling (n=80)



Maize shelling while using Traditional Tool



Maize shelling while using Modern Tool



Modern tool used in maize shelling activity



Working posture adopted while working with modern tool



Dimensions of Modern tool (Length: 13 inch; Width: 10 inch; Height: 15 inch; Weight: 5kg)

Table 6: Cardiovascular and physiological parameters of maize shelling activity while working with traditional and modern tools (n=80)

Cardiovascular and Physiological parameters	Traditional tool	Modern tool	Percent change (%)
Average working Heart Rate (AWHR)	112.40 beats/min	107.64 beats/min	4.23%↓
Energy Expenditure (E.E.)	7.24 kJ/min	6.18 kJ/min	14.64%↓
Total Cardiac Cost of work (TCCW)	1262.85 beats	1029.10 beats	18.50%↓
Physiological Cost of work (PCW)	24.75 beats/ min	20.39 beats/ min	17.61‰↓

Table 7: Percentage change in grip strength of the respondents while working with traditional and modern tools (n=80)

Grip strength	Traditional	Modern	Percent change
(kg)	tool	tool	(%)
Right	20.79	21.60	3.89%↑
Left	17.57	19.70	5.29%↑

Results from Figure 3 depicts that intensity of pain felt while working with traditional and modern tool shows that intensity of pain in right hand, left hand, lower back, upper back, fingers and upper arm shifts from severe (with value 4.05, 3.85, 3.75, 3.7, 3.65, 3.6 respectively) to moderately severe pain (with value 3.25, 3.15, 2.85, 2.75, 2.65 respectively). For wrist, intensity of pain shifts from severe (3.55) to mild (2.30). In case of neck, lower arm, knee, shoulder, leg and feet intensity of pain shifts from moderately severe (with value 3.45, 3.25, 3.15, 3.05, 2.65, 2.6 respectively) to mild pain (with value 2.2, 2.15, 2, 1.8, 1.85, 1.6 respectively).

Drudgery experience was carried on the basis of work demand, feeling exhaustion, posture assumed while performing maize shelling activity, difficulty perception and workload perception. Results from Figure 4 revealed that mean score of work demand, feeling of exhaustion, posture adopted, difficulty perception and workload perception had decreased while working with modern tool (with value 3.1, 3.05, 3, 2.75 and 3.05 respectively) in comparison to traditional tool (with value 4.05, 4.15, 4.2, 3.6 and 4 respectively). Therefore it could be concluded that drudgery experienced by the respondents declined significantly while working with modern tool. Similar results were obtained in study conducted by Patel et al (2015) which revealed that improved tool was helpful in reducing the drudgery level from medium to low as compared to the traditional tool.

Data from Figure 5 shows work output of maize shelling with traditional and modern tool. According to results pertained average maize grains were 14 kg/ hr for traditional tool which increased to 26 kg/hour while using modern tool. This may be due to hand operated system of modern tool. Thus results shows that work output was increased with the use of modern tool. In support of above results similar study of Singh *et al.* (2010) could be considered where the use of



Figure 3: Intensity of pain felt while working with Traditional and Modern tools



Figure 4: Drudgery experienced while working with traditional and modern tool



Figure 5: Output while working with Traditional and Modern Tools

improved tool increases the working productivity by 19.5 per cent.

CONCLUSION

Based on above results, it could be concluded that respondents were performing maize shelling activity in awkward and uncomfortable postures which may cause serious musculoskeletal disorders in upper and lower extremities. Results also showed that modern tool had helped in significantly reducing the cardiovascular, physiological and muscular disorders. Work output was also significantly increased with modern tool Thus, modern tool could be stated as better option for performing maize shelling since it not only increases the efficiency of farmwomen but also saves the time.

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Research Article

Farm Women Contribution in Management of Natural Water Bodies in Uttarakhand Hills

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ABSTRACT

In Indian perspective, groundwater and water from river system are the main source of water supply for drinking, domestic and agricultural purposes, but in hilly areas, natural water bodies like streams and springs are serving the purpose. The water source naturally appears in the hills is slowly and slowly moving toward scarcity which would have negative impact on hill agriculture and as a result on the survival of the hilly people. In hilly areas of Uttarakhand, only the natural water is used and no treatment is given to water before consumption, so this research was undertaken to study the availability of water bodies in the villages and their current status in terms of their functionality, to assess the role of women in management of water resources and to assess the water quality as affected by different conservation practices. The study was conducted in the Jaunsar region of Kalsi block, Dehradun and Tehri Garhwal district in Uttarakhand. Total 200 respondents were selected for interview. Results depicted that under traditional water sources, about 93 per cent respondents have *chasma / naula* as water source. Only 37 per cent natural water sources are functional which are used for drinking and other domestic purposes. Majority of the respondents (56%) are cleaning and maintaining the resources twice in a year followed by 38 per cent respondents who used to clean on monthly basis. Women (91%) were doing afforestation activities followed by digging of temporary ponds to harvest rain water.

Keywords: Natural resource, Springs, Water bodies, Water management

INTRODUCTION

The state of Uttarakhand is bestowed with major water sources including large ravine system with its tributaries. In Uttarakhand, a large portion of the population (about 77%) lives in the hilly areas and about 90 per cent of these populations depend upon the natural spring water for their daily water demand (Jain *et al.*, 2010; Singh *et al.*, 2012). The hilly areas of Uttarakhand have 8 catchments, 26 watersheds, 116 sub-watersheds, and 1120 micro watersheds. In spite of the plenty of water sources, the people of the state are facing the problem of safe fresh water due to slope factor, management issues, increasing urbanization, deforestation and other environment related factors. In terms of both planning and demand, now the focus has been shifted from 'water for irrigation' to 'water for drinking'. Natural springs, which are around 2.6 lakh in number, are the biggest source of drinking water in rural areas. Approximately, 12,000 springs have dried up, Pant (2020).

Over the last decade, it has become increasingly hard for women folks to source water around their village in hilly areas. According to a study conducted by Rawat *et al.* (2019), about 93 per cent farmers (women as well as men) reported that they have *chasma/ naula* as traditional water resource followed by 51 per cent who have *gadhera* (stream). About 6 per cent apprised that spring/*dhara* as natural water resource. While India's aquifers are currently associated with replenishing sources, the country is also a major

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grain producer with a great need for water to support the commodity. With regard to conventional water resources available in hilly areas of Uttarakhand, Rawat *et al.* (2020) concluded availability of water tank by 98 per cent respondents followed by water pipeline (67%). They further revealed that there were no hand pumps and ponds in the surveyed areas. As with all countries with large agricultural output, excess water consumption for food production depletes the overall water table. Rawat *et al.* (2019) concluded that landslide (reported by 95% farmers) as the prominent reason for drying up of natural water resources followed by 88 per cent respondents who reported hot weather as cause of drying up of natural resources followed by reduced rainfall (76%) and reduction in forest trees (51%).

Inherent nature of the resource, land-use changes, lack of scientific understanding, and climate variability all make springs further vulnerable to extinction. surveyed the Garhwal villages in Uttarakhand for availability of natural Rawat *et al.* (2018) water sources and found that, out of 7 water sources only 3 are functional for the last 5 years.

As we know, women are the backbone of agriculture in India and they have dependence on water

and forest resources to collect fodder and fuel and a wide range of products for consumption and trade. Women themselves are often unaware of their potential value and are not involved in water user associations, public water management bodies, and water committees, thus hindering the success of water management efforts. Study conducted on water management by women in hilly areas by Rawat *et al.* (2019) reported that majority of the people (91%) adopted afforestation/densification as a most popular means of overcoming water shortage.

MATERIALS AND METHODS

The present study was conducted in the mid Himalayas of Uttarakhand in which 2 districts i.e. Dehradun and Tehri Garhwal were selected (Figure 1). From each district, 4 villages and from each village, 25 respondents (20 females and 5 males) were selected, thereby total 200 respondents were selected. These villages are small with limited facilities of transportation, education, health and employment. The geographical coordinates are given below in the Table 1. The altitude of the villages varied between 1270-1500 meters. The Research design was exploratory in nature. The data were



Figure 1: Schematic diagram of selection of locale

Blocks	Villages	Latitude	Longitude	Alt. m (above MSL)
Kalsi	Dhoira	30°33′19.33"N	77°49′59.25"E	1132
	Nichhiya	30°33′54.58"N	77°49′45.09″E	1383
	Jhutaya	30°34′3.59"N	77°50′15.45″E	1480
	Deu	30°34′45.40"N	77°51′06.19"E	1435
Thatyur	Banali	30°11′10.65"N	78°19′28.45″E	1270
	Hindola khal	30°11′4.40″N	78°18′47.13″E	1374
	Agra khal	30°12′48.37"N	78°19′40.07″E	1466
	Pata	30°13′37.75"N	78°20′18.45″E	1309

 Table 1: Geographical coordinates of the sample villages

collected through survey and In-depth discussion/ Focused group discussion. Primary data was collected through Interview schedule (structured/semistructured). The secondary data was also collected through reports, literature published by various government/ non-government agencies and other sources.

RESULTS AND DISCUSSION

Traditional water sources are the base on which entire hill eco system is dependent. Their upkeep and maintenance are of very much importance for sustainable hill eco system. The Table 2 shows the various natural water sources which are available in the villages but due to ignorance and non-maintenance, they are drying up. The '*Chaal*' also known as *Khal* is principally used for animal consumption. The '*Naula*' is a surface-water harvesting method typical to the hilly areas of Uttarakhand. These are small wells or ponds in which water is collected by making a stone wall across a stream. This is used by the people for their self consumption. The '*Dhara*' or spring is the point where water emerges from an aquifer to the earth's surface. It is quite common from the findings that under traditional water sources, about 93 per cent respondents reported that they have *chasma/ naula* as water source followed by 51 per cent who have *gadhera* (stream) in their village. About 6 per cent respondents apprised spring/*dhara* as natural water source under traditional water sources. It was reported that women associated availability of water to the status of forest and by improving the situation of forest they can tackle the problem of water scarcity in the region.

With regard to conventional water sources, availability of water tank was reported by 98 per cent respondents followed by 67 per cent respondents who informed that pipeline is also available in the villages. Further, the handpumps and ponds were not present in the study area. It seems that the *gharat* (water mill) is not currently functional for milling. Overall, this information highlights the diverse uses of different water harvesting structures and their importance in meeting various needs of communities. It is important to consider both traditional and conventional methods of water harvesting in designing sustainable water management systems that can cater to the needs of different users.

Table 2: Tradition	ul /	Conventional	water	harvesting	structure and	their usage
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Traditional water harvesting structure	Respondents	Usage
Chaal khal chuptyaula	51 (0.51)	Animal consumption
Chasma/ Naula / baori	93 (0.93)	Domestic water use
Dhara (Spring)	6 (0.06)	Drinking water, occasionally irrigation from large dharas
Conventional water harvesting structure		
Pipeline	67(0.67)	Irrigation
Hauzi (small tank)	98 (0.98)	Irrigation
Gharat (water mill)	All	Non functional

In the state, the perennial water sources are regularly covered with snow at high altitude range. In last decade, with 4.88 per cent increase in urban population, the Uttarakhand population has gone up to 101.16 lacs (Census of India, 2011). It has been reported that in Uttarakhand only 52 per cent population has full access of safe drinking water CII (2009). As per the recommendations of Bureau of Indian Standards, for domestic usage, per head per day water requirement is at least 70-100 litre in urban communities which does not include the flushing requirement (BIS, 1993). The fresh drinking water in sufficient quantity is an important criterion for the selection of place for inhabitation purposes in the hilly regions. Due to the presence of excessive suspended and dissolved solids in rainy season, the fresh water of major rivers of the state is generally unsuitable for human consumption. Both in urban as well as rural areas of the state, the availability of fresh and pure water quality has become a serious concern. Besides this, the problem of standard water quality is faced by the people in hilly and the plain area of the state Gupta et al. (2012); Sharma et al. (2015); Dobhal et al. (2012).

With regard to domestic sector, women in almost every household are responsible for collecting water and managing water needs for food, drinking, sanitation, and other household needs. As per the United Nations Department of Economic and Social Affairs (UNDESA), World's Women statistics, in rural areas of Sub-Saharan Africa, women (15 years or older) in approximately 65 per cent of households are responsible for water collection. Women travel long distances to collect water due to less availability of water. On an average, women in Africa and Asia walk 6 kilometers per day to collect water (Un.org, 2015).

In the present study area of Jaunsar region, the natural water sources were observed and studied for their functionality and their various uses. The first-hand information was collected from the farm women and men of the study area. As reported by them, in all the villages, total 35 natural water sources were available but for the last 5 years, few of them have been dried up. As clear from the table that out of 35 sources, only 13 (37%) are functional which are used for drinking and other domestic purposes (Table 3). As far as ownership is concerned, all the water sources are owned by village *panchayat*.

Table 3: Water sources and their management by the Farm women

Villages	Water	Status (Functionality)	Usage		
V1	7	3 (42.86)	Drinking & household		
V2	4	1 (25)	-do-		
V2 V3		3 (30)	-do-		
V4	4	2 (50)	-do-		
V5	2	1 (50)	-do-		
V6	3	1 (33.3)	-do-		
V7	2	1 (50)	-do-		
V8	3	1 (33.3)	-do-		
Total	35	13 (37.14)			

The water quality influences life of a plant or animal on the earth. Researchers have revealed that change in water quality and quantity due to man-made reasons have lead to various harmful impacts on all. Pollution in water affects its quality and harms human health, slows economic development and reduces social wealth (Milovanovic, 2007). Quality of water always depends on the source of water, the storage technique and the treatment opted (Lim et al., 2012; Kumpel and Nelson, 2013; Wright et al., 2004). Water quality reflects the purity of water and defines its suitability for various usages like drinking, irrigation supply, propagation of aquatic organisms and generation of hydro power. Water is called impure or unfit for drinking purpose when it has high level of organic and inorganic substance beyond the standard limits given by the government. Biological organism like bacteria, viruses and protozoan is also involved in deteriorating the quality of water and further resulting in many diseases (The outburst of epidemics in the form of diseases like cholera and diarrhea, which Grabow, 1996). are major waterborne diseases and a global health problem, is the results of drinking waters contaminated with waste and sewage (WHO, 2000). Bain et al. (2014) estimated that globally, 1.8 billion people use a fecalcontaminated source for drinking water. Out of these, 1.1 billion drink 'moderate'-risk water (> 10 E. coli/ 100 ml). The contamination of the drinking water was found to be dominant in the rural regions (41%) as compared to the urban areas (12%).

The natural water bodies in the hills are generally maintained by the local people, who are using them. Especially in rainy season, water resource is surrounded by weeds, grasses and some mud also. The people use to clean the sources by removing weeds etc. It is quite obvious from the Figure 2 that majority of the respondents (56%) are cleaning and maintaining the resources twice in a year followed by 38.5 per cent respondents who used to clean on monthly basis.



Figure 2: Frequency of cleaning of water sources by women

In rural areas of developing countries, usually the drainage facility is poor and it may contaminate the ground water aquifers with microbial load. This eventually results in stomach problems like diarrhea, dysentery etc. in children. In rural areas of Faisalabad, bacteria were present in water in 68.3 per cent households (MICS, 2007-08). Such diseases could be fatal (Egoz *et al.*, 1999). Gastroenteritis and diarrhea are major causes of morbidity and mortality amongst children of developing regions (Ahmad *et al.*, 1993).

The water samples from natural water sources were collected from different sites for chemical analysis. Besides, the quality of water was also assessed on the basis of information collected from the respondents. The data regarding characteristics of water samples is given in Figure 3. It is shown that maximum of 28.5 per cent respondents reported algal growth around water sources followed by saltiness in water samples by around 23 per cent respondents.

Research was conducted in small village of Pakistan to investigate the perception of the women on taste, odour and turbidity of water. Majority of respondents rated the quality of water as good and perceived no smell, taste, turbidity or colour in water.



Figure 3: Characteristics of water samples as reported by respondents

Lack of awareness about drinking water quality barred majority of women to take preventive actions. (Anderson *et al.*, 2007)

The drinking water source in rural areas of developing countries is generally ground water. The ground water sometimes may be contaminating with different microbes. The water samples collected from different water sources were chemically analyzed. The various parameters with respect to water quality are presented in Table 4. The pH of the sample water ranged from 7.20 to 8.87.

There was a little variation in the pH because of changing chemical composition of underground rocks from which spring comes out. As compared to water quality standards given by WHO, the sample water is well within permissible limit. Electrical conductivity is direct indicator of concentration of total dissolved ions in water. In the collected water samples, it ranged from 0.05 to 0.2 dS/m.

Because of calcium and magnesium salts in the water, water becomes hard. For domestic uses, water hardness is not desirable. The Ca and Mg salts in spring water ranged from 1.30 to 4.70 and 0.2 to 4.10 meq/L respectively.

Chauhan *et al.* (2020) reported that the water samples of natural springs which were away from village were classified under 'excellent' category as compared to supply water samples. The result of survey recorded 38 per cent population suffered from dysentery, 23 per cent from diarrhea and 17 per cent from typhoid. The report of the survey and the

Sample No.	рН	Electrical Conductivity (dS/m)	K (mg/L)	Na (mg/L)	Ca (meq/L)	Mg (meq/L)	CO ²⁻ ₃ (meq/L)	HCO ⁻ ₃ (meq/L)	Cl (meq/L)
1	7.2	0.050	0.31	5.12	1.68	0.70	0.600	1.400	0.375
2	8	0.155	0.61	6.45	4.40	2.20	0.900	5.100	0.250
3	8.3	0.052	0.09	5.41	2.10	3.20	0.900	0.350	0.350
4	8.87	0.051	0.44	7.62	1.30	0.20	-	1.450	0.275
5	7.2	0.202	0.75	6.66	4.70	3.30	-	3.500	0.500
6	7.9	0.194	0.51	1.77	4.30	4.10	-	9.400	0.850

Table 4: Chemical analysis of water samples collected from sites

Normal Range: pH: 6.5-8.5; K(mg/L): 20; Na (mg/L): 82; Ca(mg/L): 75-200; Mg(mg/L): 30-100; Cl(mg/L): 250-1000

presence of coliform suggest that drinking water contamination is leading to waterborne diseases like cholera, dysentery and typhoid. The perception of people of all the villages about water quality was in line with the laboratory results of chemical parameters (Table 4) because majority of samples had no smell, turbidity etc.

The relationship between elevated sodium intake and hypertension has been the subject of considerable scientific controversy. Whereas reducing the sodium intake can reduce the blood pressure of some individuals with hypertension, this is not effective in all cases, Laragh and Pecker (1983). In addition, some data for both humans and animals suggest that the action of sodium may be at least partly modified by the level of the accompanying anion as well as that of other cations, Kurtz and Morris (1983); Morgan (1982). Although several studies suggest that high levels of sodium in drinking-water are associated with increased blood pressure in children Tuthill and Calabrese (1981) Fatula (1967) in other studies no such association has been found Tuthill and Calabrese (1985); Pomrehn et al. (1983) and Armstrong et al. (1982).

The perception of farm women about water quality plays a significant role in determining the preventive measures against different water borne diseases. If perception for water quality is poor, people would not take any water treatment measures before drinking and it will have negative impact on their health (Cairncross and Valdmanis, 2006).

The perception of risks and satisfaction for quality of drinking water are closely associated. The risk perception for water quality is defined as subjective judgment of individual (Anadu and Harding, 2000). This research reported that complex mixture of education, culture, social and psychological factors results in perception of risk for quality of drinking water.

Water resources like chaal-khaal / chasma or streams are generally managed by the group of women, who are using them on regular basis. Inspite of availability of pipelines in few villages, women have to go to the water source to collect the water, as they are damaged due to debris which is coming from the upper slope. It is clear from the Figure 4 that most adopted practice to be followed by women was afforestation activity in forest as well as in the farm area. Plantation of fast growing and multi-purpose tree species is given first priority by the women in order to manage the water resource. It was followed by digging of temporary pond to harvest the rain water and to use it for agricultural purposes. Other activities were digging trenches/ recharge pit to increase the soil water level, formation of guhls/check dams to decrease the velocity of water and to reduce the soil erosion process. The water management strategy should be implemented on the basis of dual management with local



Figure 4: Management of water resources by women (%)
communities and organizations in the states and village. There should be active role of local community for managing water resources

CONCLUSION

- Reduction in the rainy days, change in climate, unscientific and unsustainable land use, ecodegradation, marked decline in winter rains, change in precipitation pattern, etc., definitely have their contribution in making the water-stressed Himalayan region.
- The overall policy neglect of springs in the hills, ignoring the traditional knowledge and wisdom, a pronounced bias for big-budget supply projects, often characterized with an aggressive attitude towards fragile mountains, have their own share in shaping the present state of affairs.
- The participation of local people in planning, preparation, management and operation of water resources should be ensured well in advance.
- Big tanks at specific distance in steeper slopes of falling water can be constructed and through these tanks water could be channelized through pipelines to the villages located downstream. After purification, this water can be used for drinking, household consumption, animal and for agricultural purpose.
- Besides, different organizations either govt. or non govt. sector should work in collaboration to conserve the valuable natural resources for future generations and for the overall development of the state in sustainable manner.
- Awareness and sensitization regarding importance of water and use of clean water should be provided with the help of non-governmental organization.

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Research Article

Technological Gap: An analysis in adoption of Bt Cotton Practices in Bathinda District, Punjab

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ABSTRACT

Cotton is one of the oldest and most significant commercial crops in terms of global economic, political, and social concerns. Punjab cotton farmers began switching their fields from Non-Bt cotton to Bt cotton. Punjab is being a one of leading state in cotton production, researchers was curious to know the areas of improvement and productivity of Bt Cotton cultivation in the area. The present study was conducted in the Bathinda district of Punjab, as Bathinda is the major cotton-growing district of Punjab. Bathinda district comprises nine blocks, namely Bathinda, Sangat, Nathana, Rampura, Phul, Maur, Goniana, Bhagta Bhaika, and Talwandi Sabo. Out of nine blocks, two blocks were selected randomly. From each selected block, two villages were selected randomly. From each village, 20 respondents were selected randomly to make a sample size of 80 respondents. The results of the study showed that agriculture was the main occupation of the farmers. The average land under Bt cotton was 5.46 and 3.66 acres in Sangat and Talwandi Sabo blocks, respectively. The main three varieties of Bt cotton were grown by the farmers, namely, RCH 773, RCH 776, and RCH 926. The 100 percent technological gap was observed in spacing, quantities of DAP and SSP, dosage of urea, herbicide and pesticide quantities.

Keywords: Adoption, Bt cotton, Punjab, Production, Technological gap

INTRODUCTION

Cotton is a highly valuable crop that has significant global importance and cultivated around more than 60 nations worldwide. Cotton, also known as the "King of Fibre" and "White Gold" because of its enormous economic value on a global scale, stands out from all other cultivable fibre crops in a distinctive manner. It is one of the oldest and most significant commercial crops in terms of global economic, political, and social concerns. Economically it is a major cash crop that generates substantial revenue for farmers and countries that grow it. It is one of the most important fiber crops in the world, and its cultivation is a major source of income for millions of people worldwide. Exports of cotton also contribute significantly to the economies of many developing countries. Cotton is an essential raw material for the textile industry. It is used to make a wide range of products, including clothing, bed

sheets, towels, and other household items. The cotton industry provides jobs for millions of people worldwide, including farmers, textile workers, and retailers. On the other hand of agricultural diversity, Cotton is a valuable crop that helps to diversify agricultural production in many countries. Through cotton cultivation, farmers can rotate crops, which can help to improve soil fertility and reduce the risk of pest and disease outbreaks. It is a renewable resource that can be grown sustainably. Cotton farming can help to conserve soil and water resources by promoting conservation practices such as reduced tillage and cover cropping. In case of food security, cottonseed oil is a valuable byproduct of cotton cultivation. Cottonseed oil is used for cooking and in the production of a variety of food products, including margarine, mayonnaise, and salad dressings. The availability of cottonseed oil can contribute to food security in many countries.

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India ranked first in the world in cotton land, with 120.69 lakh hectares under cultivation, accounting for approximately 36 per cent of the global area of 333 lakh hectares. India grows 33 per cent of its cotton under irrigation and 67 per cent of it on rain-fed land. India ranks 38th in output with a yield of 510 kg/ha (Anonymous, 2022). The industrial cultivation of genetically modified Bt (Bacillus thuringiensis) cotton was approved by the Indian government in march 2002. A protein made by the Bt gene is poisonous to bollworms (Benett et al., 2004). Production changed course and began to rise after Bt cotton was introduced. In 2017–18, it reached 519 kg per hectare. Additionally, the area planted with cotton grew from 74.40 lakh hectares in 1990-1991 to 124.44 lakh hectares in 2017-18. Cotton is a significant industrial crop that plays a significant role in Punjab's agricultural landscape. It is the primary Kharif crop grown in Punjab's southwestern regions, also known as the "cotton belt." Punjab has irrigation systems in place to support the cultivation of cotton. About 33 per cent of the state's land area is made up of the cotton belt, which primarily includes Bathinda, Mansa, Sri Muktsar Sahib, Faridkot, Fazilka, and Barnala. Punjab had 701 thousand hectares of cotton planted in 1990-1991; by 2000-2001, that number had dropped to 474 thousand hectares. After the introduction of Bt cotton, it once again began to grow and reached 481 thousand hectares in 2012-13. Cotton output exhibited the same pattern. The total amount of bales decreased from 1909 thousand in 1990-1991 to 1199 thousand in 2000-01. Production subsequently began to rise. Cotton was grown on 285 thousand hectares of land and produced in 1267 thousand bales in the 2016–17 crop year, respectively. In present scenario, cotton was grown on 268 thousand hectares of land and produced in 634.33 kg/hectare in the 2018-2019 crop year, respectively (Anonymous, 2019). While the Punjab government's formal approval for Bt cotton cultivation didn't come until march 2005, Punjab farmers began growing it in 2002-2003, by utilizing Bt cotton, farmers may be able to safeguard their crops from some of the most dangerous pests, lowering their likelihood of crop failure. As a result, Punjab cotton farmers began switching their fields from non-Bt cotton to Bt cotton. The area in Punjab planted with Bt cotton was 60 thousand hectares in 2006–07, and it grew to 285 thousand hectares in 2016-17 (Anonymous, 2017).

The technological gap refers to the difference between technology recommended by the scientists and technology adopted by the farmers. It was felt that agricultural technology is not generally adopted by the farmers completely in all respects. As a result, technological gap appears and poor yield is obtained (Sardhara, 2020). The Bt cotton crop is a profitable business endeavor that helps farmers' livelihoods and meets the demand for raw materials from the prestigious textile industry (Iliger, 2017).

According to studies, conducted by Patel et al. (2011) the majority of cotton farmers in Gujarat's Vadodara district had medium technological gaps in their cotton cultivation, followed by low and high technological gaps. Another study glanced at the training needs of Bt cotton growers in the state of Haryana, and revealed that, on average, close to half of the respondents had a high technological gap in practices like variety or hybrid selection, agronomic practices, sowing techniques, manure and fertilizer application, pest and disease management, and cotton picking (Devender, 2014). Keeping in view the importance of Bt cotton a study entitled 'An Analysis of Technological Gaps in Bt Cotton Cultivation in Punjab' was conducted in Bathinda district of Punjab to find out the technological gap in Bt cotton.

MATERIALS AND METHODS

Multistage sampling technique was applied for the selection of the respondents. The present study was conducted in Bathinda district of Punjab, as Bathinda is the major cotton growing district of Punjab. Bathinda district comprises of nine number of blocks namely, Bathinda, Sangat, Nathana, Rampura, Phul, Maur, Goniana, Bhagta Bhaika and Talwandi Sabo. Out of nine blocks, two blocks were selected randomly. From the each selected block, 2 villages were selected randomly. From each village 20 respondents were selected randomly to make a sample size of 80 respondents. A pre-structured interview schedule was used for the collection of primary data. Analysis of collected data was performed using SPSS (statistical package for social sciences) software.

RESULTS AND DISCUSSION

The outcomes presented in Table 1 demonstrated that the mean age of Bt cotton cultivators was 42.05 and 39.92 years for Sangat and Talwandi blocks, respectively. The age groups were further categorized, and it was found that the majority of respondents in Sangat block belonged to the younger age group, while in Talwandi block the majority of respondents were middle-aged. Additionally, the average level of education of Bt cotton growers was matriculated and middle school levels in Sangat and Talwandi blocks, respectively. A larger number of farmers in Sangat block had completed their education up to the matriculation level, whereas in Talwandi block, the majority of farmers had only completed primary education. These outcomes align with the findings of Kumar et al. (2018) and Iqbal et al. (2021) Moreover, most farmers in both blocks had a small family size, with 3-7 members. The average family size in Sangat block was 6.47±2.87 members, while in Talwandi block it was 4.67±1.79 members. These findings correspond with those of Kumar (2015), which revealed that only 35.62 per cent of respondents had large families, while 64.38% had small families. Majority of farmers resided in joint families in Sangat block, whereas in Talwandi Sabo block, farmers resided in nuclear families. Furthermore, the average operational landholding was 21.31 acres in Sangat block and 12.70 acres in Talwandi Sabo block. The average land under Bt cotton cultivation was 5.46 and 3.66 acres in Sangat and Talwandi Sabo blocks, respectively.Top of Form

Table 2 displays the outcome of the study regarding the occupation of farmers, which reveals that agriculture was the primary profession in both regions. This can be attributed to the fact that farmers in Punjab owned larger areas of land in comparison

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Parameters	Bloc	cks	Statistical	Overall	
	Sangat (n=40)	Talwandi Sabo (n=40)	(p value)	(n=80)	
Average age (years)	42.05±12.94	39.92±11.43	t= 0.769 (0.191)	40.97±12.18	
Categorization of age (% respondents)					
20-37 (Young)	19 (47)	17 (42)	$z = 0.449^{**} (0.0001)$	36 (45)	
38-55 (Middle)	13 (32)	19 (47)	z =15.094** (0.0001)	32 (40)	
Above 56 (Old)	8 (20)	4 (10)	z= 2.3094* (0.02)	12 (15)	
Average education (schooling years completed) Categorization of education level (% responded	9.92±2.81 ents)	7.57±4.78	t=2.681** (0.000)	8.75±4.07	
Illiterate	1 (2)	7 (17)	$ z = 3.940^{**} (0.0008)$	8 (10)	
Primary	1 (2)	10 (25)	z = 5.438** (0.003)	11 (27)	
Middle	9 (22)	4 (10)	z= 2.7386** (0.006)	13 (32)	
Matric	15 (37)	8 (20)	z=4.199** (0.0001)	23 (29)	
10+2	11 (27)	6 (15)	z=2.686** (0.007)	17 (21)	
Graduate and above	3 (7)	5 (12)	z = 1.313 (0.190)	8 (10)	
Average family size (members)	6.47±2.87	4.67±1.79	t= 3.364 (0.091)	5.57±2.54	
Categorization of family size (% respondents)					
3-7 members (low)	32 (80)	35 (87)	z = 0.909** (0.0001)	67 (84)	
8-12 members (medium)	6 (15)	5 (12)	z= 0.709 (0.477)	11 (14)	
Above 13 members (high)	2 (5)	0	-	2 (2)	
Family type (% respondents)					
1. Nuclear	11 (27)	23 (57)	z = 2.714** (0.0001)	34 (42)	
2. Joint	29 (72)	17 (42)	z= 2.714** (0001)	46 (57)	
Average operational land holding (acre)	21.31 ± 15.07	12.70±6.78	t= 3.296** (0.000)	17.01±12.39	
Average cotton land (acre)	5.46±4.14	3.66±1.98	t=2.934** (0.000)	4.79±3.61	

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Occupation	Blocks		Statistical	Overall	
	Sangat (n=40)	Talwandi Sabo (n=40)	(p value)	(n=80)	
Only Agriculture	35 (87)	38 (95)	z =1.187** (0.0001)	73 (91)	
Agriculture + Govt. Service	1 (2)	0	-	1 (1)	
Agriculture + Private Job	1 (2)	0	-	1 (1)	
Agriculture + Labour	0	1 (2)	-	1 (1)	
Agriculture + Business	3(7)	1 (2)	z=1.769 (0.076)	4 (5)	

Table 2: Distribution of Bt cotton growers on the basis of th	heir occupation (% cotton growers)
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to other states, and they possess a strong inclination towards farming, which can account for the obtained findings. A significant difference was found between the occupation of farmers in the two blocks, with z=1.187, p=0.0001. These results correspond with those presented by Kumar (2015), which indicated that a vast majority (88.12%) of Bt cotton farmers solely relied on farming as their primary occupation.

Table 3 presents the findings of the average annual income from crop cultivation, overall household annual income, and Bt cotton income in Sangat and Talwandi Sabo blocks. The study revealed that the average annual income from crop cultivation was Rs 652,425 and Rs 560,625 in Sangat and Talwandi Sabo blocks, respectively. The overall household annual income from all sources was Rs 631,625 in the Sangat block and Rs 586,875 in the Talwandi Sabo block. Moreover, the average annual income from Bt cotton of the respondents was Rs 114,425 in the Sangat block and Rs 74,550 in the Talwandi Sabo block. The study further showed that the contribution of cotton income to the overall household annual income was 18.11 percent in the Sangat block and 12.70 percent in the Talwandi Sabo block. The study results suggest that the cultivation of Bt cotton has provided a significant income source to farmers, which motivates them to improve their farming practices. The findings are similar to those of Jambhule *et al.* (2023).

Result presented in Table 4 shows that majority of farmers grow RCH 773 and RCH 776 in both blocks, followed by RCH 926. While some farmers also cultivate more than one variety, RCH 773 and RCH 776 were cultivated by 10 per cent of farmers in Sangat and 2 per cent in Talwandi Sabo. RCH 776+RCH 926 were cultivated by 2% of farmers in Sangat block and 5 per cent in Talwandi Sabo block, while RCH 926+RCH 773 were cultivated by the farmers of Sangat only at 12 and 7 per cent, respectively. The results are consistent with those of Sharma *et al.* (2021), who found that among the many Bt-cotton hybrids cultivated in the district, RCH 773 (35.9% of total area) had the highest area, followed by Ankur 3028 (12.3%),

Annual income from	Blocks		Statistical	Overall
different sources (average)	Sangat (n=40)	Talwandi Sabo (n=40)	(p value)	(n=80)
Crop cultivation (Rs)	652425.00±404020.62	560625.00±337927.67	t =0.160(0.352)	606525±372949.72
Govt. service (Rs)	360000	0	-	360000
Private job (Rs)	108000	0	-	108000
Labour (Rs)	0	100000	-	100000
Business (Rs)	12500.00 ± 8155.15	50000	-	37500.00±110867.79
Bt Cotton (Rs)	114425.00±99083.72	74550.00 ± 12051.59	t=2.017*(0.052)	94487.50±90095.73
From all sources (Rs)	631625.00±355580.69	586875.00 ± 331033.13	t=0.125(0.353)	609250±342086.91
Percent share of cotton income in household annual income	18.11 %	12.70 %	-	15.5 %

Table 3: Annual income from all sources and percent share of Bt cotton income in overall household annual income

Varieties	I	Blocks	Statistical	Overall	
	Sangat (n=40)	Talwandi Sabo (n=40)	(p value)	(n=80)	
RCH 773	22 (55)	17 (42)	z= 1.118** (0.0001)	39 (49)	
RCH 776	16 (40)	18 (45)	z = 0.452** (0.0001)	34 (42)	
RCH 926	12 (30)	11 (27)	z= 0.741 (0.459)	23 (29)	
RCH 773+RCH776	4 (10)	1 (2)	z=2.504*(0.012)	5 (6)	
RCH 776+RCH926	1 (2)	2 (5)	z = 1.187 (0.234)	3 (4)	
RCH926+RCH773	5 (12)	3 (7)	z= 1.313 (0.453)	8 (10)	

Table 4: Adoption of	Bt cotton varieties by	v the respon	idents (% re	spondents)
			(

Table 5: Technological gap of Bt cotton growers (%)

Technology	Recommended technology	Technology used by farmers (%)	Technological gap (%)
Seed rate	0.95 kg/acre	5	95
Date of sowing	1 april-15 may	75	25
Spacing $(\mathbf{R} \times \mathbf{P})$	$67.5 \times 75 \text{ cm}$	0	100
Gap filling (DAS)	3 weeks	33	67
Sowing method	Mechanical method	100	0
Machine used for sowing	Cotton sowing drill	100	0
Recommended quantity of urea	90 kg/acre	44	56
Recommended quantity of DAP	27 kg/acre	0	100
Recommended quantity of MOP	20 kg/acre	4	96
Recommended quantity of SSP	75 kg/acre	0	100
Method of application of fertilizer	Broadcasting	100	0
Dosage of urea	2 doses (45 kg/acre each)	0	100
No. of irrigation	4-6	100	0
Herbicide quantity			
1. Pendy methaline	1 ltr/acre	12	88
2. Hit weed	0.5 ltr/acre	0	100
Pesticide quantity			
1. Confidor	150 ml/acre	7	93
2. Ulala 50 WG	80 g/acre	14	86
3. Actara 25 WG	40 g/acre	0	100
Method of harvesting	Hand picking	100	0

MRC 6588 (10.7%), RCH 776 (10.3%), and RCH 650 (7.0%).

Technological gap refers to the difference between technology recommended by the scientists and technology adopted by the farmers. Cent per cent technological gaps were observed in the spacing ($\mathbb{R}\times\mathbb{P}$), DAP, SSP, dosage of urea, hit weed, and actara, followed by seed rate (95%), date of sowing (25%), gap filling (67%), urea (56%), MOP (96%), pendy methaline (88%), confidor (93%), and ulala (86%). It is prime duty of the Agriculture department and Scientists of State Agriculture University to aware the farmers and also provide technical knowledge so that these gap can be filled. The results are consistent with those of Sable and Kadam (2012) in which it was reported that the majority of farmers applied fertilizers for nitrogen, phosphorous, and potassium in greater amounts than recommended and throughout the crop growing season. The respondents' explanation for this behaviour was that applying more chemical fertilizers continuously would result in higher yields. Numerous respondents also lacked accurate information about the suggested fertilizer dosage. Lack of understanding may have contributed to the overuse of all three fertilizers (N, P, and K), as the majority of people believed that applying the recommended amount of each would not produce the desired yield. There was no technological gap in terms of sowing methods, fertilizer application methods, number of irrigation systems, and harvesting methods. The results are consistent with those of Depathi et al. (2014) with regard to the suggested seed rate, 100% of the respondents fell into the partially adopted category.

CONCLUSION

In conclusion, this study aimed to examine the socioeconomic characteristics of Bt cotton growers in Sangat and Talwandi Sabo blocks of the Bathinda district of Punjab, India. The study found that the mean age of Bt cotton cultivators was 42.05 and 39.92 years for Sangat and Talwandi Sabo blocks, respectively. The average level of education of Bt cotton growers was matriculated and middle school levels in Sangat and Talwandi Sabo blocks, respectively. Agriculture was the primary profession in both regions, and a vast majority of Bt cotton farmers solely relied on farming as their primary occupation. The study further revealed that the cultivation of Bt cotton has provided a significant income source to farmers, and the contribution of cotton income to the overall household annual income was 18.11 percent in the Sangat block and 12.70 percent in the Talwandi Sabo block. Moreover, RCH 773 and RCH 776 were the most commonly cultivated Bt cotton hybrids in both blocks, and the technological gap was observed in several practices. The findings of this study could be useful for policymakers, extension workers, and other stakeholders in devising strategies to improve the socio-economic status of Bt cotton farmers in the Bathinda district.

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Research Article

Measures of Feminisation of Agriculture

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ABSTRACT

Due to different social contexts the involvement of women in agriculture has been increasing significantly. Feminisation of agriculture index was developed to analyse the increased participation of women in the field of agriculture. Through rigorous reviewing of literature, a list of sixty items under decision making and labour participation dimension was prepared and sent to 100 experts. Based on the 60 experts' responses 20 items in decision making and 19 items in labour participation were finalised through item analysis and relevancy test. Later, the index was administered to 60 respondents including farm women of migrant and non-migrant households for extracting weight of the items through principal component analysis (PCA). Validity and reliability of the constructed index were worked out with the help of content validity and split-half technique respectively. This developed tool will be useful to measure the extent of feminisation of agriculture and thereby providing impetus to the gender mainstreaming in agriculture.

Keywords: Feminisation of agriculture index, Item analysis, Principal component analysis (PCA), Gender role, Decision making, Labour participation

INTRODUCTION

In all developing nations, women play a crucial role in the agricultural and rural economies. In many places of the world where social and economic challenges are reshaping the agricultural sector, their roles vary greatly between and within regions and are changing quickly (Raney *et al.*, 2011). The increased visibility of women's work in agriculture can be partly attributed to research and data collection, attempting to precisely measure women's activity in rural areas. Women have also tended to become more and more involved in agricultural production over the past few decades as they increasingly assume responsibility for responding to opportunities for financial gain in commercial agriculture and guaranteeing household survival.

The term "feminization of agriculture" broadly refers to women's increased involvement in the agricultural labor sector, whether as independent producers, unpaid family workers, or wage laborers (Lastarria-Cornhiel, 2006; Najjar *et al.*, 2022). Feminization of agriculture typically results from males leaving low-paying agriculture for high-paying industries. This is thought to have occurred in India as a result of the casualization of labour, crop failure and forced migration (Menon and Yana, 2021). Kekar (2010) in his study reported that male labor outmigration, an increase in households headed by women, and the development of labor-intensive agriculture are the main factors contributing to the feminization of agriculture.

Women now make up a larger portion of the agricultural labor than men do, and their roles have expanded as a result of men leaving the industry. However, agricultural employment is declining, particularly in terms of paid employment, more than two thirds of women who work are self-employed managers and unpaid farmworkers who assist the family (Waris *et al.*, 2016). Rahman (2009) in his study in Bangladesh found that temporary male migration led to women taking over farm activities, which in turn increase their autonomy as well as work load. In the absence of men women play greater role in family

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decision making and increase their participation in dayto-day family affairs. They perform additional work such as care of animal, work in family farm or continue the family business (Desai and Banerji, 2008).

The two dimensions of feminization in agriculture are decision-making and the involvement of women in agricultural labor (measured by the number of women and the amount of time they spend doing it). The former is referred to as managerial feminization, whereas the latter is labor feminization (Gartaula et al., 2010). During male outmigration the work load of women increase as they replace the lost man power. Whereas, women perform more farm work, their contribution in decision making is clearly less than their male counterpart (Kaspar, 2005). Considering the importance of increased participation of women in agriculture, it is important to study the process of feminisation of agriculture in terms of decision making in farming operations and labour participation. The present study has attempted to develop an index to measure the feminisation of agriculture phenomena.

MATERIALS AND METHODS

While preparing the feminisation of agriculture index, two dimensions, namely, decision making and labour participations were chosen based on previous studies. Under each dimension 30 items, thus a total of 60 items were identified based on the review of literature. In the labour participation dimension, 19 farming activities were clubbed to create eight domains i.e., land preparation activities, nursery raising and transplanting, intercultural activities, input application, harvesting, post-harvest activities, care of animals, and sell of produce.

To finalise the items Likert summated rating technique (1932) and relevancy test was followed. To find out the relevancy of the 60 statements, a questionnaire was prepared with the help of Google form, where each statement is presented with a threepoint continuum- most relevant (3), relevant (2), and least relevant1 (1) and was sent to 100 experts. The responses were obtained from the 60 experts. Subsequently, the relevancy percentage (RP), relevancy weightage (RW) and mean relevancy score (MRS) were computed based on the responses. To categorize the respondents into high group and low group, the summated scores of the respondents were arranged in a descending order. The top 25 per cent consisting of 15 respondents constituted the high scoring group and the bottom 25 per cent consisting of 15 respondents constituted the low scoring group. Significance of the items was calculated by t-statistics.

To assign weight to the items a questionnaire was prepared with the screened items and administered to 60 respondents including both migrant and nonmigrant wives in a non-sampling area. In decision making dimension, 20 statements were finalised and measured in 5-point continuum of always-4, mostly-3, sometimes-2, rarely-1, never-0. In the second dimension (labour participation), 19 different activities, included under eight domains performed by the women, which were measured in term of working hour. Principal component analysis (PCA) for both the dimensions were performed to calculate the weight of the items. Split-half technique was used to establish the reliability of the index. Validity of the tool was satisfied through content validity.

RESULTS AND DISCUSSION

The first step in construction of index involved a thorough literature review to identify the items in relation to decision making in production process and farming activities performed. A total of 60 items were modified using Edwards' (1957) principle and accordingly statements were prepared in a google form format and sent to a group of 100 experts working in field of migration, gender and empowerment related issues in agriculture and rural areas. Judges were asked to rate the items in 3-point scale. Responses were obtained from 60 judges and the relevancy of items were calculated through RP, RW, MRS using following formulas. Similar procedure for selection of items was adopted by Gupta *et al.* (2022) and Mukherjee *et al.* (2018) in their respective studies.

RP = (Frequency score of most relevant and relevant / Number of judges) X 100

RW= (Actual score obtained for the statement / Maximum possible score obtainable for the statement)

MRS = (Actual scores obtained for the statement / Number of judges responded)

Table 1 presents the items having RP above 70, RW above 0.65, and MRS above 2.00, which were

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Table 1: Selected items under	decision	making	and labour	participation	dimensions

Items/ Statements	RP	RW	MRS	t-value**
Decision making				
You take decision regarding the uses of land	96.67	0.87	2.60	4.183**
You select the crop to be sown	95.00	0.86	2.58	4.000**
You choose the variety of seed to be sown	85.00	0.77	2.32	6.873**
You decide where to get the seed/planting material	80.00	0.70	2.10	8.264**
You take decision on the amount of money to be spent for seed/planting material?	91.67	0.84	2.52	5.870**
You decide on the method of sowing of seed	85.00	0.73	2.18	4.525**
You take decision for how much to produce	83.33	0.74	2.22	5.905**
You take decision for purchase/renting of farm machinery (tractor, power tiller, etc.)	93.33	0.84	2.52	5.245**
You decide freely about the purchase of small agriculture equipment (khurpi, sickle, spade, etc.)	93.33	0.82	2.45	4.035**
You decide which fertilizers/ insecticides to be used in the field	86.67	0.75	2.25	4.025**
You decide about the use and dosage of the fertilisers/insecticides	76.67	0.69	2.08	8.366**
You supervise hiring of labour	91.67	0.82	2.47	4.025**
You decide the duration of time for which labours are to be hired	86.67	0.77	2.32	3.227**
You determine the amount of credit to be taken for agricultural purpose	96.67	0.88	2.65	5.123**
You fix the portion of income that goes for repayment of the loan	96.67	0.84	2.53	4.183**
You take decision regarding time of harvest of crops	91.67	0.76	2.28	4.183**
You decide on the quantity of produce to be separated for consumption	96.67	0.88	2.63	4.000**
You finalise whom to sell the produce	88.33	0.75	2.25	4.183**
You fix the price of the produce	85.00	0.78	2.33	7.359**
You decide in which form the produce have to be sold (e.gpaddy/rice)	83.33	0.75	2.25	2.256**
Labour participation				
Land preparation activities				
You plough the field	88.33	0.81	2.43	6.000**
You perform puddling	71.67	0.68	2.05	4.025**
You help in land levelling	78.33	0.67	2.02	5.245**
Nursery raising and transplanting				
You help in seed bed preparation	96.67	0.87	2.60	7.897**
You help in nursery raising	93.33	0.83	2.48	4.582**
You sow seed in field	95.00	0.84	2.52	5.136**
You perform transplanting operation	90.00	0.83	2.50	2.806**
Intercultural activities				
You carry out irrigation in your field	96.67	0.88	2.65	4.794**
You perform intercultural operations like weeding in the field	90.00	0.79	2.37	8.290**
Input application				
You apply fertiliser	100.00	0.89	2.67	3.227**
You spray pesticide on crops	95.00	0.78	2.35	5.245**
Harvesting				
You participate in harvesting of the crops	78.33	0.72	2.15	3.108**
You involve in threshing of crops.	96.67	0.88	2.65	4.298**
You go for winnowing of crop	98.33	0.89	2.68	5.264**

Table 1 contd				
Items/ Statements	RP	RW	MRS	t-value**
Post harvest activities				
You involve in drying grain (at home/field)	91.67	0.86	2.58	3.567**
You bag and store the grain	98.33	0.86	2.57	5.916**
You take the grains for milling	93.33	0.84	2.52	7.359**
You take care of livestock	71.67	0.66	1.97	3.227**
You are involved in the marketing of the product	96.67	0.91	2.73	5.870**

** significant at 0.01% level of significance

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finalised for further consideration. The t-statistic was calculated for each item/ statement using the mean scores of the high and low scoring groups. Finally, the 20 items under decision making dimension and 19 items under labour participation dimension having t-statistic values \geq 2.00 were included in the final index. Item selection through similar methods was also adopted by Reddy *et al.* (2023); Bareh and Ghosh (2016) and Mahajan *et al.* (2023) in their respective studies. The statistical package for social sciences (SPSS) was used to perform PCA. The steps followed for weighting of the items is as follows:

- PCA was performed to extract the factor loadings and eigen values.
- The components having eigen value greater than one were identified.
- The factor loading values of the component which explains the maximum variance in the data were considered for computing weight of the items.
- Weight was assigned by dividing the factor loading of each item with summation of all the factor loading values of the component.

Items/ Statements	Factor loading	Weight
You take decision regarding the uses of land.	0.529	4.18
You select the crop to be sown.	0.504	3.98
You choose the variety of seed to be sown.	0.228	1.80
You decide where to get the seed/planting material.	0.512	4.05
You take decision on the amount of money to be spent for seed/planting material.	0.54	4.27
You decide on the method of sowing of seed.	0.276	2.18
You take decision for how much to produce?	0.516	4.08
You contribute in the decision for purchase/renting of farm machinery (tractor, power tiller, etc.).	0.529	4.18
You decide freely about the purchase of small agriculture equipment (khurpi, sickle, spade, etc.).	0.665	5.26
You decide which fertilizers/ insecticides to be used in the field	0.863	6.82
You decide the use and dosage of the fertilisers/insecticides?	0.724	5.72
You supervise the hiring of labours.	0.718	5.68
You decide about the duration of time for which labours are to be hired.	0.804	6.36
You determine the amount of credit to be taken for agricultural purpose.	0.789	6.24
You fix the portion of income that goes for repayment of the loan.	0.784	6.20
You take decision regarding time of harvest of crops.	0.699	5.53
You decide on the quantity of produce to be separated for consumption.	0.736	5.82
You finalise whom to sell the produce.	0.725	5.73
You fix the price of the produce.	0.666	5.27
You decide in which form the produce have to be sold (e.gpaddy/rice).	0.83	6.56
Total	12.637	100

Factor analysis through PCA; Eigen value - 14.390, Variance explained - 71.951

Table 2: Weight of items under decision making dimension

Table 2 represents the respective factor loading value and weight of each item under decision making dimension.

For decision making in production process maximum weight i.e., 6.82 was obtained for decision regarding which fertilizers/ insecticides to be used in the field. Minimum weight i.e., 1.80 was obtained for decision regarding variety of seed. Table 3 represents the respective factor loading value and weight of each item under labour participation dimension.

 Table 3: Weight of items in labour participation

 dimension

Domains of labour participation	Factor	Weight
	loading	
Land preparation (LP)	0.772	13.39
Nursery raising & Transplanting (NT)	0.793	13.75
Intercultural activities (Int)	0.946	16.40
Input application (IA)	0.649	11.25
Harvesting (H)	0.958	16.60
Post harvest activities (PHA)	0.974	16.89
Care of livestock (CL)	0.058	1.00
Marketing of produce (MP)	0.619	10.73
Total	5.769	100

Factor analysis through PCA; Eigen value - 4.874, Variance explained - 60.923

For labour participation dimension maximum weight i.e., 16.89 was obtained for post-harvest activities and minimum weight i.e., 1.00 was obtained for care of animals. Utilization of PCA for extracting weight of the indicators was adopted by Singh *et al.* (2022) and Feroze *et al.* (2010).

The split-half technique was adopted to establish the internal consistency of the developed tool. The reliability coefficient (Spearman-Brown Coefficient) was 0.973 which denotes a high internal consistency of the developed tool (Table 4).

As the index was constructed with the help of sixty judges who reviewed the items and during final selection, the given recommendations were implemented into the index, the content validity of the index was satisfied. Similar method for content validity was adopted by Gupta *et al.* (2022); Chikkalaki *et al.* (2023) and Reddy *et al.* (2023) in their respective studies.

Table 4. Reliability statistics of developed tool

Reliability statistics	6		
Cronbach's Alpha	Part 1	Value	.871
		N of Items	14 ^a
	Part 2	Value	.899
		N of Items	14 ^b
	Total N of Iter	ns	28
Correlation Between	Forms		.948
Spearman-Brown	Equal Length		.973
Coefficient	Unequal Length	ı	.973
Guttman Split-Half (Coefficient		.955

CONCLUSION

The developed index represents a comprehensive and reliable tool for measuring the feminisation of agriculture. It includes two dimensions, namely decision making and labour participation to understand the changing role of women in agriculture. It can be seen that higher weightage are given in the decision-making dimension for decision regarding application of fertiliser/pesticides, duration of hiring of labour, credit for agricultural purpose, repayment of loan; for labour participation dimension higher weightage given to post harvest activities, harvesting and intercultural activities. Being a unique instrument, it holds promise for wide applicability in future research. Recognizing the social changes occurring due to various social and economic factors, the information derived from this index can assist administrators and policymakers in making unbiased decisions while planning programs to empower women and rural community. Additionally, with suitable modifications, this index could be adapted for use in variety of social and geographic context.

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Research Article

Technological Needs of Various Components in the Integrated Farming Systems of Kerala

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ABSTRACT

Integrated farming system is considered as a viable option to ensure financial as well as food security for the farm families. For maintaining the profitability and productivity of adopted components, various technologies are needed to be adopted in an IFS unit. An attempt was made among the IFS units of Kerala to identify various technological needs for maintaining different components in a unit. The study was conducted in 180 IFS units of Kerala. Technological needs were analyzed for various components separately. In general, IFS farmers perceived the need for value addition technologies more when compared with production technologies. In case of value addition, more need was reported for processing technologies, followed by product diversification and storage.

Keywords: Components, Farming systems, Integrated, Technological needs

INTRODUCTION

Integrated Farming System is broadly defined as a system comprising of different agro-based enterprises which are complementary to each other. It serves to raise the standard of living for farm families by ensuring maximum production per unit area and better utilisation of all available resources with little environmental impact (Sheikh et al., 2023). Hence, IFS is a strong bet which could help the farmer maximise the profitability from a unit area without disturbing ecological and socio-economical balance (Nair et al., 2019). Contrary to Specialised Farming Systems (SFS), integrated farming systems are centred around a small number of carefully chosen, interdependent and frequently interlinked production systems centred on a limited number of crops, animals and associated ancillary professions. It involves the use of primary and secondary products from one system as the principal input of another system, resulting in the mutual integration of the two systems as a whole. Several researchers have advocated that IFS can be used to

satisfy the numerous objectives of poverty reduction, food security, competitiveness and sustainability (Rao et al., 2019). The efficient use of the components in an IFS model is based on the fundamental principles of a farming systems approach, such as complementarity, recycling, farmer participative and dynamism among others (Shyam et al., 2023). Adopting an integrated farming system enables different businesses to maximise the use of the natural resources that are now accessible in order to satisfy the requirements of the family, resulting in sustainability and stability in farm revenue. It also attempts to provide the minimum amount of farm revenue necessary for the farm family to continue to be interested in farming, limiting the exodus of people from the industry (Rathore et al., 2019). Even in extremely susceptible climate, a high standard of food production with minimal environmental impact is ensured via an integrated agricultural system with accessible resources for farmers. It has transformed traditional cattle farming as well as aquaculture, poultry, horticulture and related industries. IFS is a trusted method for achieving high

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productivity with the significant nutrient economy, in addition to maximising compatibility and replenishment of organic matter through the efficient recycling of organic residues/wastes etc. generated through the integration of diverse land-based industries.

Technology is described as an organised body of knowledge and practices, typically applied to industrial practices but can be applied to any recurring action (Mc Graw, 1982). It enables man to live more comfortably and securely by putting scientific knowledge into direct application (Hoda, 1979). Raju (1982) defined a new technology in the agriculture system as any new item in the farming system, including different commodities, farm operations, equipment and other services. Adoption of better agricultural technology is one of the main strategies to increase farmers' revenue. Agricultural productivity and output have clearly benefited from the use of new technology. More precisely, these have a bearing on raising farmers' income, diversifying their sources of income, protecting the environment, enhancing the efficiency of input usage, creating job possibilities and encouraging diversity (Joshi and Varshney, 2022). To fulfil the diverse and shifting demands of the public for food, fibre and other commodities and services that are offered, the agricultural industry must use a wide range of evolving technology and farming practises across many different farming systems and structures (Kapur, 2018). The development of userfriendly technologies is the main goal of agricultural research (Thomas and Kumar, 2015).

A farmer may have different technology needs depending on how various components are integrated in their unit. Technology need refers to a probabilistic prognosis of technical advancements based on prospective features of useful equipment, systems, or procedures and the customer's needs (Rao, 1998). Technology forecasting is required for any planning process due to rapid technological innovation and the increased rate of depreciation of available technologies. A technology forecast is a stochastic projection of future technical advancements in the form of beneficial machines, methods or trials and customer needs. It is essential for any planning process due to the quick advancement of technology and the escalating rate of technological depreciation. In this context, an attempt was made to analyse the technological needs of various components in the IFS units of Kerala.

MATERIALS AND METHODS

This study was carried out in the IFS units of Kerala State. Out of the total fourteen districts of Kerala, Kollam district (southern Kerala), Thrissur district (central Kerala) and Kannur district (northern Kerala) were selected randomly. From each district, four *Panchayats* were selected randomly. A list of dairy based IFS farmers was prepared with the help of officials in various departments as well as local leaders and from the list, fifteen IFS farmers were selected from each *panchayat*. Thus, 180 dairy based IFS farmers were randomly chosen for conducting the study.

Predominant components in the IFS units of Kerala were identified. Among the nine identified components, mainly six components contributed to their family income. The technology needs assessments were worked out for these six components using the procedure followed by Thomas (2004) with slight modifications. The scores of technology needs for all components in the selected IFS units were compiled, statistically analysed and on the basis of that, farmers were categorised into the four groups viz; technology not available for adoption, technology available but not applicable, technology available but not sustainable, technology available, applicable and sustainable group with respective scores 4, 3, 2, 1. A mean technology need score was also calculated on different aspects of technology for each component. The category with the highest score was considered to be the most needed technology in each component.

RESULTS AND DISCUSSION

A perusal of Table 1 showed that regarding various aspects of crop cultivation, IFS farmers had adequate availability of technologies, except a few. The highest need was noticed for processing technologies (Total Technology Need Score - 414), followed by farm inputs and new varieties (TTNS - 411), plant protection (TTNS - 399), storage (TTNS - 387), product diversification (TTNS - 374), as well as climate monitoring and forecasting technologies (TTNS - 343). None of the farmers had the opinion that the technologies were not available for adoption, but majority of them were worried about the applicability as well as sustainability of the existing technologies. Since most of the respondents felt that technologies like water harvesting, waste management, soil management, harvesting and farm mechanisation were readily available, applicable and sustainable, this suggests that there was little need for these technologies in the study area.

In case of value addition technologies, less than half of the farmers were reported to be satisfied with the technologies that were available for value addition and most of them were facing applicability and sustainability issues with the available technologies. The high technology need reported for value addition technologies may be attributed to the high perishability of agricultural products and the inadequate storage facilities available to farmers. Since climate change was a serious issue, they might have thought that if new technologies were available for monitoring and forecasting climate changes, they could take precautions accordingly and reduce issues like crop loss to a greater extent. Now more farmers prefer green labelled newgeneration pesticides and fungicides. This may have contributed to the high demand for new plant protection related technologies. Similar findings were reported by Thomas (2004) who found that among homesteads of Kerala, it was seen that farmers required more technologies for processing, value addition and storage irrespective of the crop categories.

Table 2 highlight that, among the selected dairy related technologies, high degree of technological need was noticed in feed related technologies (TTNS- 402) followed by processing (TTNS- 343) and storage (TTNS- 299) technologies. Regarding feed related technologies, the percent of completely satisfied farmers in terms of availability, applicability and sustainability of existing technologies were very less as compared to other technological aspects. Among the total farmers, nearly half of them (42.78%) reported that the existing technologies could not be applied to the field conditions. More than one third of the farmers (37.78%) were dissatisfied with the sustainability of existing feed related technologies. In terms of value addition technologies like storage and processing, nearly half of the respondents had concern about the applicability and sustainability of existing technologies. The figures also revealed that, nobody in the study area was reported to have unavailability of technology for adoption but had worries related to its applicability and sustainability. This implies that, due to the high level extension orientation they were aware of available technologies and they may have tried those technologies as much they could. The performance might not have

Categories of technology needed	Frequency	and percenta	ge (in bracket	t) (n =180)	Total	Expected
for crop cultivation	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)	technology need score	score range
Water harvesting and management	0	0	59 (33)	121(67)	239	
Farm inputs and new varieties	0	93 (52)	45 (25)	42 (23)	411	
Plant protection related	0	65 (36)	89 (49)	26 (15)	399	
Soil management	0	0	78 (43)	102 (57)	258	
Climate monitoring and forecasting	0	45 (25)	73 (41)	62 (34)	343	180-720
Waste management	0	0	48 (27)	132 (73)	228	
Harvesting related	0	53 (29)	48 (27)	79 (44)	334	
Farm mechanisation	0	32 (18)	67 (37)	81 (45)	311	
Storage	0	77 (43)	53 (29)	50 (28)	387	
Processing	0	89 (49)	56 (31)	35 (20)	414	
Product diversification	0	74 (41)	46 (26)	60 (33)	374	
Mean technology need score					336.18	

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Categories of technology	Freque	ncy and percent	tage (in bracket) (n =180)	Total	Expected
in dairy farming	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)	technology need score	score range
Housing management	0	0	29 (16.11)	151 (83.89)	209	
Breeding related	0	0	63 (35.00)	117 (65.00)	243	
Feed related	0	77 (42.78)	68 (37.78)	35 (19.44)	402	
Clean milk production	0	27 (15.00)	37 (20.56)	116 (64.44)	271	180-720
Disease management	0	0	97 (53.89)	83 (46.11)	277	
Farm waste management	0	0	54 (30.00)	126 (70.00)	234	
Storage	0	22 (12.22)	75 (41.67)	83 (46.11)	299	
Processing	0	61 (33.89)	41 (22.78)	78 (43.33)	343	
Product Diversification	0	0	49 (27.22)	131 (72.78)	229	
Mean technology need score					278.55	

Table 2: Distribution of respondents based on technological needs in dairy component

met their expectations, which may be the reason for small percent concern expressed in case of applicability and sustainability.

In spite of these concerns, the majority of the respondents were pleased with the housing management technologies, which include the establishment of high-tech cattle sheds with climateadaptive practices, breeding related technologies like artificial insemination facilities, milk production related technologies and farm waste management technologies that are currently available in Kerala. As a result of various programmes implemented by the government, majority of dairy farmers were exposed to numerous technologies related to welfare and milk production aspects and they were able to apply to their field conditions in a sustainable manner. That might be the reason for the low technological need in these aspects. At the same time, due to the increase in feed prices, farmers were unable to choose scientific feed management and instead chose more unscientific approaches, which had an impact on both health and productivity. Since the raw materials were acquired from other states, lowering the price of feed was also difficult. This implies that the extension system needs to pay more attention to the development of new feed combinations and value related technologies that can be applied easily and sustainably to the current field conditions. Because the utilisation of modern dairy technologies is key to ensure profitability and productivity (Janssen and Swinnen, 2019).

With respect to poultry component, processing (TTNS- 389) and product diversification (TTNS- 350) were identified as having the greatest need among the selected technologies (Table 3). Since the majority of the farmers were satisfied with other production technologies, there was less need for new technologies. However, when it came to value-adding technologies, most of the farmers were concerned about the applicability of available technologies, which highlights the need for more technologies that are readily accessible and adaptable in field conditions in a useful manner.

When looking at fisheries technologies, Table 3 indicated that a technology need was noticed for product diversification (TTNS- 245), processing (TTNS- 239), nursery and rearing management (TTNS- 221) and water quality management (TTNS- 201). More than half of the farmers (61% for processing and 63.10% in product diversification) were marked that the available technologies were not practically applicable in their field conditions. In case of production related technologies, only less than one third of the IFS farmers were satisfied with water quality management and nursery as well as rearing stock management technologies. Although there were numerous technologies available for scientific fish farming, most

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Categories of technologies needed	Freque	ency and perc	entage (in bra	icket)	Total	Expected
for identified components	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)	technology need score	score range
Poultry (n=158)						
Scientific housing techniques	0	38 (24)	14 (9)	106 (67)	248	
Nutrition and Feed management	0	0	72 (46)	86 (54)	230	
Health management	0	0	76 (48)	82 (52)	234	158 -632
Farm waste management	0	0	0	158 (100)	158	
Hatchery, Brooding & rearing manageme	ent 0	24 (15)	38 (24)	96 (61)	244	
Storage	0	36 (23)	24(15)	98 (62)	254	
Processing	0	97 (61.40)	37 (23.41)	24 (15.19)	389	
Product Diversification	0	69 (44)	54 (34)	35 (22)	350	
Mean technology need score					263.38	
Fisheries (n=95)						
Pond Preparation	0	0	0	95(100)	95	
Water Quality Management	0	37 (39)	32 (34)	26 (27)	201	
Nursery, Rearing and Seed Stocking/ breeding stock management	0	48 (50.50)	30 (31.60)	17 (17.90)	221	
Feeding management	0	0	57 (60)	38 (40)	152	95 - 380
Pest & Disease management	0	0	26 (27)	69 (73)	121	
Harvesting	0	0	0	95 (100)	95	
Storage	0	24 (25)	20 (21)	51 (54)	163	
Processing	0	58 (61)	28 (29.5)	9 (9.5)	239	
Product Diversification	0	60 (63.10)	30 (31.60)	5 (5.3)	245	
Mean Technology Need Score					170.22	

Table 3: Distribution of respondents based on technological needs in poultry and fisheries component

farmers had trouble in implementing those technologies in their small units. The income obtained from fisheries component in IFS units of Kerala was found to be medium to low (Chandran *et al.*, 2023). This could be connected to the technological need of farmers. In this context, serious attention is needed for the development of more farmer-friendly technologies that can be easily applied to the field condition in a sustainable way.

A glance at Table 4 showed that all the farmers who had added apiculture in their units were satisfied with the existing production technologies. Thus, the majority of the farmers agreed that the existing technologies could be applied sustainably in production-related aspect, there was no need for new technologies in those areas. In case of value addition, a need was noticed for product diversification (TTNS-116) and processing (TTNS-111) technologies. In this context, serious attention is needed for the development of more farmer-friendly value addition technologies that can be easily applied to smaller units in a sustainable way.

In case of mushroom related technologies (Table 4), in terms of value addition aspects, the majority of the mushroom farmers, perceived difficulties for applying available technologies in field conditions. Regarding this, the highest need was noticed for processing (TTNS-27) and product diversification (TTNS-27) followed by storage (TTNS-26) technologies. In production related technologies, when

Categories of technologies needed	Freque	ency and perc	entage (in bra	acket)	Total	Expected
for identified components	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)	technology need score	score range
Apiculture (n=55)						
Seasonal Colony management	0	7(12.72)	10 (18.18)	38 (69.10)	79	
Feeding management	0	0	10 (18.18)	45 (81.82)	65	
Harvesting related	0	0	0	55 (100)	55	55-220
Storage	0	0	0	55 (100)	55	
Processing	0	18 (32.73)	20 (36.36)	17 (30.91)	111	
Product Diversification	0	26 (47.27)	9 (16.37)	20 (36.36)	116	
Mean technology need score					80.16	
Mushroom (n=11)						
Sterilization and inoculation technologie	es 0	6 (55)	3 (27)	2 (18)	26	
Substrate related	0	0	6 (55)	5 (45)	17	
Climate control technologies	0	0	0	11 (100)	11	
Waste management	0	0	0	11(100)	11	11-44
Harvesting	0	0	0	11(100)	11	
Storage	0	6 (55)	3 (27)	2 (18)	26	
Processing	0	7 (64)	2 (18)	2 (18)	27	
Product Diversification	0	6 (55)	4 (36)	1 (9)	27	
Mean Technology Need Score					19.50	

Table 4: Distribution of respondents based on technological needs in apiculture and mushroom component

compared to other technologies, a need was noticed for sterilisation and inoculation related technologies (TTNS- 26). Even though they were aware of the technologies, they had not adopted them yet. This could be due to the fact that the majority of the mushroom farmers had small production units and adopting technologies which require advanced infrastructure facilities and a high cost are not feasible for their condition.

Various technologies needed for identified components in an IFS unit had been recognised mainly in terms of production and value addition aspects and the technology needs of IFS farmers were examined. In light of this, the technological needs were compiled again to analyse the most needed technology among those components for which a technology need had already been identified. A component wise categorisation of technological needs based on the mean technology need score is presented in Table 5.

It was quite evident from Table 5 that IFS farmers perceived the need for value addition technologies more when compared to production (Mean Total Score-1.86) technologies. In case of value addition, more need was reported for processing technologies (2.28), followed by product diversification (2.12) and storage (1.75). For major crops, plant production (2.28) and plant protection (2.22) were identified as having the greatest need in terms of production, while dealing with value addition, processing (2.30), followed by storage technologies (2.15), and product diversification (2.08) were identified as having the greatest need. Similarly, in the dairy component, highest need was marked for production (2.23), processing (1.91) and storage (1.66). When it comes to fisheries, the highest

Agricultural	Categories of technologies		Me	an technolo	ogy need	score		Mean
operations		Crop	Dairy	Fisheries	Poultry	Mushroom	Apiculture	Total Score
Production	Production	2.28	2.23	2.33	1.57	1.55	1.18	1.86
	Harvesting	1.87	1.51	1.00	1.23	1.00	1.00	1.27
	Protection/health management	2.22	1.54	1.27	1.48	2.36	1.36	1.71
	Farm waste management	1.27	1.30	1.00	1.00	1.00	1.00	1.09
Value addition	Storage	2.15	1.66	1.71	1.61	2.36	1.00	1.75
	Processing	2.30	1.91	2.52	2.46	2.45	2.02	2.28
	Product diversification	2.08	1.27	2.58	2.22	2.45	2.11	2.12
Mean total		2.02	1.63	1.77	1.65	1.88	1.38	1.72

Table 5: Component wise categorisation of specific technological needs

score was given to product diversification (2.58), followed by processing (2.52) and production techniques (2.33). In mushroom related technologies, the highest demand was for processing and product diversification, with a score of 2.45 each, followed by storage and protection related technologies (2.36 each). With respect to poultry and apiculture components, there was a considerable need for processing and product diversification technologies in the IFS units of Kerala. In general, an IFS farmer, expects more cost-effective, easily available and efficient technologies that can be deployed and used eternally. More attention should be paid to value-added technologies that will help to boost product diversification, which was expected to improve the profitability of IFS units.

CONCLUSION

By considering the benefits of IFS, the acceptance of IFS is increasing among the farmers of Kerala. In an IFS unit, more scientific technologies should be applied to ensure optimal productivity from each adopted component. The results showed that, in Kerala, even though IFS farmers were aware of the various technologies available, they had not yet adopted them. Majority of the farmers in the study area had issues related to the applicability and sustainability of available technologies. Thus, more attention is needed to solve the technological gap that exist there. A farmer may have different technology needs depending on how various components are integrated, how the field is managed and the shortfalls in availability and requirements for the specialised components. This finding highlights the need for more market-driven

technologies that aid in increasing the value of agricultural products and thereby increasing the income of farm families. It highlighted the need for more cost effective, convenient and efficient new methods that can be easily deployed in small units.

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Research Article

Farm Profitability under Rising Input Costs in Punjab: Issues and Concerns

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ABSTRACT

The results of the present study revealed that farmers didn't consider the adoption of alternative crops as profitable due to non existent of public procurement of crops other than wheat and paddy in the state and other crops continued to suffer at the hands of private companies due to lack of effective implementation of MSP and thus, markets for such crops considered often riddled with imperfections. Agricultural production process in the state has become cost intensive due to higher need and high use of inputs and the cost of inputs increased faster than the output prices. Capital investments are required for the purchase of productive assets and deepening of tubewells, replacement of centrifugal to submersible pumps. Besides, hefty amounts required for the repair of machinery and equipment, thus squeezing the profitability of agriculture and cause a big drain on farmers 'income. Farmers had to borrow credit at high rate of interest to meet the farm expenses. The farmers growing different crops revealed that the income from farming was not adequate and various coping strategies were under taken by the households in the wake of economic risks faced viz. reduce household consumption expenditure, deferred social and family functions, borrowed money from input dealers at a higher rate of interest. Therefore, farmers in the state need sustained support in the form of increased returns from their crop cultivation. Concerted efforts are required to be taken to strengthen the non-price incentives such as the procurement system and market infrastructure for the crops other than paddy and wheat.

Keywords: Costs, Imperfections, Inputs, Output, Markets, Procurement

INTRODUCTION

Punjab known as '*The Bread Basket of India*' has played the key role to ensure food security and self sufficiency in food grains to the Nation. Despite negligible share of 1.53 percent in total geographical area of India, its share in the central pool of rice and wheat has been very significant especially after Green Revolution period. In 2019-20, share of rice and wheat was 20.92 per cent and 37.82 per cent respectively (Anonymous, 2021).

Owing to the earlier years of high agri-growth that Punjab had one of the lowest poverty ratios (7.7% in rural Punjab) in the country in 2011-12, as per Tendulkar poverty line, which was almost one-third of the levels of poverty at all India level. Providing food security to the country and reducing its own poverty to lowest levels within all India context, have been the most laudable achievements of Punjab. But lately, as a result of its decelerating agri-growth, Punjab has lost its pre-eminent position of being the state with highest per capita income in India, a title it carried since its inception in 1966 till 2002-03. Punjab slipped down in terms of per capita income ranking across major Indian states from first rank in 1991-92 to second rank in 1992-93, to sixth rank in 2009-10, 14th rank in 2013-14, rank 15th in 2014-15 and same rank in 2017-18 (Goyal, 2019). And if current growth trends continue, it won't be a surprise that Punjab slips further down in this hierarchy of large Indian states in terms of its per capita income (Gulati *et al.*, 2017).

After a tremendous performance for about there decades since the mid1960s, the agriculture sector in

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Punjab is facing many challenges. Slow down in agricultural growth rate, escalation in costs of production, falling profitability in farming, reduction in employment elasticity of agriculture sector, increasing incidence of landlessness and indebtedness among the farmers and farmers' suicides are the major issues currently afflicting the Punjab agriculture. Fall in the groundwater table, increasing soil fertility imbalance, appearance of new pests and weeds are posing major threats to the long-term sustainability of agriculture. Farmers have to invest heavily to develop land and groundwater initially and again for deepening of the wells as the water table are receding fast ultimately lead to their indebtedness (Kaur and Vatta, 2015). Mismatch in increase in cost of production and output prices has further exacerbated the situation.

Agricultural production process in the state has become cost intensive due to higher need and high use of inputs. Consequently, financial requirements of farming have gone up overtime and they have to borrow credit from different sources, institutional or non-institutional. The return from farming is on the decline as pricing and procurement are unfavorable. Even crops like maize, which have been even recommended for diversification in the state, is not being purchased at the minimum support price (MSP) announced. Factors like cost of cultivation of the crop, market price of the produce, marketing facility from government agencies, etc. play an important role in deciding the profit. In the backdrop of this, the present study was conducted to examine the erosion of farm profitability with the specific objectives (i) to analyse the product markets (output) including price(s) received (market as well as MSP), marketing channels, market structure and bottlenecks (ii) to estimate the expenses incurred on the purchase of inputs, (iii) to analyse farmers 'access to credit (iv) to identify the reasons for inadequacy of income from farming and coping strategies of farmers during economic hardships.

MATERIALS AND METHODS

The farm level primary data were collected from a sample of 300 farmers representing different farm size categories and agro-climatic regions of state. To meet the specific objectives of the study, at first stage of sampling three districts of Punjab viz. Moga, Bathinda and Hoshairpur representing each regions of

the state were selected randomly. Moga district represents the central plain zone, while Bathinda and Hoshairpur districts represent south-western plain zone and the sub-mountain undulating zone of the state, respectively. The districts were chosen with sufficient variation in the cropping pattern across the districts. At second stage, from each district, two villages were selected with sufficient geographic spread. The selected villages were not contiguous in location. A complete household listing was carried out in the selected villages. If a village was very large (>500 households), listing of at least 300 households, from all the locations in the village, was carried out. If a village was having less than 300 households, the cluster of villages were selected randomly for the farm household survey. Finally from each of the selected village /or cluster, 50 representative farm households, in proportion to their respective proportionate share in different categories in the village viz., marginal (up to 2.5 acre), small (>2.5-5.0 acre), medium (>5.1-10.0 acre), large (>10.0-25.0 acre) and very large (>25 acre) were selected randomly. Thus, overall from state, total sample of 300 farmer households comprising 103 marginal, 102 small, 52 medium, 35 large and 8 very large farmers formed the basis for the present enquiry.

To address the aforementioned objectives of the study, detailed information on production of crops and use of inputs in physical as well as monetary terms along with other socio-economic aspects of farm households was collected through the interview method using the specially designed schedules for the purpose. The information was pertained to the crop year 2018-19. Tabular analysis and simple statistical tools such as averages and percentages were used for the interpretation of the results.

RESULTS AND DISCUSSION

From the total sample of 300 households the number of marginal, small, medium, large and very large farmers were 103(34.33%), 102(34%), 52(17.33%), 35(11.67%) and 8(2.67%) respectively. Overall, the average size of holding was 2.57 ha while it varied from 0.77 ha to 14.07 ha across landholding categories. Cultivation was found to be the principal occupation of 94 per cent out of the respondents whereas farmers engaged in non-agriculture labour, salaried employment and remittances were 1.67, 4.00 and 0.33 per cent

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S. Particulars/Landholding categories Marginal Small Medium Verv Total/ Large No. large overall 103 300 1 Number of households 102 52 35 8 2 0.77 3.2 14.07 Average size of land holding (ha) 1.66 6.96 2.57 3. Livestock possession (No.) Milch cows 34 51 22 a) 20 6 133 b) Milch buffaloes 51 58 43 7 185 26 Total 85 129 65 46 13 318 4. Possession of farm machinery/equipment (No.) a) Electric pump 53 91 52 35 8 239 b) Bullock cart 5 12 20 20 6 63 27 53 48 35 8 171 c) Tractor 5. Principal occupation (No.) Agriculture 87 100 a) 52 35 8 282 5 5 b) Non-agri. labour c) Salaried employed 10 2 12 _ Remittances 1 1 d) _ _ Total 103 102 52 35 8 300 6. Annual household income from various sources (ROVC)* Cultivation 82919 858215 a) 188907 409852 1527274 304591 b) Animal husbandry 7856 23576 11848 26520 12296 16188 421699 Total 90775 212483 884735 1539570 320779

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* ROVC=Returns over variable cost

respectively (Table 1). Over all, the proportion of net income from cultivation from total income was 94.95 per cent while from animal husbandry the net income was 5.05 per cent. On an average, farmers received Rs 3.04 lakh as an annual net income from cultivation (returns over variable cost) while from animal husbandry, annual net income (returns over variable cost) received was Rs. 16188. All the households among landholding categories were found having the possession of livestock. Households were having the possession of farm machinery and equipment. Across the land holding categories, electric pumps were possessed by more of marginal farmers (62%) followed by small (58%), medium (43%) large (39%) and very large farmers (36%). More number of medium farmers (40%) were having the possession of tractors followed by large (39%), very large (36%), small (34%) and marginal farmers (32%) respectively.

The cropping pattern of households presented in Table 2 reveals that wheat was grown by all the respondent farmers i.e. 300 farmers (26.64%) while paddy was grown by 227 farmers (20.16%). Maize was found to be the next important crop grown by the respondent farmers after wheat and paddy crops. It was observed that marginal, small and medium farmers cultivated more area under wheat and paddy crops followed by maize and cotton crops while large and very large farmers besides growing wheat and paddy preferred to cultivate potato and mungbean crop. Maize crop was not cultivated by large and very large farmers in the study area. It was brought out that only less number of farmers diversified their cropping pattern while majority of the farmers went for monoculture of paddy and wheat. Adoption of alternative crops was not considered profitable due to the non-existent of public procurement of crops other than wheat and paddy in the state.

All the sampled farmers sold their crops in their first disposal and none of the farmers used second and third disposal for selling their crops. A perusal of

Land holding	Paddy	Maize	Cotton	Sugarcane	, Wheat	Potato	Munobean	Spring	Overall
categories	2 0003		Contoin	o ugui cuite		100000		maize	o vorum
Per hectare sa	le value of	crops prod	luced						
Marginal	129966	38621	110336	-	52348	-	-	-	73371
Small	123522	34209	118568	197099	66919	85993	-	82500	83860
Medium	125792	31586	110751	182338	81995	100321	77802	121975	102033
Large	128852	-	142893	195185	80133	132503	60534	108539	106215
Very large	130339	-	-	223004	83559	138494	70741	110644	113460
Overall	127528	35491	117506	210643	75081	122967	64584	112855	98517
Per farm sale	value of cr	ops produc	ced (Total)						
Marginal	52239	10158	2550	-	36013	-	-	-	100959
Small	132023	13308	3766	1565	99414	3836	-	324	254236
Medium	343872	5285	5388	6382	232598	15222	2723	9500	620969
Large	840262	-	4940	22586	478991	85824	27309	13800	1473712
Very large	1617669	-	-	282100	948290	147150	57300	27938	3080447
Overall	263596	8928	3666	11796	167652	17879	5186	4112	482816

 Table 2: Cropping pattern across the landholding categories in Punjab, 2018-19

Table 3: Crops sold through different Agencies in Punjab, 2018-19

Land holding	Paddy	Maize	Cotton	Sugarcane	Wheat	Ро	tato	Mungbean	Spring
categories/ crops/ agencies	cooperative & Govt. agency	Mandi	Mandi	processors	cooperative & Govt. agency	Local private	Regional trader	maize Mandi	Mandi
Marginal	62 (27.32)	38 (54.28)	5 (31.25)	-	103 (34.33)	-	-	-	-
Small	73 (32.16)	29 (41.42)	5 (31.25)	1 (16.66)	102 (34.00)	-	4 (19.04)	-	1 (11.11)
Medium	49 (21.58)	3 (4.28)	4 (25.00)	2 (33.33)	52 (17.33)	-	7 (33.33)	1 (14.28)	4 (44.44)
Large	35 (15.42)	-	2 (12.50)	1 (16.66)	35 (11.66)	2 (100.00)	8 (38.09)	5 (71.42)	3 (33.33)
Very large	8 (3.52)	-	-	2 (33.33)	8 (2.66)	-	2 (9.52)	1 (14.28)	1 (11.11)
Overall	227 (100.0)	70 (100.00)	16 100.00)	6 (100.00)	300 (100.00)	2 (100.00)	21 (100.00)	7 (100.00)	9 (100.00)

Table 3 reveals that all the paddy growers (227) and wheat growers (300) sold their paddy and wheat crop to the cooperative and government agency while maize, cotton, mungbean and spring maize was sold to processors and potato was sold to regional traders and local private traders by the sampled farmers respectively.

The satisfaction /dissatisfaction regarding disposal channels for selling their produce revealed by the farmers is presented in Table 4. All the paddy and wheat farmers (100%) were satisfied with the disposal channels of their produce. The dissatisfaction regarding the disposal channels for sale of their maize, cotton, sugarcane, crops was revealed by 54.29, 87.50, 83.33 per cent respectively for getting the price lower than the market price. In case of potato, all the potato (100%) and mungbean growers (100%) revealed dissatisfaction with the disposal channels for receiving lower price than the market price for their produce. In case of spring maize, 33.33 per cent of the farmers

Table 4: Reason	ns for sati	sfaction,	/ dissatist	faction reg	rarding d	isposal ch	nannels of	different	t crops in	Punjab, 2	018-19 (N	lumber)				
Land holding	Paddy		Maize			Cotton		s	ugarcane		Wheat	Potato	Mung	Sp	ring maiz	9
categories	S*	s,	DS**	Total	%	DS**	Total	*S	DS**	Total	S*	DS**	DS**	*	DS**	Total
Marginal	62	23	15	38	2	3	ъ	ı	ı	ı	103	ı	ı	ı	ı	ı
%	100.0	60.53	39.47	100.0	40.0	60.0	100.0	ı	ı	ı	100.0	ı	I	ı	ı	I
Small	73	8	21	29	ı	IJ	5	1	ı	1	102	4	I	1	I	1
%	100.0	27.59	72.41	100.0	I	100.0	100.0	100.0	I	100.0	100.0	100.0	I	100.0	I	100.0
Medium	49	1	2	3	ı	4	4	ı	2	2	52	7	1	ı	4	4
%	100.0	33.33	66.67	100.0	ı	100.0	100.0	ı	100.0	100.0	100.0	100.0	100.0	ı	100.0	100.0
Large	35	I	I	ı	I	2	2	I	1	1	35	10	IJ	2	1	С
%	100.0	I	ı	ı	ı	100.0	100.0		100.0	100.0	100.0	ı	100.0	66.67	33.33	100.0
Very large	8	I	I	ı	ı	I	I	I	7	7	8	7	1	I	1	1
%	100.0	I	ı	ı	ı	ı	I	ı	100.0	100.0	100.0	100.0	100.0	ı	100.0	100.0
Total	227	32	38	70	2	14	16	1	Ŋ	9	300	23	7	3	9	6
%	100.0	45.71	54.29	100.0	12.50	87.50	100.0	16.67	83.33	100.0	100.0	100.0	100.	33.33	66.67	100.0
*Satisfaction; **	Dissatisfac	ction														

were satisfied with the disposal channels while 66.67 per cent of the farmers revealed dissatisfaction with the disposal channels for receiving lower price than the market price of their spring maize produce.

About 73.12 per cent of the sampled farmers growing paddy out of 227 farmers revealed that prices which they received for paddy crop was reasonable. Out of the total farmers growing wheat, maize, cotton, sugarcane, spring maize, 79.66, 45.71, 12.5, 16.00, 16.00 per cent respectively reported the prices as reasonable for their crops. None of the potato and mungbean farmers reported that the prices for these crops as reasonable. Only few of large (14.46) and very large farmers (2.41) stated the price of paddy and in case of wheat crop, 10.04 per cent and 1.67 per cent of these farmers reported the prices as reasonable.

The farmers reported the reasons for the unreasonable prices for various crops. Overall, the major reasons revealed by the sampled farmers for unreasonable prices of wheat and paddy were high input costs (52.46%) and high lease rent (34.43%). For maize, cotton, potato and mungbean and spring maize, farmers revealed unreasonable prices as there was no procurement of these crops by the government agencies and they got less price for their produce. Another reason for unreasonable cotton price revealed by the farmers was collusion of private buyers. Sugarcane growers reported that sugarcane prices were unreasonable due to high input costs.

This is shown in Table 5 that overall expenses incurred per farm on inputs for producing various crops were to the tune of Rs. 2.29 lakh. The major item of expenditure was rent for lease in land and it was estimated to be Rs. 87118. The next major item of expenditure was cost of human labour (Rs. 29241) followed by cost of hiring of machinery (Rs. 27237), plant protection chemicals (Rs. 25032), fertilizers (Rs. 21495), diesel (Rs. 14242), seed (Rs. 12848).

Credit availed by different categories of farmers to meet the farm expenses from different sources is presented in Table 6. The cooperative societies were the most preferred source of credit of 288 farmers (57.83%). while from government banks and micro finance/community group/NGO's credit was borrowed by 99 (19.88%). and 111 farmers (22.29%). respectively, category-wise it was also found that

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Land holding categories	Seeds	Fertilisers	Manures	Plant protection chemicals	Diesel	Human labour	Irrigation	Repair of machinery	Cost of hiring of machinery	Other expenses	Interest	Lease rent for land	Total
Marginal	3409	5779	1	6132	1279	8835	1279	1199	12227	1068	927	2842	44977
Small	7576	13322	384	14767	5559	18444	1135	3004	23286	2347	2021	14402	106247
Medium	14697	24913	1758	32300	19719	32918	800	7077	30274	4380	3799	84298	256932
Large	35969	63331	3371	73506	49446	80677	7503	7900	61080	7106	8773	339629	738291
Very large	88418	122785	4450	139922	102317	180681	I	8313	103044	8075	17055	1012875	1787934
Overall	12848	21495	947	25032	14244	29241	1839	3803	27237	2968	3142	87118	229913

majority of the marginal (61.49%) and small (59.88%) farmers borrowed loan from cooperative societies. From micro finance/community group/ NGOs, more percentage of large (32.86%) and very large (33.33%) farmers borrowed money as compared to marginal (19.88%), small (17.90%) and medium (24.44%) farmers. From government banks more percentage of small farmers (22.22%) borrowed money than farmers of the other categories. It was revealed that rate of interest paid by the farmers of different categories for availing loan from cooperative societies was 7 per cent. The various categories of farmers i.e. marginal, small, medium, large and very large farmers were charged 7.15, 8.36, 9.25, 10.00 and 11.50 per cent by government banks. Overall, the government banks charged 8.45 per cent as rate of interest for disbursing loan amount. The rate of interest charged by micro finance/ community groups/ NGO's was much more as compared to cooperative societies and government banks. On an average 17.92 per cent rate of interest was charged on loan amount. The farmers of marginal, small, medium, large and very large categories paid 17.91, 17.80, 17.86, 18.00 and 18.00 per cent rate of interest respectively on agricultural credit from micro finance/ community groups/ NGO. Majority of the farmers (91.92%) obtained credit from government banks for the purpose of both Current expenditure. in farm business and consumption expenditure while from cooperatives, 87.15 per cent and 11.81 of the farmers obtained credit for meeting the current expenditure. in farm business and non-farm business respectively. From the micro finance/ community groups and NGO's, majority of the farmers (92.79%) obtained loans for current expenditure in farm business and consumption expenditure respectively.

The farmers growing different crops revealed that the income from farming was not adequate and this was reported by 291 farmers (97%) out of 300 framers. Only 9 framers were satisfied with the income from farming (Table 7). Dissatisfaction over the income from farming was revealed by 100 per cent each of the large and very large farmers, 96 per cent each of the marginal and small and 98 per cent of the medium farmers respectively.

The reasons for inadequate income were revealed by farmers. Majority of the farmers (62%) revealed

Land holding	Cooperative	Government	Micro finance/	Total	Rate of interest (%)			
categories	societies banks		community groups and NGO's		Cooperative societies	Government banks	Micro finance/ commodity groups and NGO's	
Marginal	99	30	32	161	7.00	7.15	17.91	
Percentage	61.49	18.63	19.88	100.00				
Small	97	36	29	162	7.00	8.36	17.90	
Percentage	59.88	22.22	17.90	100.00				
Medium	52	16	22	90	7.00	9.25	17.86	
Percentage	57.78	17.78	24.44	100.00				
Large	32	15	23	70	7.00	10.00	18.00	
Percentage	45.71	21.43	32.86	100.00				
Very large	8	2	5	15	7.00	11.50	18.00	
Percentage	53.33	13.33	33.33	100.00				
Total/overall	288	99	111	498	7.00	8.45	17.92	
Percentage	57.83	19.88	22.29	100.00				

 Table 6: Sources of money borrowed and rate of interest charged from the landholding categories in Punjab, 2018-19 (Number)

Table 7: Whether income from farming is adequate in Punjab, 2018-19

Land holding categories	Nur hou	nber of seholds	Percentage of households		
	Yes	No	Yes	No	
Marginal	4	99	3.89	96.11	
Small	4	98	3.93	96.07	
Medium	1	51	1.93s	98.07	
Large	-	35	-	100.00	
Very large	-	8	-	100.00	
Total	9(3.00)	291(97.00)	100.00	100.00	

Figures in the parentheses indicate the percentages to the total number of HHs

pest problems/crop diseases followed by destruction of crops by other animals (54.33%), high input costs (30%), problem of paddy straw management (25.67%), small land size (25.67%), prices not remunerative (18.67%), fluctuating rainfall (16.33%) and high interest rates charged on loan amount (14.17%) respectively.

The coping strategies under taken by the households in the wake of economic risks faced is presented in Table 8. On the whole, 30 farmers (29.41%) deferred their social and family functions,

while 43 farmers (42.16%) reduced their household consumption. Other strategies under taken by the farmers to bear risks were borrowed money from input dealers/commission agents (6.86%), borrowed money from bank ((5.88%), started petty business/ shop (4.90%), stored crops for better price (8.82%). Among the different categories of farmers, majority of the marginal (48.39%), small (50%), medium (40%), large farmers (29.17%) reduced their household consumption in the wake of economic risks faced while very large farmers (40%) stored their crops for better prices along with reduced consumption expenditure. On marginal farms, 48.39 percent of the farmers opted to reduce household consumption expended while others deferred social and family functions (35.48%) borrowed money from input dealers (3.23%), borrowed money from friends and relatives (3.23%) and started petty business/shops (9.68%) etc. Majority of the small farmers (50%) reduced their household consumption expenditure while others deferred social and family functions (22.73%), borrowed money from bank (9.09%), borrowed money from input dealers/ commission agents (9.09%) and started petty business/ shops (4.55%). The coping strategies opted by 15, 40, 30, 5 per cent each of the medium farmers were stored crops for better price, reduced household consumption,

Land holding categories	Stored crops for better price	Reduced household consumption exp.	Deferred social & family functions	Borrowed money from bank	Borrowed money from input dealer/ commission agents	Borrowed from friends/ relatives	Started petty business/ shops	Total
Marginal	-	15	11	-	1	1	3	31
Percentage	-	48.39	35.48	-	3.23	3.23	9.68	100.00
Small	1	11	5	2	2	-	1	22
Percentage	4.55	50.00	22.73	9.09	9.09	-	4.55	100.00
Medium	3	8	6	1	1	-	1	20
Percentage	15.00	40.00	30.00	5.00	5.00	-	5.00	100.00
Large	3	7	7	3	3	1	-	24
Percentage	12.50	29.17	29.17	12.50	12.50	4.17	-	100.00
Very large	2	2	1	-	-	-	-	5
Percentage	40.00	40.00	20.00	-	-	-	-	100.00
Total	9	43	30	6	7	2	5	102
Percentage	8.82	42.16	29.41	5.88	6.86	1.96	4.90	100.00

Table 8: Coping strategies undertaken by the households with respect to the economic risks faced in Punjab, 2018-19 (Number)

deferred social and family functions, borrowed money from banks and borrowed money from input dealers and starting of petty business and shops. Majority of the large farmers (29.17% each) reduced household consumption and differed social and family functions to cope with economic risks. Storing crops for better price and reducing household consumption was opted by 40 per cent each of the very large farmers to cope with economic risks.

CONCLUSION

The results of the study brought out that majority of the farmers cultivated paddy (227 farmers) and wheat crops (300 farmers) while other crops viz. maize, cotton, sugarcane, potato, mungbean, spring maize were grown by only 70, 16, 6, 23, 7 and 9 farmers out of the total sample of 300 farmers. Adoption of alternative crops was not considered profitable due to the non-existent of public procurement of crops other than wheat and paddy in the state and other crops continue to suffer at the hands of private companies due to lack of effective implementation of MSP and thus, markets for such crops are often riddled with imperfections. Further, it was revealed that crop diversification cannot take place unless there is an alternate MSP- based procurement system in place. For the crops like maize, cotton, mungbean, spring maize where there is no assured government purchase even after the announcement of minimum support prices in the state, they have no option but to sell their produce in the open market at much lower prices whereas for paddy and wheat crops there is 100 per cent government procurement at MSP. The prices of various crops were considered unreasonable due to high input costs and high lease rent and it was brought out that the cost of inputs increased faster than the output prices. Farmers had to borrow credit at high rate of interest to meet the farm expenses. Punjab agriculture has become highly capital intensive as it was reported by farmers that capital investments were required for the purchase of productive assets and deepening of tube wells, replacement of centrifugal to submersible pumps. Besides, hefty amounts were required for the repair of machinery and equipment, thus, squeezing the profitability of agriculture and caused a big drain on farmers' income. The farmers growing different crops revealed that the income from farming was not adequate and this was reported by 291 farmers (97%) out of 300 framers Various coping strategies were under taken by the households in the wake of economic risks faced viz. reduce household consumption expenditure, deferred social and family functions, borrowed money from institutional as well as non-institutional sources (input dealers) at a higher rate of interest. Therefore, farmers need sustained support in the form of increased returns from their crop cultivation. Thus, mere increase of minimum support price (MSP) for crops alone would not guarantee better income to the farmers. Along with price incentives, concerted efforts are required to be taken to strengthen the non-price incentives such as the procurement system and market infrastructure for crops other than paddy and wheat which fits well in the diversification plan of the Government of Punjab. Further, educating the farmers about subsidiary occupations, providing loans at low rates of interest, creating sufficient non-farm employment opportunities, assured purchase of agricultural produce with effective minimum support prices of alternative crops and further subsidizing agricultural inputs can help in minimizing some of the existing problems of the farmers and thus increase their incomes.

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Research Article

Gender Differences and Childhood Aggression

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ABSTRACT

The present study was conducted to study the gender differences in physical and verbal aggression of urban and rural preschool children. Study was conducted in Hisar city for urban study and Block-II of Hisar district for rural study. From Block II, Kaimari and Mangali villages were selected as per the demand of the study. Sixty aggressive children in the age group of 4-6 years were selected from various preschools of Hisar city and sixty from the selected villages. Thus 120 children, 60 from urban and 60 from rural in the age group of 4-6 years constituted the sample. A checklist was prepared to observe the major forms of aggressive behaviour. T-test was used for calculating the differences in the means of childhood aggression according to gender and within area. There were also significant differences in boys' and girls' physical and verbal aggression in both areas except physical aggression in rural backgrounds. In urban and rural areas, girls were more verbally aggressive than boys. Boys were more physically aggressive than girls in urban areas, but in rural areas, they were almost comparable. The implications of results can be used for developmental models of aggressive behaviour problems and for preventive interventions.

Keywords: Childhood aggression, Physical and verbal aggression, Rural-urban background

INTRODUCTION

"Aggression is that behaviour that is intended to hurt or harm others" (Crick and Grotpeter, 1995). Shaw et al. (2000) described early aggressive behaviour as an "act directed toward a specific other person or object with intent to hurt or frighten, for which there is a consensus about the aggressive intent of the act". Aggression manifests itself in a child's behaviour from early years. Aggressive behaviours tend to be highly stable from early childhood to adolescence and adulthood (Waldman, 1996). In preschool years, childhood aggression is an important predictor of difficulties in social adjustment, delinquency (Hay et al., 2000) and psychological dysfunction (McFayden-Ketchum et al., 1996). Highly aggressive behaviour often occurs alone and may be predictive of poor academic performance and increased risk of dropping out of school (Rubin et al., 1998).

Aggression manifests itself from early years. Children quarrel, bite or fight, kick or punch, threaten to hit and shoot and call names. Some amount of aggressive behaviour in children has been accepted by most psychologists as normal and universal. Lorton (1979) thought that pre-schoolers sometimes use aggressive types of behaviours to work out or display their emotions, because of their ego-centric nature. Young children are quick to display pleasure or anger. As preschool children grow older, they tend to participate more frequently in group play, aggression and conflicts occur with increasing frequency as part of the whole pattern of social participation. Aggression becomes a way of releasing or showing emotions.

Gender is a factor that plays a role in human aggression. Males are generally more aggressive than females (Coie and Dodge, 1997). Boys tend to use direct physical or verbal aggression, whereas girls tend to use more indirect forms of aggression (Hess and Hagen, 2006). Not only this, aggression has been found to be more stable over time in boys than girls. There is evidence that males are quicker to aggression and more likely than females to express their aggression physically (Bjorkqvist *et al.*, 1994). However, some researchers have suggested that females are not necessarily less

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aggressive, but that they tend to show their aggression in less overt, less physical ways (Hines and Saudino, 2003). For example, females may display more verbal and relational aggression, such as social rejection.

So, keeping the above facts in view the study on childhood aggression is taken into consideration with the objective to study the differences in childhood aggression by gender and rural-urban background.

MATERIALS AND METHODS

The present study was conducted purposively in rural and urban areas of Hisar District of Haryana State. The urban study was conducted in Hisar City and the rural study was conducted in block-II of Hisar District. From Hisar city, three schools were selected randomly. The schools were selected through purposive convenient sampling. These schools were private English medium, coeducational, medium fee charging and catering to middle socioeconomic strata. Finally, a list of 60 children from Hisar city was prepared. Similarly, from rural areas, three preschools were selected from village Kaimari and three preschools were selected from village Mangali. These preschools were also coeducational and private English/Hindi medium. Finally, a list of 60 children from rural areas was prepared. Thus, a total of 120 children was the sample size for the present study.

Tools for Data Collection

Observation Checklist: A checklist was prepared to observe the major forms of aggressive behaviour manifestation and to identify the names of children who displayed aggressive behaviour frequently. The observation checklist consisted of 20 items out of which the first 10 were meant to observe physical aggression and another 10 were for verbal aggression.

In the observation checklist for pre-schoolers, three responses namely, "Always, Often and Never" were assigned for every activity. Score "3" was assigned to Always, "2" was assigned to Often and "l" was assigned to Never. Final scores, separately for physical and verbal aggression, were calculated by adding their respective score numbers/responses.

T-test comparisons were used to observe the major forms of aggressive behaviour among gender, urban and rural children.

RESULTS AND DISCUSSION

Differences in childhood aggression according to gender, and urban and rural background in activities leading to physical and verbal aggression in children were studied.

Table 1 showed that in urban areas, the mean scores for physical aggression for boys and girls were 7.39 and 4.29 respectively. The data further revealed that the t-value was found to be significant ($t=5.622^*$). For verbal aggression, the mean scores for boys and girls were 5.36 and 6.79 respectively. The t-value (t=2.204*) was found to be significant. In rural areas, the mean scores for physical aggression for boys and girls were 5.27 and 5.13 respectively. For verbal aggression, the mean scores for boys and girls were 4.76 and 7.53 respectively also the t-value (t=2.204*) was found to be significant. In urban areas, the t-test comparison for physical and verbal aggression was found to be significant for boys and girls whereas, in rural areas, the t-test value was significant for verbal aggression only, for boys and girls.

The results in Table 2 reveal mean scores of childhood aggression according to urban and rural background. The mean scores obtained by the children in physical aggression were 6.15 and 5.38 39.86 respectively. The mean scores of verbal aggressions were 5.93 and 5.45 respectively. The mean value showed that urban children were more physically and verbally aggressive, whereas in rural areas, they were almost comparable. T-test comparison was not significant for urban-rural backgrounds.

Table 1: Mean scores of childhood aggression according to gender (n=120)

Variables		Urban			Rural	
	Boys (n=36) Mean SD	Girls (n=24) Mean SD	t value	Boys (n=45) Mean SD	Girls (n=15) Mean SD	t value
Physical Aggression	7.39+1.32	4.29+2.47	5.622*	5.27+2.34	5.13+1.87	0.783
Verbal Aggression	5.36+2.11	6.79+2.67	2.204*	4.76+1.86	7.53+2.13	4.503*

* Significant at 5% level

Variables	Urban (n=60) Mean SD	Rural (n=60) Mean SD	t value
Physical Aggression	6.15+2.39	5.38+2.23	1.814
Verbal Aggression	5.93+2.43	5.45+2.27	1.126
*C:: C+ =+ E0/ 1	.1		

Table 2: Mean scores of childhood aggression according to urban-rural background (n=120 Variables)

*Significant at 5% level

The outcome of research, made in this respect, has proved that male aggressiveness is more direct, visible, and physical than female aggressiveness. This does not mean that males are more aggressive than females, but females show aggressiveness indirectly, invisibly, and most of the time, verbally, the different expectations of civilizations and the social practices of males and females might bring forth such differences.

One of the more widely reported gender differences in social and emotional development is across cultures. Males tend to be more vulnerable to family and life stresses than those boys exhibit more aggression than girls. Although there seems to be little difference in the rate of aggression in infancy, by the time children enter preschool, boys engage in more conflict and in more verbally and physically aggressive acts than girls. According to Underwood (2002), this gender difference holds across socioeconomic groups (Patterson *et al.*, 2000). It has been postulated, however, that males are reinforced for more aggressive and competitive behaviour by family members and peers, which accounts for increasing differences in their social patterns as they develop (Coie and Jacobs, 2000).

Although the rate of overt aggression is much higher among boys, relational aggression is higher among girls. Relational aggression "harms others through manipulation or control of relationships" (Crick, 2000). Crick and her colleagues designed teacher and peer rating scales to measure relational aggression in preschool children. Behaviours that reflected relational aggression included not inviting a classmate or peer to a birthday party, not letting a peer play in the group, and not listening to a peer or other person because of feelings of anger toward that individual. These behaviours contrasted with those that reflected overt aggression such as pushing and shoving and throwing objects at others in response to frustration. Crick and her colleagues found that teachers particularly rated preschool-aged girls as more relationally aggressive and less overtly aggressive than preschoolaged boys. They also found that children who showed either type of aggression were rejected by their peers more often than those who were not aggressive.

In urban and rural areas, all boys and girls always used force on others. The frequency of physical aggression in humans peaks at around 3-5 years of age. It then declines gradually on average (Tremblay, 2000). These observations suggested that physical aggression is mostly not a learned behaviour and that development provides opportunities for the learning of self-regulation. A maximum of boys and girls threw objects/toys in urban and rural areas. A maximum of boys and girls snatched toys/objects in urban and rural areas. Benenson, Carder and Geib-Cole (2007) demonstrated that approximately 50 per cent of boys at all four age levels (and less than 10% of girls) reported that at least one of their three favourite toys was used for inflicting harm through physical aggression on an animate being. Further, with increasing age, boys rated physical aggression in play activities and on television as more enjoyable than alternative male sextyped play and television content. Results suggested that advancing understanding of the development of physical aggression requires acknowledging the pleasure it provides to males. Almost all the boys and girls never kicked, bite or hit others in both urban and rural areas. A maximum of boys in urban areas did fight with others whereas girls (urban and rural) and boys urban were not so interested in fighting with others. More than half of the boys (urban) and girls (Rural) often tripped others whereas, for boys (Rural) and girls (urban), uniform distributions of three responses were there. In urban areas, a maximum of boys always shoved i.e., pushed roughly others while the maximum of girls never shoved i.e., pushed roughly others. In rural areas, uniform distributions of three responses were there. Fagot and Hagan (2004) stressed that boys produced more assertive acts than girls, Girls'

assertive acts were ignored significantly more than boys. Boys responded more to the acts of other boys than to the acts of girls, while girls responded more equally to the assertive acts of boys and girls. Hitting and taking objects received similar responses from peers. Responses to assertive acts are seen as information sources for the assertive child. In urban and rural areas, a maximum of boys and girls never destroyed their own or other belongings. In urban areas, a maximum of boys squirmed and fidgeted while more than half of the girls never squirmed and fidgeted. In rural areas, maximum of boys and girls never squirmed and fidgeted. In urban and rural areas, a maximum of boys and girls never twitched, mannerized or ticked off the face and body. Crick et al. (2006) observed that girls are more relationally aggressive than male peers and boys are more physically aggressive than female peers. Moreover, children primarily direct their aggressive behaviour to same-sex peers. Results were discussed regarding the importance of developing methods to investigate behaviour patterns for understanding the early development of and future social-psychological risks associated with relational aggression. Maximum of boys (urban) and girls (urban and rural) never used abusive language whereas all the boys of rural areas always used abusive language. Almost all the boys (urban) and girls (urban and rural) shouted/screamed at others whereas, for boys in rural areas, uniform distributions of responses were there. Most of the boys (urban) and girls (urban and rural) never lied while the maximum of boys from rural areas always lied. A maximum of boys (urban) and girls (urban and rural) had problems of stutter or stammering whereas boys in rural areas never had the problems of stutter or stammering. More than half of the girls (urban and rural) always bullied other children whereas almost all the boys (Rural) never bullied other children. Nearly half of the boys always and never, bullied other children. In urban areas, a maximum of boys and girls refused to share toys/objects often whereas in rural areas, generally boys never and often refused to share toys/objects, and more than half of the girls refused to share toys/objects. Most of the girls (urban and rural) always cried whereas most of the boys (urban) often cried and more than half of the boys (Rural) never cried. A maximum of boys (urban) and girls (urban and rural) always called the other(s) by name (s) while boys of rural areas never called the other(s) by name(s). Half/more than half of the boys never teased the other one while more than half of the boys (Rural) teased the other one and for boys of urban areas, an almost uniform distribution of responses was recorded. In urban areas, a maximum of boys never insulted the other(s) whereas half of the girls always

insulted the other(s) and half of the girls never insulted the other(s). In rural areas maximum of boys and girls always insulted the other(s). Hess and Hagen (2006) reported that boys tend to use direct physical or verbal aggression, whereas girls tend to use more indirect forms of aggression that prominently feature gossip. They also found that women had a stronger desire than men to aggress indirectly, even after controlling for perceptions of social norms and approval.

In urban and rural areas, more than half of the boys and girls were average physically and verbally aggressive. When gender-specific forms of aggression are considered, there is evidence to suggest that girls are as aggressive as boys (Moretti and Odgers, 2002). Girls tend to engage in relational aggression while males tend to display overt aggression; both forms of aggression are equally hostile. Snethen and Puymbroeck (2008) said that girls were increasingly becoming the perpetrators of physical aggression. They examined the aetiology of aggression in girls and described the changes in types of aggression perpetrated by girls.

In urban areas, t-test differences for physical and verbal aggression were found to be significant for boys and girls whereas in rural areas, the t-test value was significant for verbal aggression only, for boys and girls. The overall conclusion showed that boys were more physically aggressive and girls were more verbally aggressive, in Rural and urban areas. Baillargeon et al. (2005) found that males are generally physically aggressive, whereas females are verbally aggressive. Archer and Parker (2006) stated that girls showed higher expressive scores than boys, although the sex difference was diminished. This supported the view that there is a general sex difference in reactions to aggressive or hostile acts, independent of their form. However, analysis of individual questionnaire items showed that it was a lack of emotional control and subsequent regrets about the act that most clearly distinguished the sexes. It is argued that these differences arise from more general gender role characteristics rather than being specific to aggression.

CONCLUSION

It is concluded that boys were more physically aggressive and girls were more verbally aggressive. Moreover, urban background children were physically
and verbally aggressive than rural background children. There seems a need to educate the mothers how to deal with their aggressive children and adopt right type of parenting style. Children may also be provided with some games and activities to help them reduce their aggression. Teachers of the children may also be provided with some suggestions and activities to cope with the aggression of children.

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Research Article

Awareness and Availability of Social Media among Higher Secondary School Students of Haryana

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ABSTRACT

The Social media refers to the use of web-based and mobile technologies to turn communication into an interactive dialogue. Social media is a computer-based technology that facilitates the sharing of ideas, thoughts, documents, pictures, videos and information through the building of virtual networks and communities. The comparative study was conducted between four rural and urban schools (government and private higher secondary schools) of Hisar district of Haryana. Thus total sample comprised of 160 respondents and the data collected by the simple random method. The findings highlighted the facts that majority of students keep themselves updates with latest know and how through newspaper (80.00%), television (80.00%), mobile phones (80.00%) and mobile with internet connections (82.50%). Majority of the students were aware and utilizing social media such as facebook (90.00%), whatsapp (85.00%), youtube (88.75%), messenger (58.70%), and wikipedia (58.70%) and generally spent more than two hours on social media irrespective of their locale.

Keywords: Attitude, Facebook, Internet, Purpose, Social media, Utilization, Whatsapp

INTRODUCTION

In recent years social media networks have experienced a massive growth in membership. Social media are used to create, share or exchange the information and ideas in virtual communities and they are able to network with other members who share similar or common interest, dreams and goals (Sharma and Shukla, 2016). The online world has changed dramatically; young men and women now exchange the ideas, facts, feelings, thoughts, personal information, pictures and videos at truly astonishing rate. Globally, social media defined as web-based tools that allow users to interact with each other in some way by sharing information, opinions, knowledge and interests online is shaping human interactions in varied ways (Sultan and Christian, 2014). Social media has become ubiquitous and almost inescapable, revolutionizing the way students communicate, interact and socialize; has become an integral part of their social life. Teenagers and young adults have especially embraced these sites as way to connect with their peers, share information reinvent

their personalities, and showcase their social lives (Boyd and Ellison, 2007). The social sites are growing at a very fast speed and act as easy available portals for communication and entertainment for young generation through a wide variety of communication tools. Billions of population use facilities like web pages, search engines, e-mails, e-newspapers, texting, video and photo sharing, making profiles, online gaming and online purchasing, make phone calls, explore fashion trends, watch television, shows or movies, internet banking and telephony, conferencing etc. Social networking sites and applications are designed to enable people to share any information in fast and more efficient manner. Social media helps users to remain in touch with others. Social media facilitates communication among school/college students when they express themselves by posting status updates, links, videos and photos. It also allows them to follow others' online companionship by keeping track of regular updates about their family, friends, classmates, and acquaintances (Smock et al., 2011).

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Social media use in the first five months of the pandemic (Covid-19) has increased growth in the amount of postings that are besting done by users on various platforms like instagrams, facebook and twitter (Ahmad and Sheikh, 2019). Face-to-face social interaction has become restricted in recent times due to restrictions in movement during the covid-19 pandemic. Another major reason for the growing usage is to maintain the "self-status", i.e. to constantly update their online network regarding the recent happening in their life (Narasimhamurthy, 2014).

MATERIALS AND METHODS

The comparative study was conducted in urban and rural areas of Hisar district (Haryana). The survey method of research was used to conduct the study and questionnaire was used as a data collection tool. The sample comprised of four schools i.e. two higher secondary schools (one government and one private school) and two higher secondary schools from rural area (one government and one private school). Hisar district comprised of nine blocks, from which Hisar-I was randomly selected. From the selected schools, lists of 10+1 and 10+2 students were procured from school records. From these lists, 40 students (both male and female) were selected randomly from each school. The questionnaire was administered personally to ensure the excellent response rate as well as to avoid any

misunderstanding while providing responses. Structured questionnaire was used to collect data for the study and analyzed using descriptive statistical tools namely frequency and percentages and rank.

RESULTS AND DISCUSSION

The data depicted in Table 1 showed that the sources of communication available to children. Availability of mass media was recorded on two aspects one was print media and another was electronic media. Cent per cent students of government school from rural area had availability of newspapers, mobile and television, whereas hundred percent students of private school had availability of newspaper, television and mobile phones. Hundred per cent students of government school from urban area had availability of newspaper, mobile and television per cent students of private school availability of newspaper, mobiles and televisions.

The data depicted in Table 2 showed that the availability and use of tuition facilities by the students. Cent per cent students of both government as well as private school from rural area had availability of tuition facility within one km. whereas 77.5 per cent government school students of urban area had availability of tuition facilities within 1-2 km. Although in private school 67.5 per cent students of private school had availability of tuition facilities within 1-2 km.

Communication sources	R	Rural		ban	Total	
	Govt. (n=40) f(%)	Private (n=40) f(%)	Govt. (n=40) f(%)	Private (n=40) f(%)	Govt. (n=80) f(%)	Private (n=80) f(%)
Print						
Newspaper	40(100.00)	40(100.00)	40(100.00)	40(100.0)	80(100.0)	80(100.00)
Magazines	01(2.50)	2(5.00)	8(20.00)	12(30.0)	9(11.20)	14(17.50)
Leaflet/pamphlets	0	01(2.50)	01(2.50)	03(7.50)	01(1.20)	04(5.00)
Electronic						
Telephones/landline	0	0	03(7.50)	03(7.50)	03(3.70)	03(3.70)
Mobiles	40(100.00)	40(100.00)	40(100.00)	40(100.00)	80(100.00)	80(100.00)
Mobile with internet	25(62.50)	28(45.00)	31(77.50)	38(95.00)	56(70.0)	66(82.50)
Television	40(100.00)	40(100.00)	40(100.00)	40(100.00)	80(100.00)	80(100.00)
Computer/laptop	0	03(7.50)	02(5.00)	04(10.00)	02(2.50)	07(8.70)
Computer/laptop with internet	: 0	01(2.50)	0	01(2.50)	0	02(2.50)
Multiple responses						

Table 1: Communication sources available to students

Tuition facility	R	ural	U	rban	Total	
	Govt. (n=40) f(%)	Private (n=40) f(%)	Govt. (n=40) f(%)	Private (n=40) f(%)	Govt. (n=80) f(%)	Private (n=80) f(%)
Availability						
Within 1 km	40(100.00)	40(100.00)	06(15.00)	11(27.50)	46(57.60)	51(63.70)
1-2 km	0	0	31(77.50)	27(67.50)	31(38.70)	27(33.80)
More than 2 km	0	0	03(7.50)	02(5.00)	03(3.70)	02(2.50)
Use						
Yes	11(27.50)	19(47.50)	21(52.50)	24(60.00)	32(40.00)	43(53.70)
No	29(72.50)	21(52.50)	19(47.50)	16(40.00)	48(60.00)	37(46.30)

Table 2: Availability and use of tuition facilities by students

km. From the above data we can concluded that urban areas students have easy availability of educational resources as compared to rural background.

In rural area private school students were using the tuition facility for making good academic performance while in urban area there are no major differences in using the tuition facility. Study reported that parents strive hard to pay high expenses of their children's education and tuition and they are agreed to sacrifice their other desires too to afford extra expenses for the best future of their offspring (Chaudhry and Javed, 2015). Some get help at their home from their family members and others go for private tuition where they get help to complete their syllabus that is the common practice of the majority of tutors. While students experienced to learn problem solving more easily in tutorial classes than in school (Das and Das, 2013).

The data depicted in the Table 3 showed that the awareness and availability of different social media sites for students in rural area. Awareness of social media among students were facebook 1.96 WMS ranked first followed by whatsapp 1.93 WMS ranked second and youtube 1.87 WMS ranked third other sites weighted mean score were 1.67 (4th), 1.62 (5th), 1.40 (7th), 1.35 (8th) and 1.15 (9th) respectively. Data regarding awareness of online shopping applications were amazon 1.71 WMS ranked first followed by flipkart 1.68 WMS ranked second and myntra 1.66 WMS ranked third and left applications were with their weighted mean score with rank 1.57 (4th), 1.53 (5th), 1.52 (6th), 1.46 (7th) and 1.45 (8th) respectively. With regard to academic sites were bigthink.com 1.36 WMS

followed by ecollegeofindia.com 1.33 WMS ranked second and eshiksha.com 1.31 WMS ranked third and other left sites with their mean score value were 1.28 (4th), 1.27 (5th), 1.23 (6th), 1.17 (7th) and 1.15 (8th) respectively.

The data further showed the availability to access of social media sites for students were facebook 1.82 WMS ranked first followed by whatsapp 1.78 WMS ranked second and youtube 1.76 WMS ranked third and left sites were sited with their score value were 1.58 (4th), 1.50 (5th), 1.46 (6th), 1.25 (7th), 1.23 (8th) and 1.06 (9th) respectively. With regard to academic sites were amazon 1.60 WMS ranked first followed by flipkart 1.51 WMS ranked second and myntra 1.43 WMS ranked third and left sites were sited with their score value were 1.41 (4th), 1.36 (5th), 1.31 (6th), 1.30 (7th) and 1.26 (8th) respectively. The data related to academic sites revealed that the students had access on educational sites on bigthink.com 1.32 WMS ranked first followed by admissionnews.com 1.26 WMS ranked second and ecollegeofindia.com 1.25 WMS ranked third and other sites weighted mean score value were 1.23 (4th), 1.18 (5th), 1.13 (6th), 1.12 (7th) and 1.08 (8th) respectively.

From the data we concluded that the students had aware about the sites and easy availability for access. The students from rural background were using facebook and whatsapp and instagram to make in touch with their friends and family members. The results were discussed with the of the social networking sites in academics found the majority of the respondents (83.33%) referred social networking sites for gaining knowledge from educational sites, for referring new

Social media						Rural				
	Awareness					Availability				
	Yes (n=80) f(%)	No (n=80) f(%)	TMS	WMS	Rank	Yes (n=80) f(%)	No (n=80) f(%)	TMS	WMS	Rank
Recreational sites										
Facebook	77(96.20)	3(3.75)	157	1.96	1	66(82.50)	14(17.50)	146	1.82	1
Whatsapp	75(93.70)	5(6.25)	155	1.93	2	63(78.70)	17(21.25)	143	1.78	2
Instagram	44(55.00)	36(45.00)	124	1.55	6	37(46.20)	43(53.75)	117	1.46	6
Youtube	70(87.50)	10(12.50)	150	1.87	3	61(76.20)	19(23.75)	141	1.76	3
Snapchat	28(35.00)	52(65.00)	108	1.35	8	20(25.00)	60(75.00)	100	1.25	7
Messenger	54(67.50)	26(32.50)	134	1.67	4	40(50.00)	40(50.00)	120	1.50	5
Telegram	32(40.00)	48(60.00)	112	1.40	7	19(23.70)	61(76.20)	99	1.23	8
Twitter	12(15.00)	68(85.00)	92	1.15	9	5(6.25)	75(93.75)	85	1.06	9
Wikipedia	50(62.50)	30(37.50)	130	1.62	5	47(58.70)	33(41.25)	127	1.58	4
Online Shopping										
Amazon	57(71.20)	23(28.75)	137	1.71	1	48(60.00)	32(40.00)	128	1.60	1
Flipkart	55(68.70)	25(31.25)	135	1.68	2	41(51.20)	39(48.75)	121	1.51	2
Snapdeal	36(45.00)	44(55.00)	116	1.45	8	29(36.20)	51(63.75)	109	1.36	5
Myntra	53(66.20)	27(33.75)	133	1.66	3	35(43.70)	45(56.25)	115	1.43	3
Olx	37(46.20)	43(53.75)	117	1.46	7	21(26.20)	59(73.75)	101	1.26	8
Shopclues	43(53.70)	37(46.25)	123	1.53	5	25(31.20)	55(68.75)	105	1.31	6
Indiamart	42(52.50)	38(47.50)	122	1.52	6	24(30.00)	56(70.00)	104	1.30	7
Paytm mall	46(57.50)	34(42.50)	126	1.57	4	33(41.20)	47(58.75)	113	1.41	4
Academic sites										
nptel.ac.in	12(15.00)	68(85.00)	92	1.15	8	10(12.50)	70(87.50)	90	1.12	7
edx.org	15(18.70)	65(81.25)	95	1.18	7	11(13.70)	69(86.25)	91	1.13	6
indiaeducation.net	19(23.70)	61(76.25)	99	1.23	6	19(23.70)	61(76.25)	99	1.23	4
academicearth.org	14(17.50)	66(82.50)	94	1.17	7	15(18.70)	65(81.25)	95	1.18	5
eshiksha.com	25(31.20)	55(68.75)	105	1.31	3	7(8.75)	73(91.25)	87	1.08	8
ecollegeofindia.com	27(33.70)	53(66.25)	107	1.33	2	20(25.00)	60(75.00)	100	1.25	3
bigthink.com	29(36.50)	51(63.75)	109	1.36	1	26(32.50)	54(67.5)	106	1.32	1
brightstorm.com	23(28.70)	57(71.25)	103	1.28	4	19(23.70)	61(76.25)	99	1.23	4
admissionnews.com	22(27.50)	58(72.50)	102	1.27	5	21(26.20)	59(73.75)	101	1.26	2

Table 3: Awareness and Availability of	f social media for rural students
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Multiple responses

updates and gaining exposure from facebook, instagram and whatsapp etc. (Rana and Singh, 2012).

The data depicted in the Table 4 revealed the awareness and availability of different social media sites for students from urban background. According to the students responses awareness of recreational sites among students were facebook 2.50 WMS ranked first followed by whatsapp 1.95 WMS ranked second and youtube 1.93 WMS and others sites with their mean score value were 1.80 (4th), 1.70 (5th), 1.68 (6th), 1.58 (7th), 1.57 (8th) and 1.33 (9th respectively. Further data showed awareness of online shopping applications were amazon 1.88 WMS ranked first followed by flipkart 1.83 WMS ranked second and myntra 1.73

Table 4: Awareness and availability of social media for urban students

Social media						Rural					
		Ā	warene	ss			Availability				
	Yes (n=80) f(%)	No (n=80) f(%)	TMS	WMS	Rank	Yes (n=80) f(%)	No (n=80) f(%)	TMS	WMS	Rank	
Recreational sites											
Facebook	100(100.00)	0	200	2.50	1	72(90.0)	8(10.00)	152	1.90	1	
Whatsapp	76(95.00)	4((5.00)	156	1.95	2	68(85.0)	12(15.00)	148	1.85	3	
Instagram	55(68.70)	25(31.25)	135	1.68	6	36(45.0)	44(55.00)	116	1.45	6	
Youtube	75(93.70)	5(6.25)	155	1.93	3	71(88.75)	9(11.25)	150	1.87	2	
Snapchat	47(58.70)	33(41.25)	127	1.58	7	40(50.00)	40(50.00)	120	1.50	5	
Messenger	56(70.00)	24(30.00)	136	1.70	5	47(58.7)	33(41.25)	127	1.58	4	
Telegram	46(57.50)	34(42.50)	126	1.57	8	31(38.7)	49(61.25)	111	1.38	7	
Twitter	27(33.70)	53(66.25)	107	1.33	9	5(6.25)	75(93.75)	85	1.06	8	
Wikipedia	64(80.00)	16(20.00)	144	1.80	4	47(58.7)	33(41.25)	127	1.58	4	
Online shopping											
Amazon	71(88.70)	9(11.25)	151	1.88	1	64(80.0)	16(20.00)	144	1.80	1	
Flipkart	67(83.70)	13(16.25)	147	1.83	2	59(73.7)	21(26.25)	139	1.73	2	
Snapdeal	59(73.70)	21(26.25)	139	1.73	4	50(62.50)	30(37.50)	130	1.62	3	
Myntra	60(75.00)	20(25.00)	140	1.75	3	44(55.00)	36(45.00)	124	1.55	5	
Olx	53(66.20)	27(33.75)	133	1.66	5	45(56.20)	35(43.75)	125	1.56	4	
Shopclues	39(48.75)	41(51.25)	119	1.48	8	39(48.70)	41(51.25)	119	1.48	7	
Indiamart	46(57.50)	34(42.50)	126	1.57	7	30(37.50)	50(62.50)	110	1.37	8	
Paytm mall	48(60.00)	32(40.00)	128	1.60	6	40(50.00)	40(50.00)	120	1.50	6	
Academic sites											
nptel.ac.in	16(20.00)	64(80.00)	96	1.20	8	11(13.70)	69(86.25)	91	1.13	8	
edx.org	8(10.00)	72(90.00)	88	1.10	9	10(12.50)	70(87.50)	90	1.12	9	
indiaeducation.net	32(40.00)	48(60.00)	112	1.40	3	26(32.50)	54(67.50)	106	1.32	4	
academicearth.org	19(23.75)	61(76.25)	99	1.23	7	15(18.70)	65(81.25)	95	1.18	6	
eshiksha.com	29(36.20)	51(63.75)	109	1.36	5	29(36.20)	51(63.75)	109	1.36	3	
ecollegeofindia.com	31(38.70)	49(61.25)	111	1.38	4	27(33.70)	53(66.25)	107	1.33	5	
bigthink.com	40(50.00)	40(50.00)	120	1.50	1	36(45.00)	44(55.00)	116	1.45	1	
brightstorm.com	34(42.50)	46(57.50)	114	1.42	2	31(38.70)	49(61.25)	111	1.38	2	
admissionnews.com	28(35.00)	52(65.00)	108	1.35	6	14(17.50)	66(82.50)	94	1.17	7	

Multiple response

WMS ranked third and other left sites weighted mean score value were 1.73 (4th), 1.66 (5th), 1.60 (6th), 1.57 (7th) and 1.48 (8th) respectively. Data from academic sites revealed that academic sites bigthink.com 1.50 WMS ranked first followed by brighystorm.com 1.42 WMS ranked second and indiaeducation.net 1.40 WMS ranked third, 1.38 (4th),1.36 (5th), 1.35 (6th), 1.23 (7th), 1.20 (8th) and 1.10 (9th) respectively. Data further inferred the availability of social sites for the accessability. Data from recreation sites showed that facebook 1.90 WMS ranked first followed by youtube 1.87 WMS ranked second and whatsapp 1.85 WMS ranked third and 1.58 (4th), 1.50 (5th), 1.45 (6th), 1.38 (7th) and 1.06 (8th) respectively. Data from online shopping applications showed that students were using amazon 1.80 WMS ranked first followed by flipkart 1.73 WMS ranked second and snapdeal 1.62 WMS ranked third and 1.56 (4^{th}), 1.55 (5^{th}), 1.50 (6^{th}), 1.48 (7^{th}), and 1.38 (8^{th}) respectively.

The data related to academic sites revealed that the students had access on educational sites on bigthink.com 1.45 WMS followed by brightstorm.com 1.38 ranked second and eshiksha.com 1.36 WMS ranked third and 1.33 (4th), 1.32 (5th), 1.18 (6th), 1.17 (7th), 1.13 (8th) and 1.12 (9th) respectively. From the data we concluded that the students from urban background were accessing facebook and whatsapp and instagram to make in touch with their friends and family members. The findings also support by a study with majority of the respondents (197) representing 86.45 per cent were using facebook with first rank and next whatsapp with 132 (57.90%) respondents. Also many of these students use the sites for the purpose of maintaining social contacts with friends/ relatives and they also use them for academic purposes (Odunola, 2015). The similar findings of the study were found that students use Facebook a social networking site for academic reasons and entertainment purposes (Adomi and Ejirefe, 2012).

CONCLUSION

Social media is an emerging tool to popularize and to increase the visibility of the useful technologies at a great extent and to educate the individuals and development of youth to save the time and resources. A comparison on the extent of use of information sources reveals that television, mobile phones and mobile with internet connection as an electronic media and newspaper as a print media were using to keep themselves update with the latest know and how. Majority of the student's had availability of tuition facility within one km. and they were using the tuition facility for improving their academic performance. Data revealed that majority of the students were aware about the different types of social media viz; Facebook, Whatsapp, Youtube, Messenger and Wikipedia. However the most popular media used by them from recreational section were Facebook, Whatsapp, Youtube and Messenger. Under online shopping section most preferred sites were Amazon, Flipkart and Myntra respectively. In case of academic section the most preferred sites were ecollogeofindia.com, eshiksha.com and brightstorm.com by the students for career and further studies in institutes. It is the first elearning gateway dedicated to corporate India and professional students. They can themselves up to date e-content on prevailing topics on emerging technologies for future ready workplace. E-learning platform for diverse leaning needs allowing learners to access anytime and anywhere from device.

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Research Article

Knowledge of Rural Women Regarding Selection of Furniture and Furnishings

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ABSTRACT

The study was undertaken in two villages of sidhwanbet block of Ludhiana district in the year 2021. A total of 60 female respondents were taken for this study to assess the knowledge level regarding selection and arrangements of furniture and furnishing. The results of the study revealed that that most of respondents were having knowledge of use of multipurpose furniture, light weight and simple design of furniture. About half of the respondent had knowledge about height of table and height and width of bed. Majority of respondents (78.02) had knowledge about arrangements of furniture and furnishings. Style, beauty and utility were the main preferences of respondents while purchasing furniture and furnishing.

Keywords: Furniture, Knowledge, Rural, Women

INTRODUCTION

A house is a place which is confined with four walls, but a housewife plays a major role to make a house into the home where all family members spend their time and share their feelings. Family members can only feel comfortable and satisfied when they meet with all requirements of the body. Therefore, proper selection and arrangements of various elements like furniture, fabrics, floor coverings, wall covers, etc. can make an empty space into a comfortable, useful, attractive and pleasing area. Through having knowledge of interior designing, a housewife can make her home a comfortable, attractive and pleasant place for family members and also for visitors. But it has been seen that mostly in rural houses, interior designing area is neglected by them. So it is the main reason that they mostly remain deprived from psychological and physiological benefits of interior designing.

Furniture we purchase must meet the psychological and physiological and anthropometric requirements of the user, otherwise it is the wastage of money, energy and time. Moreover it makes the body uncomfortable due to which it results the pain in the body. If uncomfortable furniture is being used for longer periods, it causes postural deformities. Having poor design of furniture, mostly cases are found of postural disorders and spinal complaints.

Colour is a source of the universal pleasure, everyone should have beautiful and pleasing colours in their homes so that they can enjoy them. Careful use of colours in the decoration makes the things more attractive (Gupta et al., 1993). It is essential to have some knowledge of colours so that living in homes makes them delight and fortify them against dullness elsewhere. While planning colour schemes for the rooms, it is necessary to consider them for the entire home as one unit to obtain a unifying effect. One should start planning of colour schemes from drawing room, then dining room and finally bed room (Seetharaman and Pannu). Selection of furniture should be according to the size, shape, exposure and foremost the colour schemes of rooms where it is to be used. Therefore, knowledge of furniture, furnishings and rooms itself is very important and keeping all the aspects in mind while purchasing so that all can be maximally utilised by every member of the house. So the present research study had been planned to find out the knowledge of housewives with respect to selection of furniture and furnishing and knowledge of arrangement of these.

MATERIALS AND METHODS

The present study was conducted in year 2021. For this, Sidhwanbet block was selected, out of this block, two villages namely Jandi and Rasulpur were selected falling in Jagraon tehsil of Ludhiana district of Punjab. Thirty female respondents were selected from each village thus making total 60 respondents. The participation of all female members involved in household decision making and also household activities were assessed. They were taken as respondent of the study. An interview schedule was constructed and data were collected in terms of knowledge level of rural female respondents regarding selection of furniture and furnishings keeping in view of proportion and utility of the rooms. Information related to respondent's age, education, type and income of family and category were taken. The collected data were tabulated and analysed using frequency, percentages and ranking.

RESULTS AND DISCUSSION

Table 1 shows the background information of respondents pertaining to their age, education, type of family, caste and income. Most of the respondents (39.84%) were belonged to the age group 30-40 years, 24. 9 per cent were in the age between 40-50 years and 11.62 per cent were above of the age 50 years. Regarding the education of respondents, it is found that about half of respondents (53.12%) were educated up to matric and only 8.3 per cent were graduation. As far as type of family concerned, 56.44 per cent were belonged to nuclear family. Majority of the respondents (61.42%) were belonged to SC/ST family. In case of income of the family, it was showed that majority of the respondents (91.3%) were having income 2-3 lacs whereas 26.56 per cent families had income below one lac.

Table 2 depicts the knowledge of respondents regarding selection of furniture and furnishings. It is showed from table that majority of respondents (87.98%) were having knowledge of use of multipurpose furniture followed by light weight and simple design of furniture (79.68%), height of table (53.12%) and height and width of bed (48.14%). It is the fact that multipurpose furniture occupies less space and light weight furniture is easy to move anywhere. About 36.52 per cent respondents had knowledge with respect to colour, texture and pattern for different

(N=60)		
Particulars	Frequency	Percentages
Age		
20-30 Years	14	23.24
30-40 Years	24	39.84
40-50 Years	15	24.9
>50 Years	7	11.62
Educational Status		
Primary	6	9.96
Middle	11	18.26
High School	32	53.12
Intermediate	6	9.96
Graduation	5	8.3
Type of Family		
Nuclear	34	56.44
Joint	26	43.16
Caste		
General	14	23.24
OBC	9	14.94
SC/ST	37	61.42
Family Income/Year		
<1Lac	16	26.56
1-2 Lac	23	38.18
2-3 Lac	55	91.30
> 3 Lac	26	43.16

Table 1: Socio-demographic profile of respondents (N=60)

Table 2: Knowledge of respondents regarding practices related with selection of furniture and furnishings (N=60)

Practices	Frequency	Percentage
Selection of colour, texture,	22	36.52
pattern for different rooms		
Role of related colour schemes	8	13.28
Role of contrast schemes	17	28.22
Role of cool colours	24	39.84
Role of warm colours	22	36.52
Distribution of pattern in rooms	s 9	14.94
Height and width of bed	29	48.14
Height of table	32	53.12
Height of seat	18	29.88
Depth of seat	13	21.58
Back rest of a seat	21	34.86
Multipurpose uses of furniture	53	87.98
Light weight and simple design of furniture	48	79.68

rooms. Low level knowledge (13.28%) was seen in relation to role of related colour schemes. Respondents were also found not having knowledge of usage of such colours on walls which could reflect more light and add beauty to the furniture and furnishings using in the room. The findings are in the line with results of the study conducted by Gill (1996).

Table 3 indicates the knowledge of respondents with respect to the arrangements of furniture and furnishings. Majority of the respondents (78.02%) had knowledge of use of traditional furniture as these furniture's were mostly used in the rural houses and were found indiscreetly in majority of the homes. 44.82 per cent respondents were had knowledge of grouping of furniture for proper circulation. Rest of the respondents had arranged the furniture haphazardly. As far as grouping of furniture and hanging pictures concerned, it was observed that 38.18 per cent had knowledge of how to make groups of furniture and how to hang pictures so that they could seen without taking unnatural posture. Only 33.20 and 31.54 per cent respondents were aware about the use of balance in furniture arrangement and placement of accessories. Rest of respondents were not having knowledge about this and they were using furniture and accessories anywhere they found space free without keeping the principles of balance in mind. It can be concluded from the results of table that the beauty and usage of home was only possible if arrangements of furniture could be done in view of principles of arrangements.

Table 4 depicts preferences the homemakers give while purchasing the furniture and furnishing. It was clearly found that majority of respondents gave the first preference to style of furniture whether it was modern or traditional style. Second and third preference was given to utility and beauty respectively. Sixth

Table 3: Knowledge related arrangement of furniture and furnishing (N=60)

Practices	Frequency	Percentages
Grouping of furniture	23	38.18
Grouping of furniture for proper circulation	27	44.82
Balance in furniture arrangement	20	33.20
Use of traditional items	47	78.02
Placement of accessories	19	31.54
Hanging pictures	23	38.18

Table 4: Preferences given by respondents while choosing furniture and furnishing (N=60)

Preferences	Frequency (%)	Ranks
Comfort	38(63.08)	VII
Weight	49(81.34)	IV
Expressiveness	28(46.48)	IX
Style	56(92.96)	Ι
Beauty	50(83.00)	III
Utility	52(86.32)	II
Balance and style	46(76.36)	V
Construction	41(68.06)	VI
Firmness and rigidity	37(61.42)	VIII

preference was given to construction that was type of wood to be used while making furniture. Preference to comfort was given seventh rank and last rank that is ninth was given to expressiveness. It was clear from table that main preferences given to style, utility and beauty, not more emphasis was given to construction and firmness and weight of furniture. Comfort is also important aspect to which one should also give preference that is furniture should be according to anthropometric measurements of user.

CONCLUSION

In this paper, it is concluded that respondents mostly were belonged to 30-40 age group and more than half of the respondents were passed matric and above ninety percent respondents were fall in 2-3 lac income. Lesser number of respondents had knowledge of usage of different pattern in rooms to create the rooms more in balance. Majority of respondents were having no knowledge of various ergonomic features to be kept in mind while selecting the different furniture items. They are mostly influence by friends, neighbours, relatives and views given by shopkeepers so that's why they did not give emphasis to comforts of body

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Research Article

Geographically Weighted Ridge Regression Estimator of Finite Population Mean to Tackle Multicollinearity in Survey Sampling

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ABSTRACT

The utilization of auxiliary information in survey sampling significantly contributes to the estimation process. The presence of spatial information necessitates the exploration of a spatial model. The Geographically Weighted Regression (GWR), a spatial model regression has been widely applied to many practical fields for exploring spatial non stationarity. However, the occurrence of multicollinearity among the local variables in GWR model affect the estimation process. In this study, a new Geographically Weighted Ridge regression (GWRR) estimator has been proposed by taking care of the effect of multicollinearity in survey data. Proposed estimator performs better than other traditional estimators in terms of RRMSE value.

Keywords: Geographically weighted regression (GWR), Multicollinearity, Spatial model

1. INTRODUCTION

Auxiliary information plays a vital role in illustrating conclusion about the population parameters of the study variable. It is used to enhance estimation of population parameters of the main variable under study. During the process of computation and estimation, supplementary information is employed to enhance the accuracy of estimation. Occasionally, auxiliary information is available prior to a survey, while other times it is not known beforehand. There are many examples in survey sampling where auxiliary information is known in advance e.g. number of banks in a city, number of employees, educational status, number of educated male and females in a city etc.

Graunt (1662) was the first who estimated the population of England using auxiliary information. Olkin (1958) suggested ratio estimator based on multiauxiliary variables for multivariate case. John (1969) provided multivariate ratio and product type estimators for estimating the population means. Further comprehensive contribution of multivariate ratio and regression estimators using multi-auxiliary variables

were taken up by Ahmad and Hanif (2010) for estimating population mean. Isaki (1983) proposed ratio and regression type estimators for estimating the population variance. Cebrian and Garcia (1997) worked on variance estimation by using auxiliary variables. The regression estimator is widely used as the preferred method when auxiliary information is accessible in survey data. In defining the regression estimator, regression superpopulation model is often introduced to describe a population and (or) as a basis of the estimation of the population characteristics. If the auxiliary variables have strong linear relationship with the study variable, then regression estimator permits a significant gain in efficiency in comparison with traditional estimator. Following Isaki (1983), Singh et al. (2009) proposed exponential estimator for estimating population variance and Abu-Dayyeh and Ahmed (2005) provided some multi-variate ratio and regression-type estimators in two-phase sampling and studied some properties of the proposed estimator through simulation study using real data. Kadilar and Cingi (2006) suggested the regression type estimator for estimating variance using known population variance

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of the auxiliary variable. Many other authors including Upadhyaya *et al.* (2006); Ahmed *et al.* (2000); Yadav and Kadilar (2013); Singh and Solanki (2013); Ahmed *et al.* (2016) etc. have worked on variance estimation for using population variance of the auxiliary information. Asghar *et al.* (2014) provided some exponential-type estimator for variance using population means of multi-auxiliary auxiliary variables. Park and Yang (2008) have proposed a ridge regression estimator under superpopulation model framework.

In many practical scenarios, the auxiliary variables are spatial in nature i.e. their behaviour changes from location to location. Availability these auxiliary variables urges the researcher to work on spatial framework. Geographical Weighted Regression (GWR) (Brundson et al., 1998) is a spatial regression model in which the dependent variable is remain variant at different locations. These property is called spatial nonstationarity. This GWR method is popular by being applied in crime occurrences (Cahill and Mulligan, 2007), health risks (Gilbert and Chakraborty, 2011) and species distribution (Miller and Hanham, 2011). Chandra et al. (2012) have applied GWR model for small area estimation and proposed geographical weighted empirical best linear unbiased predictor (GWEBLUP) for estimating small area average. Liu et al. (2018) proposed Geographically Weighted model assisted estimator for estimation of population total using local linear method. Huang et al. (2010) proposed a geographically and temporally weighted regression to model both spatial and temporal variability simultaneously. Lu et al. (2014) studied GWR model by applying the local weighted least square approach with non-Euclidean distance metrics.

In GWR model, dependencies among the regressor variables will lead to multicollinearity issue in the model. Multicollinearity in survey sampling not only affect the estimation process but also affects the variance estimation process. The multicollinearity and variable selection on GWR was investigated by Wheeler and Tiefelsdorf (2005) and Wheeler (2007, 2009). Multicollinearity in GWR was explored by other researchers like Paez *et al.* (2011); Fotheringham and Oshamn (2016) and Liverani *et al.* (2016).

Methodologically basic GWR proposed by Brundson *et al.* (1996) is a kernel-based methods in which the locally weighted least square procedure is used to estimate the regression coefficients in the model. However, it is well known that the least square estimator is not robust to deal with multicollinearity issue. Horell and Kennard (1970) proposed ridge regression, a biased method of estimation to tackle multicollinearity. There is no significant work to address multicollinearity issue in survey sampling. Therefore, in this article an attempt has been made to develop an estimator using ridge regression technique to estimate population mean under GWR model. The remainder of the article is organised as following. Section 2 describes the material and methods which includes basic GWR method and the proposed Geographically Weighted Ridge regression (GWRR) estimator. Simulation studies were done to assess the performance of proposed estimator and the description of the simulation along with the simulations results are discussed in Section 3. The article concludes with some final remarks and future scope.

2. MATERIAL AND METHODS

2.1 Geographical weighted regression

A spatially varying Geographical Weighted Regression (GWR) model is given by

$$y_i = \sum_{j=1}^p \beta_j(u_i, v_i) x_{ij} + \varepsilon_i = \mathbf{x}_i^T \boldsymbol{\beta}(u_i, v_i) + \varepsilon_i, i = 1, 2, \dots, N \dots (2.1)$$

where, y_i and $x_i = (x_{i1}, x_{i2}, \dots, x_{ip})^T$ are the response and associated p auxiliary variables at location (u_i, v_i) ; $\beta(.) = (\beta_1(.), \beta_2(.), \dots, \beta_p(.))^T$ is a p-dimensional vector of unknown location specific regression parameter; ε_i is random error for the location (u_i, v_i) having zero mean and constant variance σ^2 .

The parameters in model (2.1) are estimated using weighted least square method by minimizing

$$\sum_{i=1}^{N} \left\{ y_i - \sum_{j=1}^{p} \beta_j (u_0, v_0) x_{ij} \right\}^2 K_h(d_{0i}) \qquad \dots (2.2)$$

where, K_h (.)=K(./h)/h with K(.) being a given kernel function and h being the bandwidth and d_{0i} is the distance between locations (u_0, v_0) and (u_i, v_i).

The resultant location specific regression parameter estimate at a particular location (u_0,v_0) is provided by

$$\begin{bmatrix} \hat{\beta}_1(u_0, v_0), \hat{\beta}_2(u_0, v_0), \dots, \hat{\beta}_p(u_0, v_0) \end{bmatrix}^T$$

= $[\boldsymbol{X}^T \boldsymbol{W}(u_0, v_0) \boldsymbol{X}]^{-1} \boldsymbol{X}^T \boldsymbol{W}(u_0, v_0) \boldsymbol{Y}$... (2.3)

where, $X = (x_1, x_2, ..., x_N)^T$, $x_i = (x_{i1}, x_{i2}, ..., x_{ip})^T$, $Y = (y_1, y_2, ..., y_N)^T$; the weight matrix $W(u_0, v_0)$ is a matrix with diagonal elements as kernel weights at (u_0, v_0) is defined by

$$W(u_0, v_0) = diag[K_h(d_{01}), K_h(d_{02}), \dots, K_h(d_{0N})] = \begin{bmatrix} w_{01} & 0 & \cdots & 0\\ 0 & w_{02} & \cdots & 0\\ \vdots & \vdots & \ddots & 0\\ 0 & 0 & 0 & w_{0N} \end{bmatrix}$$

The weight matrix varies from location to location. A variety of kernel functions are employed to create distinct weight matrices. The commonly used kernel functions are listed in Table 1.

Table 1: Different kernel functions under GWR

Kernel name	Kernel function
Bi-square nearest neighbour	$\left[1-\left(\frac{d_{ik}}{h}\right)^2\right]^2$
Gaussian kernel	$\frac{1}{\sqrt{2\pi}} exp\left[\frac{-1}{2} \left(\frac{d_{ik}}{h}\right)^2\right]$
Tricube	$\left[1-\left(\frac{d_{ik}}{h}\right)^3\right]^3$
Boxcar	$K(h) = \begin{cases} 1 & if \ d_{ik} < h \\ 0 & otherwise \end{cases}$

In Table 1, d_{ik} represents the distance between (u_i, v_i) and (u_k, v_k) location and i, k=1, 2, ..., N.

We have to take the values (u_0,v_0) for each locations (u_i,v_i) (i=1,2,...,N) for estimating parameters at each location in equation (2.2).

2.2 Geographically weighted ridge regression (GWRR)

A ridge regression estimator of the vector of regression coefficients was originally proposed by Horel and Kennard (1970) to construct a non-sensitive estimator for the regression coefficients when there is multicollinearity among predictors or when sample size is small relative to number of predictors. Bardsley and Chamber (1984) introduced a procedure that relaxes the constraints on weights and showed that the procedure is a type of ridge estimator. Let us consider model (2.1) be the relationship between study variable and auxiliary variable. A sample of size n has been drawn from whole population of size N. To define a Geographically weighted ridge estimator, consider the procedure that replaces the restrictions (2.2) with a coefficient as diagonal matrix Ψ . That is the weights for the ridge estimator is obtained by minimizing

$$Q = (\mathbf{Y} - \mathbf{X}\boldsymbol{\beta})^T \mathbf{W} (\mathbf{Y} - \mathbf{X}\boldsymbol{\beta}) + (\boldsymbol{\alpha}^T \mathbf{X} - \overline{\mathbf{x}}_N)^T \Psi (\boldsymbol{\alpha}^T \mathbf{X} - \overline{\mathbf{x}}_N) \dots (2.4)$$

subject to constraint $\boldsymbol{\alpha}^T \boldsymbol{X} = \overline{\boldsymbol{x}}_N$, where $X = (x_1^T, x_2^T, ..., x_N^T)^T$, $x_i^T = (x_{i1}, x_{i2}, ..., x_{ip})$; $\overline{\boldsymbol{x}}_N = (\overline{\boldsymbol{x}}_{.1,N})$, $\overline{\boldsymbol{x}}_{.2,N}), ..., \overline{\boldsymbol{x}}_{.p,N})^T$, $\overline{\boldsymbol{x}}_{i,N} = \frac{1}{N} \sum_{j=1}^N x_{ij}$, i = 1, 2, 3, ..., p, Ψ is a positive definite diagonal matrix.

The weights for calculation of ridge estimate of β is obtained by simplifying 2.4. The solution of vector weight is

 $W^* = \boldsymbol{\alpha} + \boldsymbol{\Phi}^{-\frac{1}{2}} (\boldsymbol{I} - \boldsymbol{P}_{J_n}) \boldsymbol{X}^* [\boldsymbol{X}^{*T} (\boldsymbol{I} - \boldsymbol{P}_{J_n}) \boldsymbol{X}^* + \boldsymbol{\Psi}^{-1}] (\bar{\boldsymbol{x}}_N - \bar{\boldsymbol{x}}_n)^T \dots (2.5)$ where, $P_{J_n} = J_n (J_n^T J_n) J_n^T$, J_n is the vector of 1s of dimension $n \times 1$, $\bar{\boldsymbol{x}}_n = (\bar{\boldsymbol{x}}_{1,n}, \bar{\boldsymbol{x}}_{2,n}, \dots, \bar{\boldsymbol{x}}_{p,n})^T$; $\bar{\boldsymbol{x}}_{i,n} = \frac{1}{n} \sum_{j=1}^n \boldsymbol{x}_{ij}$

Geographically Weighted Ridge Regression (GWRR) estimator by incorporating weights for estimating mean is defined by

$$\bar{y}_{gwrr} = \boldsymbol{W}^{*T} \boldsymbol{y} = \bar{y}_n + (\bar{\boldsymbol{x}}_N - \bar{\boldsymbol{x}}_n) \, \boldsymbol{\hat{\beta}}_{ridge} \qquad \dots (2.6)$$

where, $\hat{\beta}_{ridge}$ consists all the location variant geographical weighted values.

2.3 Optimal coefficient matrix Ψ

Here, we show that deriving a linear estimator that has the minimum model MSE is equivalent to deriving the optimal value for the GWRR estimator of equation (2.6) and define the optimal ridge regression estimator under the multiple regression superpopulation model. To motivate the procedure of deriving the optimal Ψ that minimizes the MSE of the gwrr estimator, consider a single x-variable. Assume the linear model (2.1) with a single explanatory variable x_i where e_i 's are independently distributed with the mean zero and variance σ^2 , and β_0 and β be the regression coefficients. Consider, a linear estimator of the population mean of y, $\bar{y}_{lin} = \sum_{i=1}^{n} a_i y_i$, where $\sum_{i=1}^{n} a_i = 1$. Then, the error of the linear estimator in estimating the population means of y is

$$\bar{y}_{lin} - \bar{y}_N = \sum_{i=1}^n a_i e_i - \bar{e}_N + (\sum_{i=1}^n a_i x_i - \bar{x}_N) \beta$$

where, \bar{y}_N, \bar{x}_N are the population means of y,x and e respectively. The model MSE of the linear estimator for the known \bar{x}_N and conditional on the sample x's if we ignore the finite population correction factor is

$$E\{(\sum_{i=1}^{n} a_{i} y_{i} - \bar{y}_{N})^{2} / x\} = \sum_{i=1}^{n} a_{i}^{2} \sigma^{2} + (\sum_{i=1}^{n} a_{i} x_{i} - \bar{x}_{N})^{2} \beta^{2}$$
$$= (1 - R^{2})\sigma_{y}^{2} \left[\sum_{i=1}^{n} w_{i}^{2} + \frac{R^{2}}{(1 - R^{2})\sigma_{x}^{2}} (\sum_{i=1}^{n} a_{i} x_{i} - \bar{x}_{N})^{2} \right]$$

where, σ_y^2 and σ_x^2 are the population variances of y and x, σ_{xy} is the population covariances between x and y. $R^2 = (\sigma_x^2 \sigma_y^2)^{-1} \sigma_{xy}^2$. Let R^2 and σ_x^2 be known and the quadratic function of weights can be approximated by $\sum_{i=1}^{n} (w_i - a_i)^2 a_i^{-1} \approx \sum_{i=1}^{n} (w_i - a_i)^2 \bar{a}^{-1} \approx \sum_{i=1}^{n} w_i^2 \bar{a}^{-1} - n\bar{a}$, where \bar{a} is the sample mean of the a_i . Then the set of weights which minimizes the objective function (2.4), with $X = (x_1, x_2, \dots, x_N)^T$, $\Phi = \text{diag}(a_1^{-1}, \dots, a_n^{-1})$, $\Psi = \Psi I$ and $\Psi = [(1 - R^2)\bar{a}\sigma_x^2]^{-1}R^2$ would minimize the model MSE of the linear estimator \bar{y}_{lin} .

3. SIMULATION STUDY

A simulation study has been conducted to compare the proposed GWRR estimator along with other estimators such as ridge estimator (Park and Yang, 2008), traditional Simple Random Sampling (SRS) estimator, GWR estimator. A population of size 900 is generated by considering a superpopulation GWR model in the form of

$$\begin{array}{l} y_{i} = \! x_{i1} \beta_{1} (u_{i} \! , \! v_{j} \!) \! + \! x_{i2} \beta_{2} (u_{i} \! , \! v_{j} \!) \! + \! x_{i3} \beta_{3} (u_{i} \! , \! v_{i} \!) \! + \! x_{i4} \beta_{4} (u_{i} \! , \! v_{i} \!) \! + \! x_{i5} \\ \beta_{5} (u_{i} \! , \! v_{i} \!) \! + \! \epsilon_{i} \end{array}$$

where, $X = [x_{i1} \ x_{i2} \ x_{i3} \ x_{i4} \ x_{i5}]$ is obtained from the multivariate normal distribution with mean vector $\mu = [30 \ 25 \ 32 \ 29 \ 35]$ and covariance matrix as

	4	2	3	0	0	
	2	5	3.6	0	0	
Σ =	3	3.6	8	0	0	
	0	0	0	4	3	
	0	0	0	3	8	

From the covariance matrix, we can divide the whole X data space into two subsets on the basis of their independence among themselves, in which first three variables X_1 , X_2 and X_3 are highly correlated among themselves. The pairwise correlation X_1 and X_2 , X_1 and X_3 , and X_2 and X_3 are 0.45, 0.53 and 0.57 respectively. The pairwise correlation between X_4 and X_5 is 0.53. In case of remaining pairs, correlation coefficients have been considered as zero.

Spatial layout of the simulation has been considered as a spatial region of unit square. The sampling locations are m×m lattice points with latitude and longitude co-ordinates

$$(u_i, v_i) = \left(\frac{1}{m-1} \mod\left(\frac{i-1}{m}\right), \frac{1}{m-1} \left|\frac{i-1}{m}\right|\right), i = 1, 2, 3, \dots, m^2$$
(Wang *et al.*)

where, mod(a/b) and |a/b| are the remainder and the absolute value a divided by b respectively. In this study, m= 30 was taken, hence, the population size is N=m²= 900.

The following GWR model is considered in the simulation study

 $y_i = \frac{1}{2}(u_i + v_i)x_{i1} + (1 + v_i^2)x_{i2} + (1.5x_{i3}) + (1 + u_i^2)x_{i4} + 1.5(u_i + v_i)x_{i5} + \varepsilon_i, \text{ for all } i = 1, 2, \dots, N \text{ population units.}$

In this simulation study, Monte Carlo simulation has been conducted considering five different samples of sizes, i.e. n = 10% (= 90), 20% (= 180), 25% (= 225), 30% (=270) and 40% (=360) of population size that have been drawn by SRSWOR. In order to evaluate the performance of the proposed GWRR estimator (2.6), we compare it with other three available estimators such as usual SRSWOR estimator, usual estimator using ridge regression (Park and Yang 2008) and GWR estimator. The form of different estimators are as follows:

Traditional SRSWOR estimator, $\bar{y}_{SRS} = \bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i$ Geographical weighted estimator, $\bar{y}_{GWR} = \frac{1}{N} \sum_{i=1}^{N} X \hat{\beta}_{GWR}$ Ridge estimator, $\bar{y}_{ridge} = \bar{y}_n + (\bar{X}_N - \bar{x}_n) \hat{\beta}_{ridge}$.

The estimators are compared on the basis of two criteria i.e. %RB and %RRMSE. The formulas of % RB and % RRMSE are given by following expressions

$$\% RB = \frac{1}{R} \sum_{r=1}^{R} \left(\frac{\hat{t}_r - t_r}{t_r} \right) \times 100 \text{ and } \% RRMSE = \sqrt{\frac{1}{R} \sum_{r=1}^{R} \left(\frac{\hat{t}_r - t_r}{t_r} \right)^2} \times 100.$$

Table 2, 3 4 and 5 contains estimates of population mean of study variable and %RB of different estimators under consideration for all the sample sizes under four different kernel functions. From Table 2, it is clear that by increasing the sample size the %RB and %RRMSE is decreasing for most of the estimators. The proposed GWRR estimator outperformed in comparison to other estimators in the term of %RB and %RRMSE. The estimates of population mean and %RB and %RRMSE using other kernels has been shown in Table 3, 4 and 5. Similar kind of trend in results is also observed using Gaussian kernel, Tricube kernel and Boxcar kernel.

Table 2: Comparison of the proposed GWRR estimator of population mean using Bi-square kernel function with other competitors for different sample sizes

Sample size		%RB				%RRMSE			
	$\overline{y}_{\rm SRS}$	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{y}_{\mathrm{gwrr}}$	$\overline{y}_{ m SRS}$	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{\mathcal{Y}}_{\mathrm{gwrr}}$	
90	0.12	-24.29	11.33	-1.17	1.25	155.53	49.41	0.93	
180	0.21	-20.05	13.68	-0.14	1.51	95.20	55.31	0.83	
225	0.12	-24.29	11.33	-0.12	1.25	85.53	49.41	0.10	
270	0.08	-11.88	12.78	-0.10	1.09	78.63	46.60	0.06	
360	0.05	1.47	7.81	0.07	0.92	60.27	36.32	0.04	

Table 3: Comparison of the proposed GWRR estimator of population mean using Gaussian kernel function with other competitors for different sample sizes

Sample size		%	RB		%RRMSE				
	$\overline{y}_{\text{SRS}}$	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{\mathcal{Y}}_{\mathrm{gwrr}}$	\overline{y}_{srs}	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{oldsymbol{y}}_{ ext{gwrr}}$	
90	0.20	9.31	18.72	-0.97	2.14	66.53	90.13	0.95	
180	0.21	13.42	13.68	-0.62	1.51	34.22	55.31	0.71	
225	0.12	12.38	11.33	-0.14	1.25	29.48	49.41	0.09	
270	0.08	10.54	12.78	-0.07	1.09	22.69	46.60	0.07	
360	0.05	8.05	7.81	0.02	0.92	17.19	36.32	0.02	

Table 4: Comparison of the proposed GWRR estimator of population mean using Tricube kernel function with other competitors for different sample sizes

Sample size		%	RB		%RRMSE				
	$\overline{y}_{\text{SRS}}$	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{oldsymbol{\mathcal{Y}}}_{ ext{ridge}}$	$\overline{oldsymbol{\mathcal{Y}}}_{ ext{gwrr}}$	$\overline{y}_{\text{SRS}}$	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{\boldsymbol{\mathcal{Y}}}_{\mathrm{gwrr}}$	
90	0.20	3.40	18.72	0.95	2.14	293.84	90.13	1.42	
180	0.21	-20.76	13.68	-0.77	1.51	199.22	55.31	0.91	
225	0.11	-28.30	11.33	-0.16	1.25	157.40	49.41	0.18	
270	0.07	-13.06	12.78	-0.04	1.09	129.07	46.60	0.07	
360	0.05	0.74	7.81	0.04	0.92	89.07	36.32	0.04	

Table 5: Comparison of the proposed GWRR estimator of population mean using Boxcar kernel function with other competitors for different sample sizes

Sample size		%	RB		%RRMSE				
	$\overline{y}_{\text{SRS}}$	$\overline{y}_{\text{GWR}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{\mathcal{Y}}_{\mathrm{gwrr}}$	$\overline{y}_{\text{SRS}}$	$\overline{y}_{_{\mathrm{GWR}}}$	$\overline{\mathcal{Y}}_{ ext{ridge}}$	$\overline{\boldsymbol{\mathcal{Y}}}_{\mathrm{gwrr}}$	
90	0.20	-5.55	18.72	0.85	2.14	293.84	90.13	1.42	
180	0.21	-15.08	13.68	-0.80	1.51	199.22	55.31	0.91	
225	0.12	-14.26	11.33	-0.52	1.25	157.40	49.41	0.18	
270	0.08	-3.55	12.78	-0.06	1.09	129.07	46.60	0.07	
360	0.05	9.62	7.81	0.04	0.92	89.07	36.32	0.04	

CONCLUSION

In this study, an attempt has been made to develop a new GWRR estimator of finite population parameter nullifying the multicollinearity effect on the working GWR model. Ridge regression, a biased method of estimation is included in the GWR method to develop the new estimator. The simulation results show that our proposed estimator is more efficient than the other estimators, which shows the importance of considering spatial information in survey sampling. GWRR estimators can be expanded to other spatial models due to the importance of including spatial information in survey sampling. This study can further be expanded to some GWR non-linear models involving for more precise use of auxiliary information in survey sampling.

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Research Article

Employability of Postgraduate Scholars Studying in Agriculture Universities in Rajasthan

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ABSTRACT

In simple terms employability is about capability of getting and keeping fulfilling work. The study was carried out selecting a random sample of 180 postgraduate scholars studying in first and second year M.Sc. (Agri.) at Agriculture Universities in Rajasthan. The study reveals that a great majority (80.55%) of the postgraduate scholars studying in higher agriculture education had medium to high level of overall employability. The level of employability was observed higher among those postgraduate scholars, who had better academic performance, highly educated father and higher degree of library exposure.

Keywords: Agriculture, Employability, Higher agriculture education, Postgraduate scholar

INTRODUCTION

Employability refers to a person's capability of gaining initial employment, maintaining employment, and obtaining new employment if required (Hillage and Pollard, 1998). Employability depends on the knowledge, skills and abilities possessed by the job seekers, the way they use those assets and present them to the employers and the context in which they seek work. Skills such as solving problems, communicating effectively, working on a team, thinking critically, and possessing interpersonal skills are the employability skills most desired by employers. According to Fugate et al. (2004), an individual's employability includes a multitude of person-centered constructs that interactively fuse to assist individuals in successfully adapting to numerous work-related changes in the economy. From this perspective, employability is viewed as a psychosocial construct that embodies individual characteristic that foster adaptive cognition, behavior and affect, enhance the individual-work interface". An individual's employability therefore extends beyond knowledge and skills to include individual attributes and characteristics that make individuals valued assets to both prospective and current employer. Yorke (2006) accordingly defines employability as the skills, understandings and personal

attributes that make graduates more to obtain employment and be successful in their occupation to their own advantage, but also to the advantage of the labour force, the community and the economy. Auwal (2009) reported that graduates have perceived all items to be important to employability success in the teaching profession; they also felt that having experience and competence in the employability skills such as instruction, supervised agricultural experience, and computer skills was the influencing factor for their success. Until early 1990s, number of graduates and postgraduates produced by the agricultural education system was not large. With maximum absorption of graduates and postgraduates in government jobs, problem of unemployment was hardly an issue. Public sector was absorbing more than 50 per cent of the total stock of graduates and postgraduates. This situation has changed dramatically with the development effects of liberalisation and opening up of the economy becoming clearer and clearer. Currently, unemployment among graduates and postgraduates is so rampant that it can hardly go unnoticed or remain unattended. Youth unemployability also has been at an increasing rate in India. Majority of the employment opportunities in India require vocational skills, but our

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college and school output has only bookish knowledge. As a result of this, majority of the youth are unemployed due to deficiency in necessary employable skills (Sasidharan and Chauhan, 2015). The agricultural graduate and postgraduates should be enabled with some marketable professional abilities and employability skills to be successful and economic unit in the competitive technology driven world. Those specific attributes and skills that enable effective and wise use of knowledge, experience and formal education includes written communication viz: ability to express clearly in writing, verbal communication like expressing ideas clearly and confidently in speech, critical thinking skills, flexibility to successfully adapt changing situations and environment, persuading ability to convince others to discuss and reach agreement, teamwork for working confidently within a group, leadership quality to be able to motivate and direct others, planning and organizing capacity to be capable to plan activities and carry them through effectively, Considering above fact, there is an urgent need to evaluate existing level of employability to find out gap amongst the agricultural graduates in different State Agricultural Universities.

MATERIALS AND METHODS

An Ex-post-facto research design was used in the present study. The present study was conducted in Rajasthan which literally means "Land of kings". In Rajasthan agriculture institution was started in the year of independence, July 1947. At present Rajasthan state comprises of five Agricultural Universities, out of which three Agricultural Universities namely Swami Keshwanad Rajasthan Agriculture University, Bikaner, Maharana Pratap University of Agriculture and Technology, Udaipur & Sri Karan Narendra Agriculture University, Jobner were selected on the basis of post graduate programmes (M.Sc. in Agriculture) are running for more than 20 years in various disciplines. From the list so prepared, 60 post graduate scholars were selected from each identified college with the help of random selection technique. Thus, a total of 180 post graduate students were included in the sample of study.

RESULTS AND DISCUSSION

The ten components selected as indicators to measure employability of postgraduate scholars were fundamental employability aptitude, communication skills, habit of information collection, Information and Communication Technology skills, ability to face interviews, creativity skills in solving problems, leadership quality, self-confidence, competition orientation, and team work and coordination.

Overall employability was measured considering 10 major indicators. The 10 major components selected as indicators to measure overall employability of postgraduate scholars were fundamental employability aptitude, general knowledge about agriculture, knowledge about current issues, communication skills, Information Communication Technology skills, ability to face interviews, self-confidence, competition orientation, habit of information collection, attitude towards agriculture education, team work and coordination, creativity skills in solving problems and leadership quality. The results about overall employability have been presented in subsequent tables.

It is observed from Table 1 that a great majority of the postgraduate scholars (71.67%) of SKNAU, Jobner were with medium level of employability followed by 20.00 per cent of the postgraduate scholars of MPUAT, Udaipur and 31.66 per cent of the postgraduate scholars of SKRAU, Bikaner were with

Table 1. Distribution of pe	osigraduai	le scholars ac	column i	o then overall	rempioyai	JIIII (II-180))	
Level of overall employability	MPUAT Udaipur		SKNAU Jobner		SKRAU Bikaner		Total	
	f	%	f	0⁄0	f	0⁄0	f	%
Low (less than 307.98)	7	11.66	9	15.00	19	31.66	35	19.45
Medium (307.98-339.19)	41	68.34	43	71.67	30	50.00	114	63.33
High (Above 339.19)	12	20.00	8	13.33	11	18.34	31	17.22
Total	60	100	60	100	60	100	180	100

Table 1: Distribution of postgraduate scholars according to their overall employability (n=180)

f= frequency, %= per cent

high and low level of employability, respectively. The overall distribution of employability shows that a majority of the postgraduate scholars (63.33%) studying in Agriculture Universities of Rajasthan had medium level of overall employability, followed by 19.45 per cent of them had low level of overall employability and the rest 17.22 per cent of them had high level of overall employability.

The structure of the academic syllabus in the period of investigation had been change by the University authority. The current syllabus gives priority to practical classes, assignments and examination. This new development in the University might be a major contributing factor to the result of having medium to high level of overall employability among 80.55 per cent of the postgraduate scholars of Agriculture Universities of Rajasthan.

This result was similar with the views expressed by Prasanna *et al.* (2022) revealed that three-fourth (75.00%) of the postgraduates had high to medium level of overall employability and also similar with the findings Omede and Kanani (2015) and Devi *et al.* (2019).

To find out the overall employability of postgraduate scholars total ten major statements were considered in the scale. For this, the Mean Percent Score (MPS) for each statement was calculated and ranked accordingly. The results are presented in Table 2.

A perusal of data presented in Table 2 reveals that "Creativity Skills in Solving Problems" was expressed as most important aspect in the overall employability with the extent of 87.24 per cent and it was ranked first by the respondents. This was followed by the statements namely "Information Communication Technology Skills", "Leadership Quality", "Ability to face interviews", "Team work and Coordination" and "Fundamental employability aptitude" with 85.51, 83.20, 81.12, 80.35 and 80.28 per cent and ranked second, third, fourth, fifth, and sixth, respectively by the postgraduate scholars. Table 2 further shows that majority of the postgraduate scholars agreed with the statements namely "Habit of Information Collection", "Competition Orientation", "Communication Skills" and "Self Confidence" with 79.09, 78.33, 77.85 and 68.07 per cent and ranked seventh, eighth, ninth and tenth, respectively.

To find out the variation or similarity in the overall employability of the postgraduate scholars, Analysis of Variance-Oneway test was carried out and results were presented in the Table 3.

 NH_{ot} : There is no significant difference among the postgraduate scholars with respect to their overall employability.

 RH_{i} : There is a significant difference among the postgraduate scholars with respect to their overall employability.

Aspect-wise overall employability	MF Ud	PUAT aipur	SKNAU Jobner		SKRAU Bikaner		Total	
	MPS	Rank	MPS	Rank	MPS	Rank	MPS	Rank
Fundamental employability aptitude	82.30	4	79.03	6	79.53	5	80.28	6
Communication Skills	79.08	9	77.68	9	76.79	9	77.85	9
Habit of Information Collection	81.59	6	77.70	8	77.98	7	79.09	7
Information Communication Technology Skills	85.47	2	86.15	2	84.91	2	85.51	2
Ability to face interviews	81.91	5	81.31	4	80.15	4	81.12	4
Creativity Skills in Solving Problems	87.38	1	87.72	1	86.61	1	87.24	1
Leadership Quality	82.73	3	82.22	3	84.67	3	83.20	3
Self Confidence	68.94	10	67.83	10	67.44	10	68.07	10
Competition Orientation	79.72	8	78.05	7	77.22	8	78.33	8
Team work and Coordination	81.33	7	80.56	5	79.16	6	80.35	5

Table 2: Aspect wise overall employability among the respondents (n=180)

MPS = Mean Percent Score

Source of variation	SS	df	MS	F value	F critical value
Between Group	165.2411	2	82.62056	0.845 ^{NS}	3.000
Within Group	175592.9	1797	97.71448		
Total	175758.2	1799			
Within Group Total	175592.9 175758.2	1797 1799	97.71448		

Table 3: Comparison of overall employability among the postgraduate scholars

NS = Non-Significant

Data presented in Table 3 show that calculated F value was 0.845 found to be less than the tabulated value which is statistically non-significant at 5 per cent level of significance. Thus, the null hypothesis (NH₀₁) "there is no significant difference among the postgraduate scholars with respect to overall employability" was accepted and research hypothesis (RH₄) was rejected. It infers that there was no significant difference among postgraduate scholars of MPUAT, Udaipur, SKNAU, Jobner and SKRAU, Bikaner with regard to their overall employability. The non significant difference may be due to similar nature and homogeneous of the respondents they possess similar point of view about theses aspects. The present findings are supported the view expressed by Mishra and Sharma (2020) who indicated that there is no significant difference among the postgraduate scholars with respect to their attitude towards e-resources.

CONCLUSION

The present study was examining employability of the postgraduate scholars studying in higher agriculture education. It was noted that most of the postgraduate scholars studying in higher agriculture education had medium level of overall employability. Thus, it can be concluded that a vast majority (80.55%) of the postgraduate scholars associated with their overall employability was medium to high level in the study area. It was also found that there was no significant difference among postgraduate scholars of MPUAT, Udaipur, SKNAU, Jobner and SKRAU, Bikaner with regard to their overall employability.

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Research Article

Effect of Vermicompost, FYM, Poultry Manure and Bio-fertilizers on Yield and Economics in Amaranth

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ABSTRACT

A field experiment was conducted to assess the impact of vermicompost, FYM, poultry manure and bio fertilizers on yield and economics in amaranth. The experiment was laid out in a randomized block design (RBD) which consisted of eleven treatments replicated thrice. Among the treatments T_8 recorded maximum plant height (28.24, 52.14 and 55.84 cm) at 30 DAS (days after sowing), 45 DAS and at harvest, respectively. Maximum number of leaves (26.88), fresh weight (1.19g) as well as dry weight (0.25 g) of individual leaf was observed in the treatment T_8 . The same treatment showed maximum fresh weight of leaves (32 g/ plant), plant weight (88 g/plant) and leaf yield (2.86 kg/plot and 71.6 q/ha) at harvest. The highest benefit-cost ratio (3.1) was exhibited by the treatments T_9 and T_{10} due to lower price of FYM and poultry manure as compared to the price of vermicompost used in the treatment T_8 .

Keywords: Amaranth, Vermicompost, FYM, Poultry manure, Fruit yield, Economics

INTRODUCTION

Amaranth is widely cultivated green vegetable throughout the summer and rainy season in India. It is an important leafy vegetable and a good source of protein, minerals vitamin A and vitamin C. Based on the colour of the leaves, there are two types of amaranth viz., green leaf and red leaf. Amaranthus tricolour, Amaranthus dubius and Amaranthus blitum are the three most popular types of amaranth in India. One of the most vital factors for increasing the production as well as the quality of leaves is the condition of the soil. The physical, chemical and biological conditions of the soil must be ideal. The microbial community of the soil was positively influenced by organic fertilizers, which increased the soil's biomass, carbon, nitrogen content and dehydrogenase enzyme activity. Due to increased price of inorganic fertilizers the use of local resources such as farmyard manure, vermicompost, chicken manure, etc. are very much essential to make up the shortage. The use of organic manures not only supports crop yields but also significantly enhances the physical, chemical and

biological qualities of soil as well as boosts the effectiveness of fertilizers. Vermicompost enhances the physical properties by reducing the bulk density of soil and it also increases the water holding capacity of soil (Ravimycin, 2016). Well-decomposed FYM and vermicompost alone or in conjunction with biofertilizers aid in supplying the right amount of nutrients and preserve the health of the soil. It provides all of the necessary plant nutrients, which enhance the physical and chemical characteristics, increase water holding capacity and promote microbial activity in the soil. Poultry manures are extremely nutrient-rich organic manure and N, P, K content are 0.5-0.9, 0.4-0.5 and 1.2-1.7 per cent, respectively (Adekiya et al., 2019). Biofertilizers increase soil productivity by fixing atmospheric nitrogen or by solubilizing soil phosphate and boost plant growth by creating growth-promoting substances. Considering the importance of organic nutrients, the present investigation was carried out to study the impact of vermicompost, FYM, poultry manure and bio fertilizers on yield and economics in amaranth.



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MATERIALS AND METHODS

The experiment was conducted in a randomized block design (RBD) consisting of eleven number of treatments in three replications. The variety CO₃ was taken for the investigation. The treatments used in the experiment were T₁: RDF (60:30:20 kg NPK/ha), T₂: Vermicompost @ 2 t/ha, T₃: Vermicompost @ 5 t/ ha, T₄: FYM 10 t/ha, T₅: FYM 20 t/ha, T₆: Poultry manure 3 t/ha, T₂: Poultry manure 5 t/ha, T₂: Vermicompost @ 2 t/ha+ PSB+ Azospirillum @ 5 kg/ha each, T_o: FYM @ 10 t/ha+ PSB+ Azospirillum @ 5 kg/ha each, T₁₀: Poultry manure 3 t/ha+ PSB+ Azospirillum @ 5 kg/ha each and T_{11} : Untreated control. The experimental area was ploughed and exposed to direct sunshine for a short period of time. The area was then carefully leveled and harrowed to a fine tilth. The plot was divided into equal plots, each having a size of 4 sqm and each plot was separated by 50 cm.

After proper land preparation, biofertilizers were applied to the individual plots according to the treatments three days prior to sowing. In a similar manner, according to the treatment schedule, vermicompost, FYM and poultry manure were also applied to the plots. The organic manures and biofertilizers were carefully mixed into the soil. Seeds were sown in well-prepared land. At the time of sowing, seeds were mixed with fine sand for even distribution of the seeds as the seed size is very small. The seeds were sown at 1 cm depth by line sowing method and covered uniformly with thin layer of soil. For recording the observations on morphological traits five healthy plants were chosen at random in each plot and tagged properly. Excess seedlings were thinned off after the seedlings were well-established to maintain a proper spacing of 10 cm between plants. Morphological characters viz., plant height, plant width, leaves per plant at harvest, fresh weight of individual leaf at harvest, dry weight of individual leaf at harvest, fresh weight of leaf per plant at harvest, fresh weight of stem per plant at harvest, days to harvest, plant weight at harvest, stem girth, leaf to stem ratio, leaf yield, stem yield, crop yield were recorded.

RESULTS AND DISCUSSION

The mean performance of the amaranth variety CO_3 was tested by using eleven treatment combinations and significant differences were found in various growth and yield attributing characters under different treatment combinations. The mean values were presented character wise (Table 1).

The treatment T_8 recorded the highest plant height (28.24, 52.14 and 55.84 cm) at 30 DAS, 45 DAS and at harvest, respectively among the different organic treatment combinations. The treatment T_{11} (Control) showed the lowest (17.51, 31.09 and 35.17 cm) plant height at 30 DAS, 45 DAS and at harvest, respectively.

$\frac{\text{Treatments}}{T_1}$	Р	lant height (ci	m)		Plant w	idth (cm)	No. of leaves	
	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	At harvest	
T ₁	26.12	46.68	53.89	22.16	23.51	25.93	31.26	
T_2	22.46	39.89	47.69	17.34	19.51	21.73	19.01	
T ₃	22.92	41.26	50.22	20.73	22.18	23.94	21.34	
T_4	22.14	39.28	47.48	15.08	17.01	19.01	17.68	
T ₅	22.89	40.25	47.98	18.15	20.18	21.68	19.14	
T ₆	20.35	38.15	42.84	13.89	15.76	18.05	16.59	
T ₇	21.25	38.26	43.96	13.95	15.84	18.38	17.11	
T ₈	28.24	52.14	55.84	22.21	24.76	26.55	26.88	
T ₉	24.03	44.12	51.98	19.29	21.06	23.18	23.11	
T ₁₀	23.34	41.84	50.82	18.51	21.26	22.59	22.11	
T ₁₁	17.51	31.09	35.17	12.92	14.84	14.84	11.68	
SEd (±)	0.67	0.79	0.84	0.55	0.64	0.80	0.55	
CD (0.05)	1.42	1.68	1.77	1.15	1.34	1.69	1.16	

Table 1: Effect of vermicompost, FYM, poultry manure and bio fertilizers on growth and yield of amaranth

Treatments	Fresh weight of individual leaf (g)	Dry weight of individual leaf (g)	Days to harvest	Fresh weight of leaves (g/plant)	Fresh weight of stem (g/plant)	Plant weight (g)	Stem girth (cm)	Leaf to stem ratio
$\overline{T_1}$	1.19	0.24	52	32	53	84.7	2.5	0.60
T_2	1.10	0.17	53	21	42	62.7	1.9	0.49
T ₃	1.13	0.21	55	24	52	75.7	2.2	0.46
T ₄	1.07	0.16	53	19	35	53.4	1.9	0.54
T ₅	1.11	0.19	54	21	53	74.0	2.1	0.40
T ₆	0.92	0.16	56	15	38	52.9	1.8	0.40
T ₇	0.92	0.17	52	16	40	55.6	1.8	0.39
T ₈	1.19	0.25	52	32	56	88.0	2.6	0.57
T ₉	1.17	0.23	54	27	56	82.4	2.3	0.48
T ₁₀	1.13	0.21	55	25	57	81.6	2.2	0.44
T ₁₁	0.66	0.11	53	11	32	43.1	1.7	0.35
SEd (±)	0.05	0.02	0.6	1	1	1.5	0.3	0.02
CD (0.05)	0.09	0.04	1	2	2	3.2	0.5	0.04

Table 1 (Contd.): Effect of vermicompost, FYM, poultry manure and bio fertilizers on growth and yield of amaranth

Table 1 (Contd): Effect of vermicompost, FYM, poultry manure and bio fertilizers on growth and yield of amaranth

Treatments	Numbers of branches per plant	Leaf yield (kg/ plot)	Stem yield (kg/plot)	Crop yield (kg/plot)	Total leaf yield (q/ha)	Total stem yield (q/ha)	Total crop yield (q/ha)
T ₁	7.2	2.85	4.77	7.62	71.3	119.3	190.5
T ₂	5.7	1.86	3.78	5.64	46.6	94.4	141.0
Τ ₃	6.2	2.16	4.66	6.81	53.9	116.4	170.3
T ₄	5.7	1.69	3.12	4.80	42.2	78.0	120.1
T ₅	6.1	1.89	4.77	6.66	47.4	119.3	166.6
T ₆	4.8	1.35	3.41	4.76	33.8	85.1	119.0
T ₇	5.0	1.40	3.60	5.00	35.0	90.0	125.0
T ₈	7.5	2.86	5.06	7.92	71.6	126.4	198.0
T ₉	6.7	2.42	5.00	7.41	60.5	124.9	185.4
T ₁₀	6.3	2.23	5.12	7.34	55.7	127.9	183.6
T ₁₁	4.4	1.01	1.95	2.97	25.4	48.8	74.2
SEd (±)	0.4	0.07	0.10	0.14	0.2	0.3	0.4
CD (0.05)	0.9	0.16	0.21	0.29	0.4	0.5	0.7

It might be due to the biofertilizers which help the microorganisms for faster decomposition of organic matter available in the soil, thereby increasing the availability of nutrients and ultimately in higher plant growth. Similar findings were reported by Chaudhary *et al.* (2018) in amaranth. PSB encourages vegetative growth through active cell division and elongation which may be the cause of the height increase.

The treatment T_8 recorded the maximum plant width with values 22.21, 24.76 and 26.55 cm at 30 DAS, 45 DAS and at harvest, respectively. It might be due to the action of beneficial and more readily accessible microorganisms. When organic nutrients and biofertilizers were applied together, the growth characteristics were also improved. This improvement is likely attributable to a balanced C:N ratio, better organic matter buildup, effective microbial activity, better root proliferation, abundance of nutrients in the soil and increased nutrient translocation to the plant's aerial parts for the synthesis of protoplasmic proteins and other compounds. The findings were in agreement with the findings of Rather *et al.* (2018) in lettuce.

The highest (26.88) number of leaves was observed in the treatment T_8 at harvest. This increase in the number of leaves might be due to enhanced uptake of nitrogen and other nutrients which in turn increased the vegetative growth of the crop. There might be larger amount of nutrients being introduced to the soil and being absorbed by the plant, which would cause the plant to produce more leaves per plant (Kumar *et al.*, 2017).

Maximum fresh weight and dry weight of individual leaf were exhibited by T_8 at the time of harvest with values 1.19 g and 0.25 g, respectively. Fresh weight of individual leaf of the treatments T_3 (1.13g), T_9 (1.17 g) and T_{10} (1.13 g) were statistically at par with T_8 . It might be due to role of biofertilizers in enhancing the nutrient availability for uptake, which in turn enhanced plant vegetative growth. Organic nutrients help to produce phytohormones, which in turn might have boost plant growth and nutrient absorption. Similar findings were reported by Shedeed *et al.* (2014) in onion. Maximum (56 days) number of days to harvest was observed in the treatment T_6 .

The highest (32g) fresh weight of leaves per plant was observed in the treatment T_{s} . The treatment T_{10} exhibited significantly the highest (57g) mean performance for fresh weight of stem at harvest. The mean values of treatments T₈ and T₉ with a value of 56g were at par with the value of the treatment T_{10} . Among the different organic treatment combinations the treatment T_o showed significantly the highest (88.0g) mean performance for plant weight at harvest. This might be due to optimum amount of micronutrients viz., zinc, iron, copper, manganese obtained through the use of organic fertilizers as well as biofertilizers in the soil. Micronutrient such as Zn plays an important role in the synthesis of auxin and auxin have important role in plant growth, development, cell division, cell elongation and cell differentiation. Iron is an essential component of various enzymes and pigments and helps in energy production inside the plant cell. It is also essential for chlorophyll formation and thereby assists in photosynthesis. The weight of plant might be increased in the treatment T_8 due to supply of such crucial micronutrients during the early stages of crop growth through vermicompost and biofertilizers. Similar results were also reported by Baliah *et al.* (2017) in okra.

The treatment T_8 exhibited the highest (2.6 cm) mean performance for stem girth at harvest which might be due to better utilization of NPK by the plants, resulting in better growth. The results were in agreement with the findings of Singh and Mohan (2007) in pointed gourd and Sharma et al. (2010) in okra. Vermicompost might have increased stem girth because it has more available nitrogen, which is necessary for the production of structural proteins. Among the different organic treatments T₈ recorded maximum (0.57) mean performance for leaf to stem ratio at harvest. It might be due to role of bio-fertilizers on increasing the availability of nutrients for absorption by the plant which in turn increased the vegetative growth of the plants. Organic nutrients activate many species of living organisms which release phytohormones and may stimulate the plant growth and the absorption of nutrients.

Among the different organic treatments T_8 recorded maximum (0.57) mean performance for leaf to stem ratio at harvest and it was at par with the value of T_1 . The treatment T_{11} (control) showed minimum mean performance for leaf to stem ratio at harvest with a value of 0.35.

The treatment T_8 exhibited the highest mean performance for number of branches per plant with a value of (7.5). The ability of *Azospirillum* to fix atmospheric N might had contributed to the increase in vegetative growth by raising the proportion of mineral nutrients in the soil and in turn helped to produce more number of branches. The similar findings were also reported by Sarhan *et al.* (2011) in summer squash.

The treatment T_8 recorded the highest (2.86 kg) mean performance for leaf yield per plot while the treatment T_{10} recorded the highest mean performance for stem yield with a value of 5.12 kg per plot. The mean values of treatments T_8 (5.06 kg/plot) and T_9

Treatments	Total Cost (Rs/ha)	Yield (t/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	Benefit : Cost ratio
	59329.00	19.05	285750.00	226421.00	3.8
T,	74500.00	14.10	211523.00	137023.00	1.8
T ₃	104500.00	17.03	255502.00	151002.00	1.4
T ₄	67000.00	12.01	180180.00	113180.00	1.7
T ₅	79500.00	16.66	249899.00	170399.00	2.1
T ₆	66500.00	11.89	178419.00	111919.00	1.7
T ₇	74500.00	12.50	187533.00	113033.00	1.5
T_8	75500.00	19.80	296960.00	221460.00	2.9
T_9	68000.00	18.53	278020.00	210020.00	3.1
T_{10}^{-}	67500.00	18.36	275356.00	207856.00	3.1
T_{11}	54000.00	7.42	111300.00	57300.00	1.1

Table 2: Effect of vermicompost, FYM, poultry manure and bio fertilizers on economics of amaranth

Sale price Rs.15/kg

(5.00 kg/plot) were at par with the value of the treatment T_{10} . The treatment T_8 recorded the highest (71.6 q/ha) mean performance for total leaf yield and the treatment T_{10} recorded the highest (127.9 q/ha) mean performance for total stem yield. The treatment T₈ recorded the highest mean performance for total crop yield with a value of 198.0q/ha. This might be due to more nutrient availability and uptake throughout the growing period. Higher yield may have been aided by improved vegetative growth, a balanced C: N ratio and the direct or indirect control of several physiological processes within the plants by co-enzymes. These might have facilitated more root development, better nutrient uptake and faster carbohydrate synthesis which ultimately improved leaf production. Similar findings were reported by Stancheva and Mithova (2002) in lettuce. The increased yield in the treatment T_o might be due to use of vermicompost which provided both major and minor nutrients, boosted the amount of auxin and nitrogen as well as the photosynthetic activity and chlorophyll production in the plants (Dhaker et al., 2017).

The highest net return (Rs. 226421.00) was obtained in the treatment T_1 (RDF: 60:30:20 kg NPK/ha) with a benefit-cost ratio of 3.8. Among the different organic treatment combinations, the treatment T_8 (Vermicompost @ 2 t/ha +PSB + *Azospirillum* @ 5 kg/ha each) exhibited the highest (Rs.221460.00) net return with a benefit-cost ratio of 2.9, however, the maximum benefit-cost ratio 3.1 was observed in the treatments T_9 and T_{10} with net returns of Rs. 210020.00 and 207856.00 respectively, due to lower cost of FYM and poultry manure as compared to vermicompost used in the treatment T_8 (Table 2).

CONCLUSION

The present investigation showed that among the organic treatments, the treatment T_8 recorded maximum plant height, plant width, number of leaves, fresh weight as well as dry weight of individual leaf. The same treatment showed the highest leaf yield (2.86 kg/plot and 71.6 q/ha) at harvest among the various treatments. However, the maximum benefit-cost ratio (3.1) was exhibited by the treatments T_9 and T_{10} due to lower price of FYM and poultry manure as compared to the price of vermicompost used in the treatment T_8 .

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Research Article

A Study on Prevalence of Hand Discomfort Among the Gardeners

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ABSTRACT

Hand discomfort is the most common problem among professional gardeners in their day-to-day gardening activities. Due to the faulty tools used, adopting awkward working posture, repetitive and forceful motions it leads to injuries and discomfort in their hands which also affects their work performance. As hand tools are considered to be an important part of gardeners' occupation, the present study was therefore intended to study the comfort level of gardeners while using various gardening tools and to assess the hand discomfort prevalent among the gardeners. A total sample of 150 male gardeners were selected from educational institutions, community garden and nurseries of Ludhiana city. A self structured interview schedule was developed to study the comfort level of gardeners while using various tools and Cornell Hand Discomfort questionnaire was used to assess the prevalence of hand discomfort among the gardeners. Findings of the study unveiled that comfort level of majority of the respondents while using the gardening hand tools was found to be from moderate to low comfort. There are some tools which they felt were uncomfortable to use because there was increase in pain and discomfort in hands after using these tools. Further, the result of the Cornell Hand Discomfort questionnaire revealed that majority of the respondents experienced slight to moderate level of pain and discomfort in the different hand regions and it interfered in their performance of work. Further, the overall hand discomfort score was recorded maximum in right hand as compared to left hand as right hand is dominant hand for all the gardeners. The frequent movement of hands and prolonged use of improper hand tools without any safety gloves cause hand discomfort which eventually affects their work performance.

Keywords: Hand tools, Discomfort, Comfort level, Gardener, Prevalence

INTRODUCTION

Hand tools are an imperative to gardeners' profession, as majority of the gardening activities are done using hand tools. Tools such as hoe, trowel, spade, shovel, sickle (Chang *et al.*, 1999) secateur, sword, rake are regularly used by gardeners in their work. This is often accompanied by discomfort in their hand (Kuijt and Lottie, 2009) and forearm region. Moreover, the hand tools which have rough handle or are poorly designed stimulate hand discomfort.

In particular, manual work with repetitive movements is the sign that workers are susceptible to high muscular discomfort in the hand and forearm

MATERIALS AND METHODS

The study was conducted in two educational institutes, one community garden and eight nurseries of Ludhiana city. A total sample of 150 male gardeners were selected purposively who were fully engaged and have worked for five years in gardening sector. A self constructed interview schedule was used to collect the

region. Repetitive strain injuries are mostly associated with paramount of forearm muscle strain and poor wrist posture (Armstrong *et al.*, 1982; Silverstein *et al.*, 1986; Silverstein *et al.*, 1987). This eventually reduce their work performance and develop musculoskeletal discomfort and pain.

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primary data about the comfort level of respondents while using various gardening tools. Further, their responses were recorded based on 4-point scale (Scoring: High-4, Moderate-3, Low-2, Very low-1). In addition, to assess the hand discomfort prevalent among the gardeners Cornell Hand questionnaire was used. (CHDQ have been developed by Dr. Alan Hedge (1999) and ergonomics graduate students at Cornell University). Data collected were tabulated and statistically analyzed by using frequency, percentage and mean scores.

RESULTS AND DISCUSSION

The data in Table 1 depict the comfort level of workers using garden tools. The tools mostly used were hand tools and power tools. The results indicated that the comfort level of hand tools was found to be moderate for hedge cutter (mean score=3.26) followed by hosepipe (mean score=3.17), spade fork (mean score= 2.94), hand trowel (mean score=2.92), spade (mean score=2.90), secateur (mean score=2.83), sickle (mean score=2.77), shovel (mean score=2.75) and spray backpack (mean score= 2.51). Whereas, respondents were at low comfort level with some of the hand tools such as sword (mean score= 2.41) followed by watering can (mean score= 1.85) and knife (mean score=1.63). Also, the respondents felt moderately comfortable while using power tools- petrol mower (mean score= 3.13) followed by tractor mower (mean score= 3.05) and electric mower (mean score= 2.74). In overall, the result shows that respondents felt moderate to low comfort while using most of the gardening tools.

Cornell hand discomfort questionnaire was used to calculate the hand discomfort of the respondents performing various gardening activities. The hand was divided into 6 region- Area A (Index, middle finger), Area B (Ring finger and pinkie), Area C (Thumb), Area D (Metacarpal area), Area E (Thumb base) and Area F (Wrist) for the present study. The assessment of hand discomfort seeks out on the following-

On the basis of duration of pain or discomfort: For assessing the duration of pain, the survey sheet

Gardening tools	Frequency			Comfort level		
used	(%)	High	Moderate	Low	Very low	Mean± SD
Hand tools						
Spade	82(54.70)	11(13.41)	52(63.42)	19(23.17)	-	2.90 ± 0.60
Shovel	65(43.30)	7(10.77)	35(53.85)	23(35.38)	-	2.75 ± 0.63
Spade fork	71(47.30)	11(15.49)	45(63.38)	15(21.13)	-	2.94±0.60
Hand trowel	150(100.00)	30(20.00)	82(54.67)	34(22.67)	4(2.66)	2.92 ± 0.72
Secateurs	144(96.00)	37(25.69)	53(36.81)	47(32.64)	7(4.86)	2.83 ± 0.86
Knife	47(31.30)	-	5(10.64)	20(42.55)	22(46.81)	1.63 ± 0.67
Hedge Cutter	141(94.00)	57(40.43)	64(45.39)	20(14.18)	-	3.26±0.69
Sword	53(35.33)	4(7.55)	20(37.74)	23(43.39)	6(11.32)	2.41 ± 0.79
Sickle	76(50.66)	13(17.11)	33(43.42)	30(39.47)	-	2.77 ± 0.72
Hose pipe	150(100.00)	57(38.00)	62(41.33)	31(20.67)	-	3.17±0.74
Watering can	101(67.30)	-	29(28.71)	28(27.72)	44(43.57)	1.85 ± 0.84
Spray backpack	141(94.00)	15(10.64)	56(39.72)	57(40.43)	13(9.21)	2.51 ± 0.80
Power tool						
Electric mower	105(70.00)	21(20.00)	37(35.24)	46(43.81)	1(0.95)	2.74 ± 0.78
Petrol mower	29(19.30)	4(13.79)	25(86.21)	-	-	3.13±0.35
Tractor mower	58(38.70)	15(25.86)	31(53.45)	12(20.69)	-	3.05 ± 0.68

Table 1: Tools used by the respondents and their comfort level while gardening (n=150)

Note: Figures in parentheses indicate percentage

Multiple response

Score: High-4, Moderate-3, Low-2, Very low-1

was divided into 5 category- first category indicates that the respondents never felt the pain in their hand. Second category, indicates that in 1-2 times last week respondents felt discomfort. Third category, denotes the duration of pain 3-4 times in last week. In fourth category, respondents felt the pain once every day. In last category, the pain felt by the respondents several times in a day.

Results in Table 2 reveals that more than half of the respondents (56.67%) felt pain for a duration of 1-2 times in last week in ring and pinkie finger region (Area B), followed by thumb region (Area C) (48.00%), index and middle finger region (Area A) (47.33%). In thumb base region (Area E) 40.67 per cent of respondents showed discomfort for a duration of 1-2 times in last week. Whereas, less proportion of respondents (28.67%) felt pain in wrist region (Area F) while a greater proportion of respondents showed discomfort in wrist region for a duration of 3-4 times in last week. 34.67 per cent, 31.33 per cent and 26.67 per cent of respondents experienced pain in metacarpal region (Area D), thumb base region (Area E) and thumb region (Area C) respectively. Whereas, around one fourth of the respondents (25.30%) felt pain in index and middle finger region (Area A) for a duration of 3-4 times in last week. In wrist region (Area F) 22.67 per cent of the respondents felt pain once in a

day followed by metacarpal region (Area D) (20.66%), thumb base region (Area E) (19.33%) and index and middle finger region (Area A) (19.33%). As compared to other duration least proportion of respondents felt pain several times in a day.

For left hand, major proportion (69.34%) of respondents experienced the pain in ring and pinkie finger region followed by thumb region (68.00%) and metacarpal region (66.67%) for duration of 1-2 times in last week. For duration of 3-4 times in last week greater proportion of respondents (31.33%) experienced pain in wrist region followed by thumb base region (21.33%) and thumb region (19.33%). While for the frequency of pain in everyday 16.00 per cent of the respondents felt pain in wrist region and 13.33 per cent showed discomfort in metacarpal region, followed by index and middle finger region (11.33%) and thumb base region (10.00%). Likewise, as right hand in left hand also least proportion of respondents showed pain several times in a day. In nutshell, proportionately most number of respondents experienced pain in finger region, thumb region and wrist region of both the hands.

On the basis of level of pain: Assessment of discomfort was studied for three different levels such as slightly discomfort, moderate discomfort and high discomfort. For right hand, results in Table 3 shows

Discomfort]	Right hand	d				Left hand		
highlighted with shaded area in diagrams shown below	Never	1-2 times last week	3-4 times last week	Once every day	Several times in a day	Never	1-2 times last week	3-4 times last week	Once every day	Several times in a day
Shaded Area A	9(6.00)	71(47.33)	38(25.34)	29(19.33)	3(2.00)	11(7.33)	97(64.67)	25(16.67)	17(11.33)	-
Shaded Area B	8(5.33)	85(56.67)	36(24.00)	19(12.67)	2(1.33)	9(6.00)	104(69.34)	23(15.33)	14(9.33)	-
Shaded Area C	6(4.00)	72(48.00)	40(26.67)	27(18.00)	5(3.33)	6(4.00)	102(68.00)	29(19.33)	11(7.34)	2(1.33)
Shaded Area D	4(2.67)	55(36.67)	52(34.67)	31(20.66)	8(5.33)	4(2.67)	100(66.67)	22(14.66)	20(13.33)	4(2.67)
Shaded Area E	7(4.67)	61(40.67)	47(31.33)	29(19.33)	6(4.00)	8(5.34)	93(62.00)	32(21.33)	15(10.00)	2(1.33)
Shaded Area F	5(3.33)	43(28.67)	59(39.33)	34(22.67)	9(6.00)	6(4.00)	67(44.67)	47(31.33)	24(16.00)	6(4.00)

Table 2: Assessment of pain/discomfort experienced in right hand and left hand by the respondents (n=150)

Note: Figures in parentheses indicate percentage

Feeling of		Right hand				Left hand			
discomfort	Total	SD	MD	HD	Total	SD	MD	HD	
	Sample	e			Sample				
Shaded Area A	n 141(100.0	00) 87(61.70)	37(26.24)	17(12.06)	139(100.00)	92(66.19)	47(33.81)	-	
Shaded Area B	142(100.0	00) 97(68.31)	31(21.83)	14(9.86)	141(100.00)	102(72.34)	39(27.66)	-	
Shaded Area C	144(100.0	00) 72(50.00)	45(31.25)	27(18.75)	144(100.00)	90(62.50)	54(37.50)	-	
Shaded Area D	146(100.0	00) 64(43.83)	49(33.57)	33(22.60)	146(100.00)	84(57.53)	41(28.08)	21(14.39)	
Shaded Area E	143(100.0	00) 68(47.55)	35(24.48)	40(27.97)	142(100.00)	90(63.38)	37(26.05)	15(10.57)	
Shaded Area F	145(100.0	00) 47(32.42)	51(35.17)	47(32.41)	144(100.00)	73(50.69)	42(29.17)	29(20.14)	

Table 3: Assessment of level of pain/discomfort in right hand and left hand by the respondents (n=150)

Note: Figures in parentheses indicate percentage

SD- Slight discomfort, MD- Moderate discomfort, HD= High discomfort

that major proportion of respondents (68.31%) perceived slight discomfort in ring and pinkie finger region followed by index and middle finger (61.70%), thumb region (50.00%) and thumb base (47.55%). In wrist region 35.17 per cent of respondents experienced moderate discomfort. Near about one third of the respondents (33.57%) showed moderate discomfort at metacarpal region similarly, 31.25 per cent, 26.24 per cent, 24.48 per cent of the respondents showed moderate discomfort in thumb, index and middle finger and thumb base region respectively. As compared to slight and moderate discomfort less number of respondents perceived high discomfort in right hand region.

For left hand, major proportion of respondents (72.34%) perceived slight discomfort in ring and pinkie region followed by index and middle finger (66.19%), thumb base (63.38%) and thumb region (62.50%). In thumb region 37.50 per cent of the respondents felt moderate discomfort followed by index and middle finger (33.81%), wrist region (29.17%), metacarpal (28.08%) and ring and pinkie finger region (27.66%). No respondents perceived high discomfort in index and middle finger, ring and pinkie finger and thumb region. Whereas less proportion of respondents felt high discomfort in metacarpal (14.39%), thumb (10.57%) and wrist region (20.14%). So, it can be concluded from the above results that most of the respondents perceived slight and moderate discomfort.

in both the hands due to various gardening activities performed by them.

On the basis of interference in work: The discomfort felt in hand region causes interference in the work of the respondents. Interference level are categorized as- not at all, slightly interfered and substantially interfered. The results are presented and discussed in Table 4. Majority of the respondents (95.74%) felt slight interference in ability to work due to the pain in index and middle finger region. Maximum percentage of the respondents (93.83%) also showed slight interference in metacarpal region followed by thumb region (90.97%), ring and pinkie finger (90.14%) and wrist region (88.27%). Whereas, only few respondents experienced substantial interference in ability to work due to pain in right hand. For left hand, maximum number of respondents (96.52%) felt slight interference in ability to work due to pain in wrist region followed by thumb base region (92.95%), index and middle finger region (92.80%) and metacarpal region (91.90%). As for the right hand similar results was observed for left hand also where a few respondents felt substantial interference in ability to work due to pain. Thus, it can be concluded that discomfort in finger, thumb and wrist region of both the hand slightly interfered in the performance of gardening activities.

Overall discomfort score: With the help of Cornell hand discomfort survey, the total discomfort score was

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Interfere with your		Right	hand			Lef	t hand	
ability to work	Total sample	Not at all	Slightly interfered	Substantially interfered	Total sample	Not at all	Slightly interfered	Substantially interfered
Shaded Area A	141(100.00)	6(4.26)	135(95.74)	-	139(100.00)	10(7.19)	129(92.81)	-
Shaded Area B	142(100.00)	14(9.86)	128(90.14)	-	141(100.00)	17(12.06)	124(87.94)	-
Shaded Area C	144(100.00)	4(2.78)	131(90.97)	9(6.25)	144(100.00)	12(8.33)	126(87.50)	6(4.17)
Shaded Area D 🦞	146(100.00)	3(2.05)	137(93.84)	6(4.11)	146(100.00)	11(7.53)	133(91.10)	2(1.37)
Shaded Area E	143(100.00)	6(4.20)	126(88.11)	11(7.69)	142(100.00)	6(4.22)	132(92.96)	4(2.82)
Shaded Area F	145(100.00)	2(1.38)	128(88.28)	15(10.34)	144(100.00)	4(2.78)	139(96.53)	1(0.69)

Table 4: Assessment of level of interference in ability to work due to pain/discomfort in right hand and left hand by the respondents (n=150)

Note: Figures in parentheses indicate percentage

Table 5: Discomfort score using	Cornell Hand Discomfort	(CHDs) o	questionnaire ((n=150)
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Hand discomfort		Frequency of discomfort score	Severity of discomfort score	Interference in productivity score	Total discomfort score	Percentage of discomfort score
Shaded Area A (Right Hand)	N.	414.5	212	276	24253224	8.39
Shaded Area A (Left Hand)	n .	318	159	243	12286566	4.25
Shaded Area B (Right Hand)	N	368.5	201	270	19998495	6.92
Shaded Area B (Left Hand)	MA	306.5	153	241	11301574.5	3.91
Shaded Area C (Right Hand)		433	243	293	30829167	10.67
Shaded Area C (Left Hand)		329.5	169	254	14144117	4.89
Shaded Area D (Right Hand)		499.5	261	295	38459002.5	13.31
Shaded Area D (Left Hand)		367	185	271	18399545	6.37
Shaded Area E (Right Hand)		461	258	291	34610958	11.98
Shaded Area E (Left Hand)		346.5	177	258	15823269	5.47
Shaded Area F (Right Hand)	ALL STREET	531	290	303	46658970	16.15
Shaded Area F (Left Hand)	ALA	445	179	276	21984780	7.61
Overall discomfort total					288749668	

calculated. The total discomfort score was product of values of frequency of discomfort, severity of discomfort and interference in productivity. From the total discomfort score percentage of discomfort was found. The results are discussed in Table 5. For right hand, the values in table reveals that maximum discomfort score (16.15%) was found in wrist region (Area F) followed by palm region (Area D) i.e., 13.31 per cent, thumb base region (Area E) i.e., 11.98 per cent and thumb region (Area C) i.e.,10.67 per cent. Whereas, discomfort score found in rest of the right-hand region was below 10 per cent.

Table 5 unfolds the data about the left-hand discomfort that maximum discomfort score was found in wrist region (Area F) i.e., 7.61 per cent followed by palm region (Area D) i.e., 6.37 per cent, base of the thumb region (Area E) i.e., 5.47 per cent and thumb region (Area C) i.e., 4.89 per cent. Whereas, minimum discomfort score was found in other region of left hand. So, it can be concluded from the above discussion that maximum discomfort score was obtained in right hand as compared to left hand as the right hand was the dominant hand for all of the respondents. In other words, gardeners hand tools are mostly made of wooden handle and so the job demand frequent and prolonged use of hand tool without using gloves causes hand discomfort.

CONCLUSION

The inference of the research stated that gardeners perceived moderate to low comfort while working with various gardening tools. And through Cornell Hand Discomfort questionnaire it was found that most discomfort was experienced in right hand of the gardeners. As it was the dominating hand for all the gardeners. As per the research view point, the main drawback of their hand discomfort was lack of occupational health and safety training such as importance of protective clothing (Gloves) and using ergonomically designed tools. Unfortunately, in our Indian society especially people from unorganized sector have to work under hazardous condition with zero safeguard. Also, their nature toward their health is secondary as they keep avoiding their initial pain/ discomfort until it results in poor health condition.

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Research Article

Saving and Borrowing Pattern of Farmers of Banaskantha District, Gujarat

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ABSTRACT

The present study was undertaken to find out the saving and borrowing pattern of farmers of Banaskantha district of Gujarat. The study was conducted in three talukas of Banaskantha district of Gujarat. Three villages from each taluka and ten women and ten men from each village were selected randomly. So, the total sample was 180 rural people including 90 women and 90 men. Interview technique was used for collecting data from the respondents. Data was analyzed by using frequency, percentage, mean score and correlation. The findings reveal that all the respondents tried to save money but due to less income they couldn't save much. Majority of the respondents (72.2%) could be able to save very little amount of their income which is less than 10 per cent. Rural people preferred to invest money in post office saving schemes, buying land and buying precious metal i.e. gold and silver which involves less risk. Besides small saving they needed to borrow money from time to time to fulfil their basic needs. This might be due to inflation and low income. Male respondents were more aware of saving and borrowing schemes and government programmes except one scheme that is SHG-bank linkage programme where women had more knowledge than men.

Keywords: Saving, Borrowing, Farmers, Income, Knowledge

INTRODUCTION

Savings are a driving force for economic growth of an individual as well as of nation. Saving means keep something aside for future use and it is considered as deferred expenditure (Amu and Amu, 2012). Savings are very useful in the time of crises, indemnifying against times of shock, increases the possibility of future investment, enhances repayment ability and improve the quality of life of people. Savings may be made in the form of currency notes deposited in the bank and other financial institutions, jewellery, land or livestock. Rural people save money as per their convenience on daily, weekly, monthly or yearly basis.

The savings and borrowings pattern differs from person to person as per the amount of money that they earn. The earning depends on the occupation of the person. If the person has continuous source of income then he/she can save more and borrow less. In reality, they are able to save very less money due of lack of funds and they borrow money to fulfil their basic and other needs. They have limited access to formal financial institutions that leads to dependency on informal borrowing sources such as money lenders to meet out the financial requirements which make them poorer and debated. The Government of India has been regularly taking various measures and launched several saving and borrowing schemes to increase the financial security of the rural people. These schemes intend to provide financial as well as social security to the less fortunate sections of the society. But the actual benefits are generally not reached to the ultimate users due to lack of awareness.

MATERIALS AND METHODS

The present study was carried out in Banskantha district of Gujarat. Three talukas namely Deesa, Vadgam and Amirgarh and three villages from each taluka were

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selected on random basis for the purpose of investigation. From each of the selected village 10 women and 10 men were selected randomly. So, the total sample was 180 rural people including 90 women and 90 men. Interview technique was used for collecting data from the respondents. Data was analyzed by using frequency, percentage, mean score and correlation.

RESULTS AND DISCUSSION

The personal information of the respondents indicated that a majority of the respondents were of age between 36-45 years (49.4%), educated up to primary level (56.1%), belonged to the backward caste (53.3%), lived in a joint family (64.4%) and had pucca houses (76.7%). Agriculture (32.7) and animal husbandry (41.1%) were the main occupation of majority of the respondents and had annual income less than one lakh (67.8%). More than three fourth of the respondents (77.2%) had only one earning members in their family. Less than half of the respondents (48.3%) had 4-6 dependent members in their families and 41.7 percent respondents

Table 1: Distribution of respondents according to the saving pattern (n=180)

Categories	Male (n=90) f(%)	Female (n=90) f(%)	Total (n=180) f(%)
Save money	. ,	. ,	. ,
Yes	90(100.0)	90(100.0)	180(100.0)
No	0(0.0)	0(0.0)	0(0.0)
Monthly Savings			
Less than 10%	56(62.2)	74(82.2)	130(72.2)
10-20%	21(23.3)	16(17.8)	37(20.6)
20-30%	13(14.4)	0(0.0)	13(7.2)
30-40%	0(0.0)	0(0.0)	0(0.0)
40-50%	0(0.0)	0(0.0)	0(0.0)
50-60%	0(0.0)	0(0.0)	0(0.0)
More than 60%	0(0.0)	0(0.0)	0(0.0)
Channels of savings			
Formal	33(36.7)	58(64.4)	91(50.6)
Informal	90(100.0)	90(100.0)	180(100.0)
Frequency of savings			
Weekly	0(0.0)	9(10.0)	9(5.0)
Monthly	72(80.0)	62(68.9)	134(74.4)
Annually	18(20.0)	19(21.1)	37(20.6)

had additional income other than regular earning. Financial decisions of the family were taken by male respondents in most of the families (71.1%).

Data in Table 1 show that all the respondents save money. Majority of them (72.2%) saved money less than ten per cent of their income and they spent more than 90 percent of their income every month. They reported that their income is very less thus they spend major portion of their income in fulfilling their basic needs and very little amount remaining with them for savings. Appropriate channels are essential to keep the saving safe but rural people had less awareness about formal channels thus only 30.0 per cent respondents have been used formal channel viz post office or banks to save and invest their money whereas informal channels were used by all the respondents. They save money at home or by buying ornaments. Regarding frequency of savings, it was found that majority of the respondents (74.4%) saved their money on monthly basis whereas twenty percent respondents did savings on annual basis and only five per cent respondents saved money on weekly basis. In an informal discussion with respondents it was found that labourer save very little amount of their earning and they did not use any formal channel, banks or any other formal institution for saving their money.

Gender wise data depict that male respondents saved slightly higher amount than female respondents. Male respondents saved 20-30 per cent (14.4%), 10-20 per cent (23.3%) and less than 10 per cent (62.2%) amount of their savings whereas female respondents saved 10-20 per cent (17.8%) and less than 10 per cent (82.2%) amount of their savings. Formal sources of savings were used by 36.7 per cent male respondents and 64.4 per cent female respondents. Female respondents were member of self help groups and saved money through self help group bank account.

Self help group approach and credit is a way to improve women economically in rural India (Bhati *et al.*, 2020). The findings are supported with the study of Vijayabanu *et al.* (2016) that rural petti shopkeepers saving was one third of their income. As per Nayak (2013) the saving rate of rural households was very low or many people do not save at all.

Data regarding factors that motivate respondents to save money reveal that most of the respondents

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Table 2: Distribution of respondents according to the motives of saving money (n=180)

Male (n=90) $f(%)$	Female (n=90)	Total (n=180) $f(\theta_{n})$	
1(70)	1(70)	1(70)	
46(51.1)	34(37.8)	80(44.4)	
16(17.8)	30(33.3)	46(25.6)	
16(17.8)	12(13.3)	28(31.1)	
39(43.3)	27(30.0)	66(36.7)	
62(68.9)	70(77.8)	132(73.3)	
29(32.2)	20(22.2)	49(27.2)	
17(18.9)	28(31.1)	45(25.0)	
76(84.4)	83(92.2)	159(88.3)	
35(38.9)	16(17.8)	51(28.3)	
38(21.1)	27(30.0)	65(36.1)	
	Male (n=90) f(%) 46(51.1) 16(17.8) 16(17.8) 39(43.3) 62(68.9) 29(32.2) 17(18.9) 76(84.4) 35(38.9) 38(21.1)	Male (n=90) f(%)Female (n=90) f(%)46(51.1) $34(37.8)$ 16(17.8) $30(33.3)$ 16(17.8) $12(13.3)$ 39(43.3) $27(30.0)$ 62(68.9) $70(77.8)$ 29(32.2) $20(22.2)$ 17(18.9) $28(31.1)$ 76(84.4) $83(92.2)$ 35(38.9) $16(17.8)$ 38(21.1) $27(30.0)$	

saved money to meet unexpected contingencies (88.3%) and marriage of children (73.3%) (Table 2). Other motives were spending in future (44.4%), secure old age (36.1%) and education of the children (36.7%). The least chosen motive was raising the standard of living (25.6%) as they believe in simple living. Similar trend was seen in gender wise data. The findings are in line with lide *et al.* (2017) that respondents saved money to meet out unexpected expenses (43.2%), for education of children (19.6%), acquire household assets (12.2%), wedding of family members (5.9%) and undertaking a new business (16.6%).

Finding regarding extent of easiness of savings reveal that majority of the respondents (69.4%) found savings usually difficult as they don't have sufficient income. The respondents faced many hurdles which restricted them so save money viz; inflation (78.9%), no surplus income (73.3%), income fluctuation (68.9%), low interest rate (25.6%), bank procedure (28.9%) and lack of knowledge (37.2%) (Table 3).

Findings related to investment alternatives in which respondents invested money depict that 30 per cent respondents invested in post office saving schemes and almost equal number of respondents invested in real estate (49.4%) and precious metal (50.6%) (Table 4). 24.4 per cent respondents invested in pension plan and insurance and 20.6 per cent had saved their money in banks. 64.4 per cent female respondents are associated with self help groups so they save money in SHG accounts. Post office is available in maximum rural areas and people have trust in post office so they preferred Table 3: Distribution of respondents according to the Extent easiness of savings and hurdles faced by them in savings (n=180)

Categories	Male $(n=90)$	Female	Total			
	(11-90) f(%)	(11=90) f(%)	f(%)			
Extent easiness of saw	vings					
Usually easy	0(0.0)	0(0.0)	0(0.0)			
Sometimes difficult	29(32.2)	26(28.9)	55(30.6)			
Usually difficult	61(67.8)	64(71.1)	125(69.4)			
Hurdles faced in savings						
Low rate of interest	34(37.8)	12(13.3)	46(25.6)			
Inflation	69(76.7)	73(81.1)	142(78.9)			
Lack of Knowledge	29(32.2)	38(42.2)	67(37.2)			
Bank Procedure	14(15.6)	38(42.2)	52(28.9)			
No surplus income	63(70.0)	69(76.7)	132(73.3)			
Health Problem	42(46.7)	33(36.7)	75(41.7)			
Income Fluctuation	68(75.6)	56(62.2)	124(68.9)			

post office schemes most in all formal channels to invest. Besides, they chose to buy land, gold and silver ornaments if they have extra money. Respondents least preferred to invest in mutual fund and insurance schemes as they possessed less knowledge about mutual funds and insurance schemes. Although respondents had bank account in Jan Dhan Yojana but they used it for direct transfer of wages to their account.

Findings regarding the reasons which restrict respondents to make the investment show that the major hurdle is insufficient money (8.11 MS) which followed by lack of knowledge regarding investment
Categories	Male (n=90)	Female $(n=90)$	Total (n=180)
Real Estate	54(60,0)	35(38.9)	89(49.4)
Precious metals (Gold & Silver)	22(24.4)	69(76.7)	91(50.6)
Insurance and pension Plans	31(34.4)	13(14.4)	44(24.4)
Mutual Funds	25(27.8)	5(5.6)	30(16.7)
Bank deposits	24(26.7)	13(14.4)	37(20.6)
Post office saving scheme	es 33(36.7)	21(23.3)	54(30.0)
SHG Savings	0(0.0)	58(64.4)	58(32.2)

Table 4: Distribution of respondents according to invest money in different alternatives (n=180)

(6.81 MS) and respondents preferred to have liquidity in their hands (5.72 MS) (Table 5). Lack of time to manage investment (1.91 MS) was considered least restriction in investment by the respondents. Rural people had very less income and at the same time they were not aware about various invest options which restrict them to invest money. The respondents further reported that they keep some cash money with themselves to meet out unexpected expenditure.

Findings regarding borrowing money for fulfilling their financial liabilities reveal that all the male respondents and 64.4 per cent female respondents borrowed money for fulfilling family needs. It can be said that most of the respondents (85.6%) borrowed money to meet out their requirements. Data further show that 58.3 per cent respondents borrowed money for fulfilling their basic needs and 33.3 per cent respondent took loan for construction and repairing of house. More than one fourth of the respondents borrowed money for meet out the son/daughter's marriage expenses (28.3%) and medical expenses (25.6%). Twelve respondents took loan for the education of their children (Table 6).

Rural people face problems in meeting the needs required for their living due to the low level of incomes and the uncertain farming conditions. Hence, they borrow money to meet these needs. Villagers are mostly bound by the social traditions and customs and they cannot omit to perform social functions as per their traditions. Some of these ceremonies are marriage, births, deaths, religious occasions, etc and the expenditure is usually very high for the performance of these ceremonies. In order to meet these needs, the villagers took loans. The rural people borrow money for non-productive purposes which do not contribute to production and it pulls them into indebtedness. Rural people mostly take small amount of loan and it can seen from the data that 55 per cent respondents borrowed money upto Rs. 25000/- while 16.1 per cent respondents borrowed amount between Rs. 25,000 to 50,000/- . Only 11.1 percent respondents borrowed more than Rs. 50,000/-.

Regarding mode of borrowing, it was found that 43.9 per cent respondents took loan from money lenders and 64.4 female respondents took loan from SHGs. About one fourth of the respondents (23.3%) borrowed money from their friends and relatives. A very few respondents (9.4%) took loan from bank and any other loaning institute. It can be inferred that most of the respondents are still dependent on informal sources for credit due to easy availability. Less use of formal institutions for loan might be due to long and complicated process. Almost half of the respondents (51.1%) borrowed money sometimes whereas 20.0 per cent borrowed money hardly ever.

Categories	Male (n=90) Mean	Female (n=90) Mean	Total (n=180) Mean	Rank
Prefer to have liquidity in my hands.	7.72	3.72	5.72	III
Lack of knowledge regarding investment	5.71	7.91	6.81	II
Insufficient money for investment.	7.92	8.30	8.11	Ι
Lack of time to manage investment.	1.79	2.03	1.91	VII
No trust or faith in the advisors/Companies	3.33	6.74	5.04	IV
Finds investment is too risky	3.30	5.79	4.54	V
Difficult /long process of investment	2.57	6.28	4.42	VI

Categories	Male (n=90) f(%)	Female (n=90) f(%)	Total (n=180) f(%)
Yes	90(100.0)	58(64.4)	154(85.6)
No	0(0.0)	32(35.6)	32(17.8)
Purpose of borrowing n	noney		
Education	7(7.8)	5(5.6)	12(6.7)
House construction and repair	34(37.8)	26(28.9)	60(33.3)
Vehicle purchase	32(17.8)	4(2.2)	36(20.0)
Fulfil basic needs	47(52.2)	58(64.4)	105(58.3)
Medical expenses	26(28.9)	20(22.2)	46(25.6)
Son / Daughter marriage expenses	24(26.7)	27(30.0)	51(28.3)
Amount they borrow			
Upto 25,000	47(52.2)	52(57.8)	99(55.0)
25,000 to 50,000	23(25.6)	6(6.7)	29(16.1)
Above 50,000	20(22.2)	0(0.0)	20(11.1)
Mode of borrowing			
Money Lender	48(53.3)	31(34.4)	79(43.9)
Friends / Relatives	30(33.3)	12(13.3)	42(23.3)
Loan from bank/ other institute	17(18.9)	0(0.0)	17(9.4)
SHG loan	0(0.0)	58(64.4)	58(32.2)
Frequency of borrowing	g		
Always	18(20.0)	0(0.0)	18(10.0)
Sometimes	50(55.6)	42(46.7)	92(51.1)
Hardly ever	22(24.4)	16(17.8)	36(20.0)
Never	0(0.0)	0(0.0)	0(0.0)

Table 6: Distribution of respondents according to borrowing pattern (n=180)

Table 7: Distribution of respondents according to their awareness about financial schemes (n=180)

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Financial schemes	Male	Female	Total
	(n=90)	(n=90)	(n=180)
	Mean	Mean	Mean
General saving account in bank	2.77	1.39	2.08
Mutual fund	1.87	1.05	1.48
Fixed deposit	2.60	1.56	2.08
Credit card	1.97	1.13	1.55
Kisan Credit Card Scheme	2.09	1.24	1.71
SHG-Bank Linkage Programme	e 2.14	2.97	2.63
Post office recurring deposit	2.24	1.69	1.97
Post office saving account	2.03	1.38	1.71
Loan/ Borrowing Scheme			
Home loan	2.49	1.44	1.97
SHG Loan	2.51	2.99	2.75
Vehicle loan/tractor loan	3.12	1.50	2.18
Education loan	1.80	1.13	1.46
Personal loan	2.37	1.18	1.77
Loan against property	2.08	1.16	1.62
Loan against ornaments/ Gold loan	2.16	1.53	1.85
Animal loan	2.33	1.62	1.98
Crop loan	2.54	1.67	2.11

Self-help groups increase women's access to economic resources, financial services and productive assets. SHGs help women in proving loan to fulfill their needs (Roy *et al.*, 2018)

Data regarding awareness about saving and barrowing schemes is presented in Table 7. It was found from the data that male respondents were more aware about all the saving and borrowing schemes except one scheme that is SHG-bank linkage programme where women had more knowledge than men as they are members of SHGs and availing all the benefits from these SHGs. Although all the respondents did not have thorough knowledge of any scheme but many of the male respondents were aware of many features of these schemes. In case of women respondents, they either only heard about the scheme or knew very little information of these schemes. The present findings are in line with the Joshi (2014) who found that awareness about financial products like current account, demand loan, direct debit facility, credit card and mobile banking was low.

Findings regarding awareness about different government programmes and schemes show that male respondents were more aware about all the government schemes than female respondents except two schemes namely Sukanya samridhi yozana and Vidhawa pension yozana where female had more awareness (Table 8). Although female respondents are availing benefits of these schemes but they didn't possess more knowledge about these schemes. Male respondents also didn't have thorough knowledge of these schemes. Most of the respondents (2.58 MS) knew that account can be opened in Pradhan Mantri

Programmes and Schemes	Male (n=90) Mean	Female (n=90) Mean	Total (n=180) Mean
Pradhan Mantri Jan dhan yojana	2.90	2.23	2.58
Atal pension yojana	2.33	1.58	1.96
Pradhan matri Jeevanjyoti bima Yojana	2.50	1.89	2.19
Pradhanmatri Suraksha Beema Yojana	2.46	1.94	2.20
Pradhan matri vaya vandana yojana	2.71	2.19	2.45
Sukanya samridhi yozana	2.67	2.70	2.67
Vidhawa pension yozana	2.07	2.26	2.18

Table 8: Distribution of respondents according to their awareness about different government programmes and schemes (n=180)

Jan Dhan Yojana as most of them had opened accounts under the scheme. The respondents (2.19 MS and 2.20 MS) aware about getting financial aid and relief in case of injury and any fatality under Pradhan Mantri Jeevan Jyoti Bima Yojana and Pradhan Mantri Suraksha Bima Yojana. Receiving Rs. 1250/- pension by widows who are between the age of 18-60 years under Vidhwa Pension Yojana (43.67%) and it was known by majority of female respondents (2.26 MS) because widows of the villages were getting pension under Vidhwa Pension Yojana. Majority of the respondents (2.45 MS) were aware about getting Rs. 750/- per month by old age persons (above 60 years) under Vayvandana Yojana.

Overall it can be said that they had heard about the schemes and knew some of the features of these schemes. The findings are supported with the study of Maroor *et al.* (2016) who concluded that the respondents had less awareness about the role of Atal Pension Yojana in financial inclusion.

In order to ascertain relationship if any between socio- demographic variables (age, education, family type, family income, media exposure, percentage of saving and caste) and awareness about financial schemes, Pearson's correlation was computed. This has been presented in Table 9.

Age, occupation, media exposure were found to be positively associated with awareness of saving ('r'=0.063, .012, .110), borrowing ('r'=0.089, .037, .127) and Government schemes (.037, .041, .165*) (Table 9). Education, caste, gender, annual income, saving percentage and financial decision were significantly positively associated with saving, borrowing and government schemes. Regarding government schemes

Table 9: Association between awareness about financi	al
schemes and socio-demographic variables (n= 180)	

	Saving	Borrowing	Govt.
	schemes	schemes	schemes
Age	.063	.089	.037
Education	.629**	.529**	.461**
Caste	.338**	.323**	.105
Gender	.609**	.780**	.330**
Family type	.326**	.394**	180*
Occupation	.012	.037	.041
Media exposure	.110	.127	.165*
Annual Income	.647**	.509**	.181*
No. Earning members	.266**	.173*	.020
Additional income	.336**	.262**	.106
Percentage of Saving	.536**	.422**	.179*
Financial decision	.444**	.393**	.115

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

all socio personal characteristics are positively associated except one i.e. family type which is negatively associated. Overall all the socio demographic variables are positively associated with saving and borrowing awareness.

CONCLUSION

In respect to level of financial literacy, it could be concluded that all the respondents tried to save money but due to less income they couldn't save much and they preferred to invest money in post office saving schemes, buying land and buying precious metal i.e. gold and silver which involves less risk. Besides small saving they needed to borrow money from time to time to fulfil their basic needs. This might be due to the inflation and less income. Male respondents were more aware about all the saving and borrowing schemes and government programmes except one scheme that is SHG-bank linkage programme where women had more knowledge than men as they are members of SHGs and availing all the benefits from these SHGs.

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Research Article

Constructions of Three Associate Constant Block-sum PBIB Designs

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ABSTRACT

Partially Balanced Incomplete Block (PBIB) designs find extensive use in various fields, including agriculture, animal studies, and biomedical research. In biomedical research, especially with animals, there is often a need to account for carryover effects from previous experiments. This necessitates the development of designs that ensure uniform cumulative exposure to treatment levels. Constant block-sum designs have been introduced in the literature to address this requirement. In such designs, treatment levels are treated as quantitative, and the goal is to ensure that, by the end of the experiments, all experimental units have received the same constant cumulative dose. In this article, we delve into three distinct three-associate class association schemes, utilizing the Petersen Graph, Pappus Graph, and Hexagon Graph. We provide detailed insights into the construction methods for constant block-sum PBIB(3) designs, along with illustrative examples to facilitate understanding and practical application.

Keywords: Constant block-sum PBIB designs, Petersen graph, Pappus graph, Hexagon graph, Association scheme

INTRODUCTION

The reduction of animal usage in biomedical research is a significant consideration, especially because animals used in experiments often need to be reused in subsequent studies. However, these animals may have incurred partial damage due to the application of various treatments at different times, leading to carryover effects in subsequent experiments. These carryover effects cannot be completely eliminated. One approach to mitigate the impact of partial damage in future experiments is to incorporate previous treatment(s) as covariate(s) during the statistical analysis phase. Alternatively, experiment design can be structured to maintain a consistent degree of damage among experimental units. For instance, if treatments involve drug doses, ensuring nearly equal damage can be achieved by keeping the cumulative dose constant or nearly constant for all units over time. Thus, experimental design should be carefully planned to maintain a constant block-sum.

The concept of constant block-sum partially balanced incomplete block designs was introduced by Khattree (2019a, b). Khattree (2019a) proved there is no existence of constant block-sum BIBD and Khattree (2019b) provides a particular constant block-sum PBIBD with four associate classes PBIBD (v = 16, b = 36, k = 4, r = 9, (λ_1 , λ_2 , λ_3 , λ_4) = (0, 3, 2, 3), (n₁, n₂, n₃, n₄) = (4, 1, 6, 4)) by using famous Parshavnath Yantram, 4 × 4 magic square with enormous configurations leading to a constant sum of 34.

Subsequent research, including Khattree (2020), explored the construction of constant block-sum PBIBDs using various techniques such as magic squares, singular group divisible designs, paired sums, circular arrangements, magic circles, and magic oblongs. Other researchers like Bansal and Garg (2020) also discussed the existence of constant block-sum PBIB designs and developed some using regular figures like concentric circle reticles and two-dimensional *t*-level segmented pyramids.

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In this study, we have employed Petersen, Pappus, and Hexagon Graphs to define association schemes and have constructed constant block-sum PBIB designs with their respective general parameters. This research contributes to the development of experimental designs that allow for the reuse of animals while effectively managing the effects of previous treatments.

CONSTRUCTIONS OF CONSTANT BLOCK-SUM PBIB(3) DESIGNS

Three associate class association scheme using Petersen Graph: Let the number of treatments be $v = 10t (t \ge 2)$. Arrange these v treatments on each vertex of a Petersen Graph such that each vertex contains exactly t distinct treatments, then two treatments are

- i) First associates, if these lie on the same vertex.
- ii) Second associates, if these lie on the first nearest vertices.
- iii) Third associates, otherwise.

The parameters of the association scheme are:

$$v = 10t, n_{1} = t - 1, n_{2} = 3t, n_{3} = 6t$$

$$P_{1} = \begin{pmatrix} t - 2 & 0 & 0 \\ 0 & 3t & 0 \\ 0 & 0 & 6t \end{pmatrix}, P_{2} = \begin{pmatrix} 0 & t - 1 & 0 \\ t - 1 & 0 & 2t \\ 0 & 2t & 4t \end{pmatrix},$$

$$P_{3} = \begin{pmatrix} 0 & 0 & t - 1 \\ 0 & t & 2t \\ t - 1 & 2t & 3t \end{pmatrix}$$

Construction of three associate class designs using Petersen Graph: The -tuple coordinates having a constant sum found using t/2 sets of paired sums with v = 10t treatments and putted on the vertices of Petersen Graph. Now form the contents of a block by taking treatments that form a close path containing exactly three external and two internal vertices. The six blocks thus obtained to form a constant block sum PBIB(3) design with the parameters:

v = 10t, b = 6, r = 3, k = 5t, $\lambda 1 = 3$, $\lambda 2 = 2$, $\lambda 3 = 1$ with constant block sum 5/2 t(1+10t)

Example 1: For t=2 following sets of treatments

$$\begin{cases} 1 \\ 20 \end{cases} \begin{cases} 2 \\ 19 \end{cases} \begin{cases} 3 \\ 18 \end{cases} \begin{cases} 4 \\ 17 \end{cases} \begin{cases} 5 \\ 16 \end{cases} \begin{cases} 6 \\ 15 \end{cases} \begin{cases} 7 \\ 14 \end{cases} \begin{cases} 8 \\ 13 \end{cases} \begin{cases} 9 \\ 12 \end{cases} \text{ and } \begin{cases} 10 \\ 11 \end{cases}$$

are placed on Petersen's Graph as



Blocks of design are

Blocks	Block contents
Ι	(1, 2, 3, 8, 10, 11, 13, 18, 19, 20)
II	(1, 4, 5, 7, 10, 11, 14, 16, 17, 20)
III	(1, 2, 5, 6, 9, 12, 15, 16, 19, 20)
IV	(2, 3, 4, 7, 9, 12, 14, 17, 18, 19)
V	(3, 4, 5, 6, 8, 13, 15, 16, 17, 18)
VI	(6, 7, 8, 9, 10, 11, 12, 13, 14, 15)

with parameters v = 20, b = 6, r = 3, k = 10, λ_1 = 3, λ_2 = 2 and λ_3 = 1 and constant block sum 105.

with parameters v = 20, $n_1 = 1$, $n_2 = 6$, $n_3 = 12$

$$P_1 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 12 \end{pmatrix}, P_2 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 4 \\ 0 & 4 & 8 \end{pmatrix}, P_3 = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 2 & 4 \\ 1 & 4 & 6 \end{pmatrix}$$

Three associate class association scheme using Pappus Graph: Let the number of treatments be v = 9t ($t \ge 2$). Arrange these v treatments on the vertices of a Pappus Graph such that each vertex contains exactly t distinct treatments, then two treatments are

- i) First associates, if these lie on the same vertex.
- Second associates, if these lie on the vertex which is situated on the straight line passing through the vertices.
- iii) Third associates, otherwise.

The parameters of the association scheme are:

$$v = 9t, n_1 = t - 1, n_2 = 6t, n_3 = 2t$$

$$P_{1} = \begin{pmatrix} t-2 & 0 & 0 \\ 0 & 6t & 0 \\ 0 & 0 & 2t \end{pmatrix}, P_{2} = \begin{pmatrix} 0 & t-1 & 0 \\ t-1 & 3t & 2t \\ 0 & 2t & 0 \end{pmatrix},$$
$$P_{3} = \begin{pmatrix} 0 & 0 & t-1 \\ 0 & 6t & 0 \\ t-1 & 0 & t \end{pmatrix}$$

Treatments	First associates	Second associates	Third associates
1	20	2, 5, 10, 11, 16, 19	3, 4, 6, 7, 8, 9, 12, 13, 14, 15, 17, 18
2	19	1, 3, 9, 12, 18, 20	4, 5, 6, 7, 8, 10, 11, 13, 14, 15, 16, 17
3	18	2, 4, 8, 13, 17, 19	1, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16, 20
4	17	3, 5, 7, 14, 16, 18	1, 2, 6, 8, 9, 10, 11, 12, 13, 15, 19, 20
5	16	1, 4, 6, 15, 17, 20	2, 3, 7, 8, 9, 10, 11, 12, 13, 14, 18, 19
6	15	5, 8, 9, 12, 13, 16	1, 2, 3, 4, 7, 10, 11, 14, 17, 18, 19, 20
7	14	4, 9, 10, 11, 12, 17	1, 2, 3, 5, 6, 8, 13, 15, 16, 18, 19, 20
8	13	3, 6, 10, 11, 15, 18	1, 2, 4, 5, 7, 9, 12, 14, 16, 17, 19, 20
9	12	2, 6, 7, 14, 15, 19	1, 3, 4, 5, 8, 10, 11, 13, 16, 17, 18, 20
10	11	1, 7, 8, 13, 14, 20	2, 3, 4, 5, 6, 9, 12, 15, 16, 17, 18, 19
11	10	1, 7, 8, 13, 14, 20	2, 3, 4, 5, 6, 9, 12, 15, 16, 17, 18, 19
12	9	2, 6, 7, 14, 15, 19	1, 3, 4, 5, 8, 10, 11, 13, 16, 17, 18, 20
13	8	3, 6, 10, 11, 15, 18	1, 2, 4, 5, 7, 9, 12, 14, 16, 17, 19, 20
14	7	4, 9, 10, 11, 12, 17	1, 2, 3, 5, 6, 8, 13, 15, 16, 18, 19, 20
15	6	5, 8, 9, 12, 13, 16	1, 2, 3, 4, 7, 10, 11, 14, 17, 18, 19, 20
16	5	1, 4, 6, 15, 17, 20	2, 3, 7, 8, 9, 10, 11, 12, 13, 14, 18, 19
17	4	3, 5, 7, 14, 16, 18	1, 2, 6, 8, 9, 10, 11, 12, 13, 15, 19, 20
18	3	2, 4, 8, 13, 17, 19	1, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16, 20
19	2	1, 3, 9, 12, 18, 20	4, 5, 6, 7, 8, 10, 11, 13, 14, 15, 16, 17
20	1	2, 5, 10, 11, 16, 19	3, 4, 6, 7, 8, 9, 12, 13, 14, 15, 17, 18

Association scheme of the design is

Construction of three associate class design using

Pappus Graph: The t-tuple coordinates having a constant sum found using t/2 sets of paired sums with v = 9t treatments and putted on the vertices of Pappus Graph. Now form the contents of blocks of the designs by considering all possible triangles in a pappus graph. The eighteen blocks thus obtained to form a constant block sum PBIB design with the parameters:

v = 9t, b = 18, r = 6, k = 3t, λ_1 = 6, λ_2 = 2, λ_3 = 0

with constant block sum 3/2 t(1+9t)

Example 2: For t=2 following sets of treatments $\begin{cases} 1\\18 \end{cases} \begin{cases} 2\\17 \end{cases} \begin{cases} 3\\16 \end{cases} \begin{cases} 4\\15 \end{cases} \begin{cases} 5\\14 \end{cases} \begin{cases} 6\\13 \end{cases} \begin{cases} 7\\12 \end{cases} \begin{cases} 8\\11 \end{cases}$ and $\begin{cases} 9\\10 \end{cases}$

are placed on Pappus Graph as



Blocks	of	design	are	
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Blocks	Block contents
Ι	(1, 2, 7, 12, 17, 18)
II	(1, 7, 8, 11, 12, 18)
III	(1, 3, 5, 14, 16, 18)
IV	(1, 5, 6, 13, 14, 18)
V	(1, 2, 6, 13, 17, 18)
VI	(1, 3, 8, 11, 16, 18)
VII	(2, 7, 9, 10, 12, 17)
VIII	(2, 3, 9, 10, 16, 17)
IX	(2, 4, 6, 13, 15, 17)
Х	(2, 3, 4, 15, 16, 17)
XI	(3, 8, 9, 10, 11, 16)
XII	(3, 4, 5, 14, 15, 16)
XIII	(4, 5, 7, 12, 14, 15)
XIV	(4, 6, 8, 11, 13, 15)
XV	(4, 7, 8, 11, 12, 15)
XVI	(5, 7, 9, 10, 12, 14)
XVII	(5, 6, 9, 10, 13, 14)
XVIII	(6, 8, 9, 10, 11, 13)

Treatments	First associates	Second associates	Third associates
1	18	2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17	4, 9, 10, 15
2	17	1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18	5, 8, 11, 14
3	16	1, 2, 4, 5, 8, 9, 10, 11, 14, 15, 17, 18	6, 7, 12, 13
4	15	2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17	1, 9, 10, 18
5	14	1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18	2, 8, 11, 17
6	13	1, 2, 4, 5, 8, 9, 10, 11, 14, 15, 17, 18	3, 7, 12, 16
7	12	1, 2, 4, 5, 8, 9, 10, 11, 14, 15, 17, 18	3, 6, 13, 16
8	11	1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18	2, 5, 14, 17
9	10	2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17	1, 4, 15, 18
10	9	2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17	1, 4, 15, 18
11	8	1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18	2, 5, 14, 17
12	7	1, 2, 4, 5, 8, 9, 10, 11, 14, 15, 17, 18	3, 6, 13, 16
13	6	1, 2, 4, 5, 8, 9, 10, 11, 14, 15, 17, 18	3, 7, 12, 16
14	5	1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18	2, 8, 11, 17
15	4	2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17	1, 9, 10, 18
16	3	1, 2, 4, 5, 8, 9, 10, 11, 14, 15, 17, 18	6, 7, 12, 13
17	2	1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18	5, 8, 11, 14
18	1	2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17	4, 9, 10, 15

Association scheme of the design is

with parameters v = 18, b = 18, r = 6, k = 6, λ_1 = 6, λ_2 = 2 and λ_3 = 0 and constant block sum 57.

with parameters v =18, n_1 =1, n_2 =12, n_3 =4

$$P_1 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 12 & 0 \\ 0 & 0 & 4 \end{pmatrix}, P_2 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 6 & 4 \\ 0 & 4 & 0 \end{pmatrix}, P_3 = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 12 & 0 \\ 1 & 0 & 2 \end{pmatrix}$$

Three associate class association scheme using Hexagon Graph: Let the number of treatments be $v = 6t (t \ge 2)$. Arrange these treatments on the vertices of a Hexagon Graph such that each vertex contains exactly distinct treatments, then two treatments are

- i) First associates, if these lie on the same vertex.
- ii) Second associates, if these lie on the vertex which is connected by a line.
- iii) Third associates, otherwise.

The parameters of the association scheme are:

v = 6t, n₁ = t - 1, n₂ = 4t, n₃ = t

$$P_1 = \begin{pmatrix} t - 2 & 0 & 0 \\ 0 & 4t & 0 \\ 0 & 0 & t \end{pmatrix}, P_2 = \begin{pmatrix} 0 & t - 1 & 0 \\ t - 1 & 2t & t \\ 0 & t & 0 \end{pmatrix}, P_3 = \begin{pmatrix} 0 & 0 & t - 1 \\ 0 & 4t & 0 \\ t - 1 & 0 & 0 \end{pmatrix}$$

Construction of three associate class design using Hexagon Graph: The t-tuple coordinates having a constant sum found using t/2 sets of paired sums with v = 6t treatments and putted on the vertices of Hexagon Graph. Now form the contents of blocks of the designs by considering all possible triangles in a Hexagon graph. The eight blocks thus obtained to form a constant block sum PBIB(3) design with the parameters:

v = 6t, b = 8, r = 4, k = 3t, λ_1 = 4, λ_2 = 2, λ_3 = 0

with constant block sum 3/2 t(1+6t)

Example 3: For t= 2 following sets of treatments

 $\left\{ \begin{matrix} 1 \\ 12 \end{matrix} \right. \left\{ \begin{matrix} 2 \\ 11 \end{matrix} \right. \left\{ \begin{matrix} 3 \\ 10 \end{matrix} \right\} \begin{matrix} 4 \\ 9 \end{matrix} \left\{ \begin{matrix} 5 \\ 8 \end{matrix} \right\} \text{and} \left\{ \begin{matrix} 6 \\ 7 \end{matrix} \right\} \right. \right\}$

are placed on Hexagon Graph as



Blocks of design are	
Blocks	Block contents
Ι	(1, 2, 3, 10, 11, 12)
II	(1, 3, 5, 8, 10, 12)
III	(1, 5, 6, 7, 8, 12)
IV	(1, 2, 6, 7, 11, 12)
V	(2, 4, 6, 7, 9, 11)
VI	(2, 3, 4, 9, 10, 11)
VII	(3, 4, 5, 8, 9, 10)
VIII	(4, 5, 6, 7, 8, 9)

 $\frac{\text{VIII} (4, 5, 6, 7, 8, 9)}{\text{with parameters } v = 12, b = 8, r = 4, k = 6, \lambda_1 = 4, \lambda_2 = 100}$

2 and $\lambda_3 = 0$ and constant block sum 39.

It may be noted that this is a resolvable class of incomplete block designs where in the 8 blocks can be grouped into 4 sets of 2 blocks each – ({I, VIII}; {II, V}; {III, VI}; {IV, VII}) – such that every treatment appears in each set exactly once and any two blocks from different sets have 4 treatments in common. Association scheme of the design is

Treat- ments	First associates	Second associates	Third associates
1	12	2, 3, 5, 6, 7, 8, 10, 11	4,9
2	11	1, 3, 4, 6, 7, 9, 10, 12	5,8
3	10	1, 2, 4, 5, 8, 9, 11, 12	6,7
4	9	2, 3, 5, 6, 7, 8, 10, 11	1,12
5	8	1, 3, 4, 6, 7, 9, 10, 12	2, 11
6	7	1, 2, 4, 5, 8, 9, 11, 12	3,10
7	6	1, 2, 4, 5, 8, 9, 11, 12	3,10
8	5	1, 3, 4, 6, 7, 9, 10, 12	2,11
9	4	2, 3, 5, 6, 7, 8, 10, 11	1,12
10	3	1, 2, 4, 5, 8, 9, 11, 12	6,7
11	2	1, 3, 4, 6, 7, 9, 10, 12	5,8
12	1	2, 3, 5, 6, 7, 8, 10, 11	4,9

with parameters v = 12, $n_1 = 1$, $n_2 = 8$, $n_3 = 2$

$$P_1 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 2 \end{pmatrix}, P_2 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 4 & 2 \\ 0 & 2 & 0 \end{pmatrix}, P_3 = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 8 & 0 \\ 1 & 0 & 0 \end{pmatrix}$$

Note: t must be even because it is not possible to have an odd tuple constant sum coordinates which are to be placed at even number of vertices.

S.N.	v	b	r	k	$\lambda_{_1}$	λ_2	λ,	n ₁	n ₂	n ₃	E	Association scheme based on	
1	12	8	4	6	4	2	0	1	8	2	0.8800	Hexagon graph	
2	18	18	6	6	6	2	0	1	12	4	0.8500	Pappus graph	
3	20	6	3	10	3	2	1	1	6	12	0.9383	Petersen graph	
4	24	8	4	12	4	2	0	3	16	4	0.9388	Hexagon graph	
5	36	8	4	18	4	2	0	5	24	6	0.9589	Hexagon graph	
6	36	18	6	12	6	2	0	3	24	8	0.9211	Pappus graph	
7	40	6	6	20	3	2	1	3	4	24	0.9689	Petersen graph	
8	48	8	4	24	4	2	0	7	32	8	0.9691	Hexagon graph	
9	54	18	6	18	6	2	0	5	36	12	0.9464	Pappus graph	
10	60	6	3	30	3	2	1	5	16	36	0.9793	Petersen graph	
11	60	8	4	30	4	2	0	9	40	10	0.9752	Hexagon graph	
12	72	8	4	36	4	2	0	11	48	12	0.9793	Hexagon graph	
13	72	18	6	24	6	2	0	7	48	16	0.9595	Pappus graph	
14	80	6	3	40	3	2	1	7	24	48	0.9844	Petersen graph	
15	84	8	4	42	4	2	0	13	56	14	0.9822	Hexagon graph	
16	90	18	6	30	6	2	0	9	60	20	0.9674	Pappus graph	
17	96	8	4	48	4	2	0	15	64	16	0.9845	Hexagon graph	

Table 1: List of possible constant block-sum PBIB designs for a given association scheme

CONCLUSION

This article introduces three different methods for constructing constant block-sum PBIB(3) designs, which are shown to be highly efficient, with an efficiency rate exceeding 90 per cent in most cases. As emphasized in the introduction section, the primary advantage of these designs lies in their ability to treat experimental units used in subsequent experiments, following the initial set, as homogeneous. This enables the efficient reuse of these units in later experiments. A comprehensive list of constant block-sum PBIB(3) designs has been compiled for cases where v<100. This list includes design parameters as well as efficiency (E) values in comparison to a randomized complete block design. It is noteworthy that the efficiency of these designs is notably high, surpassing 90 percent, with the exception of v=12 and v=18 cases. These findings underscore the practical utility and effectiveness of constant block-sum PBIB(3) designs, particularly in situations where experimental units need to be reused and experimental resources need to be maximized.

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Research Article

Women Empowerment in Self Help Groups: Enterprise, Income and Efficiency

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ABSTRACT

Empowering women is one of the most crucial concerns of the Millennium Development Goals (MDG) of the United Nations. Women need, at the best, a tiny opportunity either to build their own pathway to empowerment. In this study we identified the relationship among and between some exogenous variables and change in empowerment of the women in SHGs. The present study was conducted in the year 2019 in Kurnool district of Andhra Pradeshwith 80 respondents selected randomly from two villages, Pandurangapuram and Gopavaram, under Nandyal and Mahanadi mandal respectively. In correlation coefficient analysis, variables such as education (x_3) , extension contacts (x_7) , no of trainings received (x_8) , mass media exposure (x_9) market facilities (x_{10}) and land holding (x_{11}) have shown positive significant correlation with the dependent variable. The results of Regression showed that 11 casual variables together have contributed 84.10 per cent of variance in consequent variable i.e., change in empowerment (y_1) . After step down regression the variables retained are education (x_3) , no of trainings received (x_9) , distance from market (x_{10}) and land holdings (x_{11}) which indicates that these variables are the most important causal variables that affects the dependent variable. The result of path analysis showed that the variable age (x_1) has got highest indirect effect on change in empowerment (y_1) .

Keywords: Change, Decision-making, Empowerment, Self help group, Women

INTRODUCTION

Empowering women is one of the most crucial concerns of the Millennium Development Goals of the United Nations. One of the crucial goals is to upgrade the status of women and facilitate their integration into the total social development (Varghese, 2011). SHGs exerted a positive impact on social and economic empowerment, and help to transform the rural economy by way of improving the economic status of each and every individual member of the SHG in the rural areas apart from providing scope for women empowerment (Rama Krishna *et al.*, 2003). The rural women who have high participation in self help groups have relatively higher social empowerment, legal empowerment, political empowerment and knowledge empowerment These resulted in an increase

in their income, savings and consumption expenditure and also gained self-confidence in decision-making process (Janagan, 2011). Women empowerment occurs in real sense when women achieve increased control and participation in decision making that leads to their better access to resources. It often involves the empowered developing confidence in their owned capacities (Narang, 2012). Women empowerment through the self help groups' benefits not only individual women, but also the family and community is benefited through collective action. Empowering women is not just for meeting their economic needs but also for more holistic social development (Rajamani et al., 2012). The impact which the self help groups are causing is significant in aspects of self-worth like capacity building and confidence by establishing self-

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employment opportunities to attain financial stability. (Sundaram, 2012). Decision-making capacity in terms of various social, political, economic, health and educational affairs and mobilizes women to fight against various types of exploitations against them in family and society at large (Heena et al., 2013). Women in India are not privileged inspite of government taking many efforts, their status is lower than men (Shettar, 2015). The participation of women in SHGs will enrich their income, savings, and empowerment. The involvement of the women in the group considerably contributes to improvement and perfection in the quality of life, social status and confidence of the members (Madanant et al., 2017). The present study focuses on identifying the relationship among and between some exogenous variables and change in empowerment of the women in SHGs. The inputs from the study will be helpful for the policy makers and administrators on which aspects to be focused to empower the women.

MATERIALS AND METHODS

The study was conducted in the year 2019 in Kurnool district of Andhra Pradesh with 80 respondents selected randomly from two villages, Pandurangapuram and Gopavaram, under Nandyal and Mahanadi mandal respectively. Eighty (80) respondents in total were selected from two villages, forty (40) from each village to conduct the study following random sampling method. Appropriate statistical tools have been used to carry out the study viz, Correlation coefficient, Step wise regression analysis, canonical covariate analysis, Factor analysis, Cluster analysis. Appropriate operationalization and measurement of the variables have helped the researcher to land upon the accurate conclusions. Therefore, the selected variables for this study had been operationalized and measured in the following manner: 1) Independent variables 2) Dependent variables. Independent variables selected for the study were age (x_1) , marital status (x_2) , education (x_3) , family size (x_4) , annual income (x_z) , experience in SHG (x_z) , extension contacts (x_{7}) , number of trainings attended (x_{9}) , mass media exposure (x_0) , distance from market (x_{10}) & land holding (x_{11}) . Dependent variable is the change in empowerment taken on 10 point scale (y_1) .

RESULTS AND DISCUSSION

The results and discussion part deals with relational, functional and directional interpretation of variables

Table 1: Co-efficient of correlation between change in empowerment (y_1) and eleven independent variables $(x_1 - x_{11})$

Independent variables	r value
Age (x ₁)	-0.491**
Marital status (x_2)	-0.458**
Education (x_3)	0.775**
Family size (x_4)	0.193*
Annual income (x_5)	-0.026*
Experience in SHG (x_{ϕ})	-0.382**
Extension contacts (x_{γ})	0.656**
No of training attended (x_8)	0.308**
Mass media exposure (x ₉)	0.770**
Distance from market (x_{10})	0.558**
Land holding (x_{11})	0.428**

**Correlation is significant at the 0.01 level; * Correlation is significant at the 0.05 level

in the form of independent and dependent variables. The respective data table and revelations are given here under with.

Table 1 presents the coefficient of correlation between change in empowerment (y) and 11 dependent variables. It has been found that the following variables viz. age (x_1), marital status (x_2) and experience in SHG are having negative but significant correlation with the dependent variable. The variables education (x_3), extension contacts (x_7), no of trainings received (x_8), mass media exposure (x_9), market facilities (x_{10}) and land holding (x_{11}) have recorded positive significant correlation with the dependent variable.

Thus, the correlation coefficient suggests that younger respondents and those are new to the SHG have recorded higher change in empowerment than that of the older respondents. This is because, the young women with academic aspirations might have undergone high school and college education, at the same time respondents having higher education, better extension contacts and more no of trainings attended, wider mass media exposure have recorded increase in income after joining SHGs and starting their micro enterprise (Shamna *et al.*, 2022).

Table 2 presents the full model of regression analysis between exogenous variable change in empowerment (y_i) vs. 11 causal variables. It is found

		-	1 11	
Variables	Reg. coef. B	S.E. B	Beta	t value
Age (x ₁)	.043	.030	.257	1.412
Marital status (x_2)	022	.026	151	830
Education (x_3)	.138	.040	.330	3.486
Family size (x_4)	.068	.059	.060	1.156
Annual income (x_5)	2.689E-005	.000	.054	1.021
Experience in SHG (x_6)	.005	.021	.014	.213
Extension contacts (x_7)	.203	.076	.194	2.670
No of training attended (x_8)	.125	.034	.194	3.729
Mass media exposure (x ₉)	.249	.084	.279	2.979
Distance from market (x_{10})	.139	.037	.205	3.720
Land holding (x_{11})	.197	.038	.274	5.219

Table 2: Regression analysis o	change in empowerment (y) vs. independent variables (x ₁	-x ₁₁)
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R square: 84.1%; Standard error of the estimate: 0.66

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Variables	Reg. coef. B	S.E. B	Beta	t value
Education (x ₃)	.252	.025	.601	9.906
Land holding (x_{11})	.182	.040	.253	4.541
No of trainings attended (x_8)	.144	.035	.223	4.083
Distance from market (x_{10})	.166	.041	.244	4.068

R square: 77.9 %; Standard error of the estimate: 0.74

Table 4: Path analysis: Decomposition of total effects into direct, indirect and residual effect (empowerment change vs. consequent variables (x_1-x_{11})

Variables	Total effect	Direct effects	Indirect effects	Highest indirect effects		
$\overline{\text{Age}(\mathbf{x}_1)}$	-0.491	.257	-0.748	-0.208 (x ₃)		
Marital status (x_2)	-0.458	151	-0.307	0.241 (x ₁)		
Education (x_3)	0.775	.330	0.445	0.221 (x ₉)		
Family size (x_4)	0.193	.060	0.133	0.077 (x ₃)		
Annual income (x_5)	-0.026	.054	-0.08	$-0.060 (x_9)$		
Experience in SHG (x_{o})	-0.382	.014	-0.396	0.157 (x ₁)		
Extension contacts (x_7)	0.656	.194	0.462	0.212 (x ₃)		
No of training attended (x_8)	0.308	.194	0.114	-0.05 (x ₁)		
Mass media exposure (x ₉)	0.770	.279	0.491	0.264 (x ₃)		
Distance from market (x_{10})	0.558	.205	0.353	0.131 (x ₃)		
Land holding (x ₁₁)	0.428	.274	0.154	0.073 (x ₃)		

Residual effect: 15.8%

that 11 casual variables together have contributed 84.1 per cent of variance in consequent variable change in empowerment (y_1) . The result suggests that the selected variables are more or less functionally relevant to estimate, Change in empowerment of the respondents. Table 3 represents step-down regression analysis, in stepwise regression analysis it is found that the variables

such as Education (x_3) , No of trainings received (x_8) , distance from market (x_{10}) and land holdings (x_{11}) has been retained in the last step. In order to scale up empowerment of the SHG members, the prime concerns could be education, size of holding and to provide trainings and market facilities (Raj *et al.*, 2022). It is interesting to note that these four variables together

have contributed 77.9 per cent of total variance explained so far to indicate their distinctive contribution in characterising Change in empowerment.

The Table 4 shows that the variable Age (x_1) has got highest indirect effect on change in empowerment (y_1) . This is well disenable that education (x_2) has got a direct and sustainable effect on Change in empowerment (y_1) and Education (x_3) has got the highest accompanying effect on change in empowerment (y_1) . It is also interesting to note that education (x_3) has the highest indirect effect as many as six variables to finally estimate the dependent variable change in empowerment. The role of education has got tremendous cohesive effect on psychological, economic, social and political empowerment of SHG women. Education enlightens the individual, improves her awareness, brings behavioural changes in an individual, contributes to their self development, change his knowledge about the unknown areas and motivates her to try the untried ideas, moreover, educated respondents have better leadership ability, selfconfidence which is essentially contributing to the change in empowerment (Bonny et al., 2022).

CONCLUSION

The group dynamics of Self Help Groups (SHGs) have gone unique in making and exerting women empowerment. The personality, socio-personal and agro-ecological variables like land holding, education, number of trainings and distance from the market has gone instrumental. Here, in this empirical study in ascribing to women empowerment the closure is market location; the higher has been the empowerment. Further studies are required to predict and access the process and ecology of women empowerment by including other factors such as perception, psychomotor, social networking, socialization process, income changes and customization has to properly access empowerment, not as rhetoric, but as an operational concept.

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Research Article

Constraints Faced and Suggestions Offered by Groundnut Growers Towards ICT for Availing Agricultural Information in the Saurashtra Region of Gujarat

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ABSTRACT

The state of Gujarat produces the majority of groundnuts in India and contributes significantly to the agrarian economy. This necessitates a more responsible approach to sustainable groundnut cultivation, as well as empowering farmers to achieve optimal farm goals. Timely availability of information through networks, mobile devices, services, and applications that support the processing, management, and exchange of data, information, or knowledge within the farming ecosystem are examples of Information and Communication Technologies (ICTs) in agriculture. Through educational processes, ICTs help farmers raise the social and educational standards of rural life while also enhancing farming practices and productivity. This raises their standard of living. Thus, it has become essential to know the various constraints faced by the Groundnut growers and the remedies suggested by them which can aid in further improvements. The study was conducted in the Saurashtra region of Gujarat. Four districts were selected purposively out of eleven districts and a total of 160 groundnut growers were selected randomly as respondents. Garrett's ranking technique was employed to analyze the constraints as perceived by farmers. It can be inferred that lack of training on ICT' ranked first among the constraints, 'high cost and lack of funds for equipment' were ranked second, and 'Lack of farmers' interest in ICT-based transfer of technology' was ranked third. The important suggestion endorsed by the respondents was that adequate and timely training on ICT should be given to (64.37%) of the respondents.

Keywords: Constraints, Groundnut growers, Information and communication technology, Suggestion

INTRODUCTION

Groundnut plays an important role in the agricultural and industrial economy of Gujarat state. Saurashtra region, which is known as the "Groundnut Bowl of India" has greater importance for groundnut as it accounts for about 92 per cent of the total groundnut area of the state. In India, Gujarat is the leading groundnut-producing state with total production for Gujarat estimated as 28,14,474 metric tonnes with an average yield of 1,647 kg/ha for the year 2021-22, and the total area of *Kharif* groundnut was 17,09,000 hectares. Groundnut is grown mainly in the districts of Junagadh, Amreli, Rajkot, Bhavnagar, Jamnagar, Sabarkantha, etc. (Anonymous, 2017b). To aid the farmers in better farming prospects, Information and communication technologies (ICTs) are a better medium. Any communication tool or application, such as a radio, television, cell phone, computer or network hardware, satellite system, etc., as well as the various services and applications that go along with them, like videoconferencing and distance learning, are included under the umbrella term of ICT (Jha *et al.*, 2023). ICTs emphasize advancing technology and communication systems to promote rural and agricultural development. About some of the major issues in the agriculture field,

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such as pest and disease outbreaks, protracted droughts, seasonality and spatial dispersion of farming, information asymmetry, and high transaction costs, the practicality of ICTs has the potential and ability to identify and promulgate a relevant solution (Anh *et al.*, 2019). ICTs entail the conception, planning, development, assessment, and implementation of innovative technologies in a rural area, with a primary focus on agriculture (Hiremath *et al.*, 2015).

Though the groundnut is a principal crop of the Saurashtra as well as Junagadh districts, there is a wide gap between the average yield of common farmers and the actual potential yield. The low yield leads to a considerable gap between the supply and demand of edible oil in our country. As a result of this gap, the price of edible oil rise beyond the reach of the economically weaker section. Thus, one of the most important problems the country faces today, and one that calls for immediate attention is that of stepping up production of all the oil seeds crops in general and groundnut in particular. Since improvement in varieties of groundnut has not been of the same order as in cereals and groundnut, one has to depend upon all the improved practices about groundnut cultivation to boost the production per unit area. Thus, the study aims to identify the constraints faced by groundnut growers while using ICT and the suggestions received from groundnut growers for the effective use of ICT tools.

MATERIALS AND METHODS

An ex-post facto research design was followed for carrying out the study. For drawing the sample for the study multistage simple random sampling technique was used. The study was conducted in the Saurashtra region. The Saurashtra region consists of eleven districts; out of them four districts namely Junagadh, Gir Somnath, Rajkot, and Amreli were selected purposively based on higher groundnut area and productivity. A total of 160 respondents were selected for the study. A sample of a total of 160 groundnut growers from sixteen villages was considered for the study. The dependent variable taken for the study was constraints faced by groundnut growers while using ICT. For this purpose, an interview schedule was formulated and it was pre-tested and translated into Gujarati. The collected data were classified, tabulated, analyzed, and interpreted to make the findings meaningful. Statistical measures such as percentage, mean, standard deviation, and correlation coefficient were used in the study. Garrett's ranking technique was used for the analysis of constraints faced by the groundnut growers. The ranks given by each respondent were converted into percent positions by using the formula:

Percent position =
$$\frac{100 \text{ x } (\text{R}_{ij} - 0.5)}{\text{N}}$$

where $R_{ij} = rank$ given for ith constraint by jth individual; $N_j =$ number of constraints ranked by jth individual. The estimated percent positions were converted into scores using Garrett's table. Further, their valuable suggestions to combat these issues were also denoted, documented, and ranked based on frequency and percentage.

RESULTS AND DISCUSSION

Groundnut growers have a critical role in the development of farming and farming community. However, they are facing many difficulties in the utilization of ICTs. To understand such difficulties, data were collected from the groundnut growers and accordingly, various constraints are presented in Table 1.

Table 1 revealed that the constraint 'lack of training on ICT' ranked first among the constraints faced by the groundnut growers while ICT utilization (66.21). The constraint of high cost and lack of funds for equipment was ranked second (64.81). The third rank was to the constraint lack of farmers' interest in ICTbased transfer of technology (59.61).

The other constraints faced by the respondents were; poor technical know-how (47.26), lack of motivation to use ICT-based extension (46.66), difficulty in developing content in the local language (45.00), slow internet connectivity (39.71), backache/ headache/ hand pain (38.58%) and adverse effect on eyesight (32.29). These results are in line with the results of (Chithra, 2015).

Suggestions are the solutions to overcome the constraints faced by groundnut growers. It is very important to solve the problems faced by the groundnut growers as these problems directly affect

S.No.	Constraints	Total Garrett Score	Mean Score	Garrett Rank
1.	Poor technical know-how	7562	47.26	V
2.	High cost and lack of funds for equipment	10371	64.81	II
3.	Lack of training in ICT	10595	66.21	Ι
4.	Poor infrastructure facilities	8117	50.73	IV
5.	Backache/headache/hand pain	6173	38.58	IX
6.	Adverse effects on eyesight	5167	32.29	Х
7.	Lack of farmers' interest in ICT-based transfer of technology	9539	59.61	III
8.	Slow internet connectivity	6355	39.71	VIII
9.	Difficulty in developing content in the local language	7201	45	VII
10.	Lack of motivation to use ICT-based extension	7467	46.66	VI

Table 1: Constraints faced by groundnut growers (n=160)

Table 2: Suggestions from respondents to overcome the constraints (n=160)

S.No.	Suggestions	Frequency	Percent	Rank
1.	Awareness about the uses and effectiveness of ICT among various stakeholders	86	53.75	III
2.	Adequate and timely training in ICT	103	64.37	Ι
3.	Enough funds should be provided for ICT facilities and services	58	36.25	IV
4.	Maintenance of already installed equipment should be regular	101	63.12	II
5.	Uninterrupted power and internet facility should be ensured	32	20.00	V
6.	The selection of ICT tools should be proper, location-specific, and need-based.	30	18.75	VI

the effectiveness of extension services and the farmers who are end users of these services. Table 2 enlists a few important suggestions given by the groundnut growers. The majority (64.37%) of the respondents suggested that adequate and timely training on ICT should be provided for utilizing its maximum potential. Regular maintenance of already installed equipment was ranked second among the suggestions. This suggestion was given by 63.12 per cent of the respondents. Awareness about the uses and effectiveness of ICT among various stakeholders ranked third among the suggestions. It was offered by 53.75 per cent of the respondents.

The other suggestions given by the respondents were enough funds should be provided for ICT facilities and services (36.25%) followed by uninterrupted power and internet facility should be ensured by (20.00%) of the respondents and the selection of ICT tools should be proper, locationspecific, and need-based (18.75%). These results are in line with the results of (Sireesha *et al.*, 2014).

CONCLUSION

A systematic institutional mechanism has to be developed wherein all the stakeholders viz., farmers, extension personnel, and research personnel have constant interaction and sharing of information about groundnut cultivation practices. This study gives us a detailed view of the constraints faced by groundnut growers concerning the use of ICTs. The results concluded that lack of training on ICT, high cost and lack of funds for equipment, and lack of farmers' interest in ICT-based transfer of technology were some of the important constraints faced by the farmers. A few important measures to be implemented to facilitate the utilization of ICTs as suggested by farmers include adequate and timely training on ICT, maintenance of already installed equipment should be regular and awareness about the uses and effectiveness of ICT among various stakeholders. It can be useful to document the understanding of farmers on ICT technology. The constraints identified and suggestions given by farmers will serve as a torch bearer to the amendments required to keep the policy with time.

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Research Article

Students' Career Choices: An Exploratory Study on the Influence of Socio-Demographic Variables on Higher Agricultural Education in India

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ABSTRACT

In India, Different higher education systems including Medicine, Engineering, Management and etc., Agriculture education is also one among them. Every student aspires to develop a strong professional career in the field of Medicine, Engineering, and Agriculture. Building their professional career in a particular field. Typically, one aspires to acquire a job that will help him be stable as well as his family and country in the long term. Career choices will depend on many factors which include socio-demographic variables. The present research aims to explore socio-demographic variables' influence on students' career choices for higher agricultural education. In this study, the target population is students of IARI, university of agricultural sciences, Raichur, and Banda University of Agriculture and Technology, Banda with a sample of 150 for collecting the desired information according to the nature of the population. we use simple random sampling to gather the data. For this study Student career choice index was developed and pretested with experts' opinions which include dimensions are Personal and Impersonal characteristics, Socio-economic factors, Career scope, and Institute image. To measure the socio-demographic variables' influence on the student's career choices, we used hypothesis and regression analysis which was performed on the data which shows that variables like gender, parent's occupation, father's education, mother's education, family income, and peer group consult positively at 5 per cent level of significance were playing important role in influencing of career choices.

Keywords: Students' Career choice, Career scope, Higher agriculture education, Socio-demographic variables

INTRODUCTION

The Indian education system consists of different higher education like Medicine, Engineering, Management and etc, among them Agriculture education is also included. Indian Agriculture Education System is under the umbrella of the Indian Council of Agricultural Research (ICAR), which is an autonomous organization within the Department of Agricultural Research and Education (DARE) of the Ministry of Agriculture and farmers welfare (M/o A&FW). ICAR comprises 101 research institutes, 71 state agricultural universities, 4 deemed universities, and 3 central agricultural universities, making it the world's largest agricultural education and research system network. Several institutions, faculties in a general university, and private agricultural universities are found in every country's 'nooks and corners' (Challah *et al.*, 2011; Kumar, 2016).

Every student wants to build a good professional career which should be continued throughout the lifetime, usually one wants to get a career that helps him to be stable and also his family and nation in the long run. In every student's life, a stage will come, where students have to choose a career to build their future as it is important which affects professional life. As

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students attempt to decide they face many problems of matching the choices they want according to their abilities and performance in the previous school/ colleges. While choosing their choices many factors such as parents, teachers, financial aspects, age, gender, parents' education, etc., will influence them.

Career choice is defined as occupation as a means of living, which has the power to change personalities, and social status, predict expected earnings, determine social groups, etc (Kazi and Akhlaq, 2017). Career choice is the stream chosen by the students on their own for their higher education. The factors that affect career choice include family, neighbours, parents' income, passion, peer group, media, and past experiences (Kohn et al., 1976; Menon, 2004; Menon et al., 2007; Cremonini et al., 2008; Sojkin et al., 2012). According to a study (Chapman, 1981) students' attributes and external factors effects such as mainly institutional factors, personal impact, and college initiatives to contact students influence college decisions the most (Hossler and Gallagher, 1987) developed a college choice model consisting of three phases 'predisposition', 'search', and 'choice'. Students, while choosing a career, may not have the necessary knowledge. For example, students want to be a doctor, engineers, veterinarians, etc. but may not know how much work should be done after choosing selected areas. These students are most influenced by eighter families, neighbours, and peer groups. The most significant factor to consider while selecting a college is academic excellence (Kinzie et al., 2004; Roszkowski and Spreat, 2010; Noel-Levitz, 2012). Even during the decision-making stage, students and parents view college as a financial, career, especially in a country like India. They examine the institute's location, fee structure, hostel infrastructure facilities, internet, network availability, and other essential factors besides the quality. The ranking of institutes and their reputations as universities are prime factors in students' career decision-making (Hazelkorn, 2009). According to various studies, students rated the campus environment for students, which encompasses the school's surroundings, social climate, and peer relationships produced by affiliation with a university, as a motive for choosing a university (Hazelkorn, 2009; Nurnberg et al., 2012), time, and effort investment (McClung and Werner, 2008).

MATERIALS AND METHODS

An Exploratory research design has been used in the present study to identify the respondents. The research study presents the data gathered from universities Selected based on the ICAR ranking list of agricultural universities 2021, among those 67 ranking agricultural universities, we categorized them into three levels, they are upper level, medium level, and lower level. Among these three levels, The Indian Agricultural Research Institute, (IARI, New Delhi), University of Agriculture Sciences, Raichur (UASR), and Banda University of Agriculture and Technology, Banda (BUAT) universities and institutes were selected by simple random Sampling and respectively from each level. In the second stage, A total population of 150 postgraduate students and 50 students from each university was selected using simple random selection. For the present research Hypothesis was constructed.

 H_{o} : There is no significant relationship between the socio-demographic variables on the students' career choice index.

Career choice: Career choice is operationally defined as making choices on a career path, which is influenced by socio-demographic factors such as education and training for a specific job.

The influence of socio-demographic variables on students' career choices was measured by an index that was developed for this purpose which consisted of the following four dimensions:

i) Personal and Interpersonal characteristics: It refers to the degree to which an individual's -behaviour towards others, attitude, characteristics, and mindset help in choosing a career choice.

ii) Socio-economic factors: It refers to the degree to which education, occupation, and financial aspects effects on student's career choice.

iii) Career Scope: Career scope was operationalized as the degree of opportunities for jobs, placements, and professional growth in the field.

iv) Institute image: Institute image was operationalized as the degree of quality educational services and infrastructural facilities provided by the institute to the students.

The criteria for selection should serve as a reference for whether or not to include an indicator in the overall composite index. It should be as specific as possible, describing the phenomena being monitored, such as input, process, and output. The dimensions in this Index were discovered by a review of relevant literature and the opinion of experts, and the indicators were selected under each dimension after being tested for relevance with thirty experts. Table 2 shows that twenty items were selected for final measurements out of thirtytwo items after the pre-test was done with scores given by the judges. The mean relevancy score of each statement was calculated and the statements with a mean relevancy score greater than 3.5 were included in the interview schedule. The student's career choice index under four indicators viz, personal and interpersonal characteristics, socio-economic factors, career scope, and institute image consisting of 5, 5, 4, and 6 respectively.

Mean relevancy score = (most relevant*5) + (relevant*4) + (neutral*3) + (irrelevant*2) + (most irrelevant*1) / Number of judges

Weightage: The influence of socio-demographic variables is operationalized to the extent that meets desired results of career choice. The dimensions and indicators were sent to experts of the concerned field for relevancy test and to provide weightage for each dimension. The mean weight was calculated and used for final measurements.

Students' career choice Index (SCCI) = $C1 \times W1 + C2 \times W2 + C3 \times W3 + C4 \times W4 / W1 + W2 + W3 + W4$

where, C1 = Score obtained on Personal and interpersonal characteristics

C2 = Score obtained on Socio-economic factor

C3 = Score obtained on Career Scope

C4 = Score obtained on Institute Image

W1 = Weightage for the Personal and interpersonal characteristics as given by judges.

W2 = Weightage for the Socioeconomic factor as given by judges.

W3 = Weightage for the Career Scope as given by judges.

W4 = Weightage for the Institute Image as given by judges

Each respondent's index value was calculated and cumulative cube root frequency was used to categorize the respondents into three strata for a better comprehensive picture of the career choices including low, medium, and high which shows the level of influence on students for career choice. For the final measurements, we used regression analysis as a statistical tool. Table 1 and Table 2 revealed that the weightage for each dimension and the mean relevancy score of indicators were obtained as per scores given by the judges.

RESULTS AND DISCUSSION

The results show that each individual index value has been calculated and categorised with the help of the cumulative cube root frequency method.

Table 3 reflects the perceived index value of students, among 150 student's 54 per cent of students perceived a high index value, 26.66 per cent perceived a medium index value, and 19.33 per cent of students perceived a low index value. The individual values obtained from the index used for regression analysis

Table 4 reflected the model summary of data or the regression statistics showed how well calculated multiple linear regression equation fits the data. As adjusted R square was more important, The R-square value also showed that all the independent variables jointly explained the student's career choice to the extent of 69.2 per cent. The adjusted R-square value showed that the number of independent variables explained the students' career choices to the extent of 66.9 per cent.

Table 5 reflects the ANOVA model which shows that the student career choice was significant at a 1 percent level of significance concluding that the

Table 1: Weightage given by judges for each dimension

Dimension	Weightage given by judges
Personal and interpersonal characteristic	cs 3.75
Socioeconomic factor	3.83
Career Scope	4.25
Institute Image	4.29

Indicators / Items	Mean
Personal and interpersonal characteristics	
I choose this path because of my personal interest/passion	3.72
An agriculture career has a lot of scope for my well-being.	4.02
Parental decisions made me choose this career.	4.39
I was influenced by my teachers to opt for the agriculture field.	4.00
A few agricultures career counselling sessions helped me in my career decision.	3.97
Socio-economic factors	
Family income is the prime factor for agriculture career choice.	4.10
I choose an agriculture university that is nearby my locality.	4.07
I choose this university Based on the institute's fee structure.	4.17
Availability of financial aid from the university.	4.12
Parents' education influences to choose this agriculture field.	4.23
<i>Career scope</i>	
The employment ratio is higher in the agriculture field.	4.33
This field has more agribusiness and enterprise opportunities.	4.20
More public sector job opportunities in the agriculture field are one prime factor.	4.02
Lucrative salary after getting the job is one factor for choosing the agriculture field.	4.07
Institute image	
Agriculture university ranking and accomplishments show its quality when choosing a career.	4.11
I choose an agriculture university due to its quality of education.	4.15
Agriculture University's social image influences students' career choices.	4.32
The infrastructure facility of the agriculture institute influences students' career choices.	4.35
Educational aid, Company placement for agriculture universities affect career choice.	4.30
The connectivity of agriculture universities with foreign institutes helps in choice-making.	4.23

Table 3: Categorisation of students based on the students' career choice index value (n=150)

ē				
Category	IARI	UASR	BUAT	Total
	frequency (f)	frequency (f)	frequency (f)	frequency (f) (%)
Low (<176)	10	9	10	29 (19.33)
Medium (176-259)	10	15	15	40 (26.66)
High (>259)	30	26	25	81 (54)
Total	50	50	50	150

Table 4: Multiple Regression Analysis of the student career choice index with Socio-demographic variables (n=150)

Model summary						
Model	R	R square	Adjusted R square	Std Error of the Estimate		
1	.743ª	0.692	0.669	3.387		

regression model fits better. This showed there was a significant relationship between the socio-demographic variables and students' career choices. So null hypothesis was rejected. Table 6 reflects that the regression coefficient value obtained from multiple linear regression analysis of independent variables with students' career choices was presented. The coefficient values explain the number

			ANOV	A		
Model		Sum of squares	df	Mean square	F	Sig
1	Regression	179003.521	10	17900.3521	31.23	<.001 ^b
	Residual	79679.2758	139	573.2322		
	Total	258682.796	149			

Table 5: Multiple regression ANOVA of student career choice index with socio-demographic variables (n=150)

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	Coefficient						
Model	Coefficient B	Standard error	Т	Sig.			
Constant	72.965	12.685	5.75	0.000**			
Gender (X ₁)	8.709	4.277	2.04	0.040*			
Age (X_2)	965	1.499	-0.64	0.520			
Locale (X_3)	2.260	2.151	1.05	0.295			
Family size (X_4)	-2.154	1.380	-1.56	0.121			
Family income (X_5)	0.565	0.204	2.77	0.007*			
Parent's occupation (X_{δ})	10.033	1.783	5.63	0.011*			
Father's education (X_7)	2.632	1.002	2.62	0.010*			
Mother's education (X_8)	3.249	1.201	2.70	0.011*			
Media exposure (X ₉)	2.447	2.181	1.12	0.264			
Peer group consult (X_{10})	15.521	2.422	6.41	0.006*			
$R^2 = 0.692$ adjusted $R^2 = 0.669$							

** 1 percent level of significance * 5 percent level of significance

 $\label{eq:2.965} \begin{array}{l} Y2 = 72.965 + \ 8.709 \ \text{X1} - 0.965 \ \text{X2} + 2.260 \ \text{X3} - 2.154 \ \text{X4} + 0.00073 \text{X}_{5} + 10.033 \ \text{X6} + 2.632 \ \text{X7} + 3.249 \ \text{X8} + 2.447 \ \text{X}_{9} + 15.521 \ \text{X10} \end{array}$

 X_1 Gender; X_2 Age; X_3 Locale; X_4 Family size; X_5 Family income; X_6 Parent's occupation; X_7 Father's education; X_8 Mother's education; X_9 Media exposure; X_{10} Peer group consult

of students' career choice changes for a unit increase in each independent variable. It revealed that out of ten independent variables, four variables viz., Age, family size, locale, and media exposure were found to be non-significantly contributing to the student's career choice. The independent variable like gender, parent's occupation, father's education, mother's education, family income, and peer group consults showed significant contributions towards student's career choice at 5 per cent levels of significance. Thus, for every one unit increase in the independent variables viz, gender, parent's occupation, father's education, mother's education, family income, and peer group consult were increase the students' career choices by 8.70, 10.033, 2.632, 3.249, 0.565 and 15.521 units respectively. The regression analysis showed a significant relationship between socio-demographic variables and students' career choices which results in the rejection of the null hypothesis.

Most of the studies on students' career choices (Lewis, 1975; Chapman, 1981; Chapman 1984; Menon, 2004; Menon et al., 2007; Sojkin et al., 2012) explored those factors like parental pressure, students' characteristics, aspirations, achievements, institutional factors and influence of peer person affect career choice (Chapman, 1981) reported that the role of a significant person greatly affected the career choice decision. There was a great contribution of significant persons during career choice and these persons include parents, family, friends, teachers, and counsellors (Chapman, 1981; Hossler, 1987). Whereas (Litten, 1982) reported that counsellors and teachers ranked third in the list of influencers after parents and peers in the influence of student's career choices (Olavinka, 2019) also studied that the parents were already decided on their children's careers, and motivated them to pursue the same (Kusumawati et al., 2010) explored those 5 factors, such as academic quality, friends, psychological factors, parents' influence, and campus environment were also important for students. Reid (2015) reported that the background of the family influenced career choice. Factors such as parent education, family income, and occupation were also positively associated with the career choice of graduates (Killam *et al.*, 2016) studied that about 18.46 per cent of the respondents felt that parents had influenced their career choice. Other factors such as occupation and profession of parents, income, education, and other family members or siblings (Strayhorn *et al.*, 2008) suggested that 3 sets of factors influenced university choice decisions: academic traits, financial traits, and individual traits or experiences.

CONCLUSION

The study was conducted to examine the effect of socio-demographic variables on students' career choices for higher agriculture education. It also showed which factors perform an important role in measuring students' career choices. The findings from the study confirmed that gender, parent's occupation, father's education, mother's education, family income, and peer group consults showed significant contributions towards student's career choice at 5 levels of significance. The index for students' career choice was developed for the study which was used to measure the influence of factors on students' career selection. The regression analysis showed a significant relationship between socio-demographic variables and students' career choices which results in the rejection of the null hypothesis.

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Research Article

Protein Fortification Improved Silkworm Productivity

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ABSTRACT

Nutrition is one of the most important factors that contribute to the growth, development and subsequent cocoons production of silkworm, *Bombyx mori* L. However, little is known about the use of bee pollen, drone brood and protinex as a fortifying agent. Mulberry leaves fortified with different proteins were fed to silkworm larvae once in 4th and 5th instar. The economical parameters of silkworm were significantly increased with optimized concentrations of different proteins. Lowest disease incidence (2%), maximum larval weight (43.43g), cocoon weight (2.26g), shell weight (0.516g), pupal weight (1.74g) and shell ratio (22.86%) were recorded at (2%) bee pollen concentration followed by protinex (10%), bee pollen (5%) + protinex (5%) and drone brood (6%).

Keywords: Bee pollen, Cocoon, Drone brood, Fortification, Protinex, Silkworm

INTRODUCTION

Silkworm is a monophagous lepidopteran economic insect and additionally a tool to convert mulberry leaf protein into commercially precious silk protein. The only source of nutrition for the silkworm, Bombyx mori owing to the presence of morin is mulberry (Tribhuwan and Mathur, 1989). It is well-known that the mulberry leaf provided to silkworm larvae as food must contain several chemical constituents such as water (80%), proteins (27%) and carbohydrates (11%) other extracts, mineral matters, vitamins etc. as cocoon characters each quantitative and qualitative depends principally on the quality and quantity of mulberry leaves (Koul, 1989). If the optimum required nutrients are not present in the leaves then silkworm may become susceptible to disease and therefore the proportion of effective rate of rearing will be decreased as the mortality rate is higher in silkworm reared on poor foodstuff.

Fortification is a modern technique in advanced sericulture research and development industry is being used to improve the cocoon yield and silk content through supplement of different nutrients on mulberry leaf. Fortification with the aim of yield improvement using vitamins, minerals, proteins, amino acids and other compounds has usually been attended from 1990s and many researches have been conducted. Over 40 completely different compounds with supplementary nutrients have been analysed at different regions with different climates and varied results have been obtained (Etebari et al., 2004). Silkworm, B. mori requires sugars, amino acids, proteins and vitamins for its normal growth, survival and for the growth of silk gland (Sengupta et al., 1972). Among these, one of the most vital is the amount of protein content in the mulberry leaves which influences the silk production. The formation of silk proteins throughout growth of the silkworm larvae was studied by Fukuda et al. (1959) wherein, they found that about 70 per cent of the silk protein produced by B. mori was taken directly from the mulberry leaves on which they were fed. It was also found that about 72-86 per cent of the amino acids and 60 per cent of the absorbed amino acids used for silk production are obtained by the silkworm larvae from the mulberry leaf (Lu and Jiang, 1988).

Bee pollen has been regarded as a complete sustenance food and contains essential amino acids, carbohydrates, vitamins, minerals etc. which is not found in foods obtained from animal origin (Guine,

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supplement of the diet due to its richness in proteins, particularly in fats and carbohydrates (Villanueva et al., 2002). Moreover, in the bee pollen, there are significant amounts of nucleic acids, especially ribonucleic one, digestible carbohydrates, reducing sugars, mainly fructose and glucose are also present (Roulston and Cane, 2000). Fresh drone brood is also a rich source of protein compared to other bee products. Among all the amino acids found in drone brood, glutamic acid (6.5%), leucine and aspartic acid (3.6% each), proline (3.4%), lysine (2.9%), valine (2.3%) and alanine (2.1%) makes up 60 per cent of all amino acids (Lazaryan et al., 2003). The protinex powder also contains sufficient quantity of protein (32g/100g), carbohydrates, minerals and vitamins. Any scientific documentation concerning the use of bee pollen, drone brood and protinex as a fortifying agent in silkworm is completely lacking. The present study is a maiden attempt to assess the effect of fortified mulberry leaves with bee pollen, drone brood and protinex on the economical parameters of silkworm, B. mori.

MATERIALS AND METHODS

The present study was conducted at Sericulture Research Laboratory, Division of Sericulture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Main Campus, Chatha.

For the present investigations, bee pollen and drone brood were collected from the apiary maintained by Division of Entomology, SKUAST-Jammu. However, the protinex powder was procured from the nearby market. Known quantity of bee pollen (g) weighed on an electronic balance was mixed with known quantity of distilled water (ml) on weight by volume basis (1:1) using a glass rod. The material was then squeezed through double layered muslin cloth. However, the drone brood (g) was crushed in known quantity of distilled water (ml) on weight by volume basis (1:1) using mixer grinder. In case of protinex, known quantity of protinex powder (g) weighed on electronic balance was mixed with known quantity of distilled water (ml) on weight by volume basis (1:4) using a glass rod in order to make protinex solution. The filtrates were maintained as stock solution, considered as 100 per cent and kept in refrigerator at -4°C for further use.

For the experiments, the test insect, bivoltine double hybrid FC1 × FC2 [(CSR6 × CSR26) × (CSR2 × CSR27)] silkworm, *B. mori* was used. The silkworms were reared as per the rearing method suggested by Krishnaswami (1978).

The experiment was laid down in a completely randomized design with seven treatments including control, each treatment was replicated thrice and in each replication 100 silkworm larvae were reared. Mulberry leaves fortified with different proteins were fed to silkworm larvae two times, once in 4th and 5th instar respectively. The economical parameters of silkworm were recorded for each replication of each treatment as designed in the experiment as per the mentioned formulas.

1. Disease incidence (%): (Number of diseased worms collected) / (Total number of larvae retained after 3rd moult) × 100

2. Larval survival (%): (Number of larvae survived till pre-spinning stage) / (Total number of larvae retained after 3rd moult) × 100

3. Ten mature larval weight (g): On fifth day of 5th instar, ten matured silkworm larvae were randomly picked from each replication of each treatment and weighed on electronic balance. It was expressed in grams.

4. Cocoon weight (g): Ten cocoons were randomly picked from each replication of each treatment and weight was recorded. Average weight for single cocoon was calculated and expressed in grams.

5. Shell weight (g): From each replication, ten cocoons were cut, pupae and cast skin were separated and the cocoon shell weight was recorded. Average weight of single shell was calculated and expressed in grams.

6. Pupal weight (g): From each replication, ten cocoons were cut, shells were separated and the pupal weight was recorded. Average weight of single pupa was calculated and expressed in grams.

7. Shell ratio (%): [Shell weight of cocoon (g)] / [Cocoon weight (g)] ×100

Statistical analysis: All the observations obtained for various parameters were tabulated and subjected to

statistical analysis by using the SPSS version 16.0. The data after tabulation firstly tested for normality and homogeneity by using Shapiro-wilk and Levene's test. Then subjected to one way ANOVA using SPSS and means were separated by using Tukey's post hoc tests.

RESULTS AND DISCUSSION

The incidence of disease in silkworm ranged from 2.00 to 7.00 per cent. The silkworm larvae fed on mulberry leaves fortified with bee pollen at 2 per cent concentration recorded significantly lowest disease incidence of 2.00 per cent which was found at par with other treatments. However, highest disease incidence to the tune of 7.00 per cent was recorded in control. Significant difference was found between treatments and control batch with respect to disease incidence (Table 1). The larval survival ranged from 93.00 to 98 per cent. All the treatments were found statistically at par with each other with respect to larval survival percentage. However, there was significant difference was recorded between treatments and the control batch (Table 1).

The reduced disease incidence and higher larval survival percentage in silkworms may be due to fortification of mulberry leaves with different proteins that might have contributed in boosting the immune system of silkworm due to presence of high level of essential amino acids. Rani *et al.* (2011) also reported that the mulberry leaves fortification not only enhanced the economic and nutritional parameters of silkworm but also prevent bacterial infection in silkworm, *Bombyx mori.* Similar studies have been carried out by Hamzah *et al.* (2016), who also reported that lowest (4%) mean larval mortality due to disease incidence was obtained when larvae were fed on fortified mulberry leaves with bee pollen (2, 4 and 6%) when compared to control in which 12 per cent of mean larval mortality was recorded. Although, proteins are very important resources for promoting host resistance and producing immunological components to resist infections by pathogens, subsisting on higher than optimal level of protein inevitable results in adversely affecting an insect's growth and development (Wilkinson, 2001).

The effect of mulberry leaves fortified with different proteins on mature larval weight is presented in Table 2 and it was found that the mature larval weight of ten silkworm larvae ranged from 31.33 to 43.43g which significantly increased with different proteins. However, the maximum larval weight (43.43g) was recorded in bee pollen 2 per cent concentration followed by protinex 10 per cent (42.63g), bee pollen (5%) + protinex (5%) combination (41.84g), drone brood 6 per cent (40.31g), bee pollen (3%) + drone brood (3%) combination (39.69g) and drone brood (5%) + protinex (5%) combination (39.43g) while the lowest larval weight to the tune of 31.33g was recorded in control. Significant difference between treatments including control was recorded with respect to mature larval weight of ten silkworm larvae. The increase in larval weight might be due to additional supplementation of proteins along with mulberry leaves. Fukuda et al. (1963) reported that the cocoon fibre spun by the silkworm was chiefly formed by the mulberry leaves consumed by the silkworm at the middle and later stages of the 5th instar. The results are in line with Hamzah et al. (2016), who also reported that silkworms fed on 6 per cent bee pollen fortified mulberry leaves recorded the highest means of larval

Table I:	Effect of	mulberry	leaves to	rtified with	amerent	proteins	on siikworm	disease ii	nciaence	and larva	ai surviva

Fortification of mulberry leaves with	Disease incidence (%)	Larval survival (%)	
Bee pollen (2%)	$2.00 \pm 0.57^{*}$	$98.00 \pm 0.57^{\rm b}$	
Drone brood (6%)	4.00 ± 0.57^{a}	$96.00 \pm 0.57^{\text{b}}$	
Protinex (10%)	2.00 ± 0.57^{a}	$98.00\pm0.57^{\rm b}$	
Bee pollen (3%) + Drone brood (3%)	4.00 ± 0.57^{a}	$96.00 \pm 0.57^{\text{b}}$	
Bee pollen (5%) + Protinex (5%)	4.00 ± 0.57^{a}	$96.00 \pm 0.57^{\rm b}$	
Drone brood (5%) + Protinex (5%)	3.00 ± 0.57^{a}	$97.00 \pm 0.57^{\rm b}$	
Control	$7.00 \pm 0.57^{\rm b}$	93.00 ± 0.57^{a}	

Each value is mean \pm standard error of three replications

Figures followed by same letter in column are non significant by Tukey's HSD test

Fortification of mulberry leaves with		Shell ratio			
	Ten Mature larval	Cocoon	Shell	Pupal	(%)
Bee pollen (2%)	$43.43\pm0.09^{\rm f}$	$2.26\pm0.03^{\rm e}$	$0.52 \pm 0.00^{\circ}$	$1.74\pm0.02^{\circ}$	$22.86 \pm 0.19^{\circ}$
Drone brood (6%)	$40.31\pm0.16^{\rm c}$	$1.83\pm0.01^{\circ}$	$0.39 \pm 0.00^{\circ}$	$1.44\pm0.01^{\rm cd}$	$21.31\pm0.27^{\rm b}$
Protinex (10%)	$42.63\pm0.11^{\rm e}$	$1.94\pm0.02^{\rm d}$	0.44 ± 0.00^{d}	$1.50\pm0.01^{\rm d}$	$22.68\pm0.04^{\rm c}$
Bee pollen (3%) + Drone brood (3%)	$39.69\pm0.05^{\rm b}$	$1.71\pm0.00^{\rm b}$	$0.36 \pm 0.00^{\mathrm{b}}$	$1.35\pm0.01^{\rm b}$	$21.05\pm0.37^{\rm b}$
Bee pollen (5%) + Protinex (5%)	$41.84\pm0.08^{\rm d}$	$1.76 \pm 0.01^{\rm bc}$	$0.37 \pm 0.00^{\mathrm{bc}}$	$1.39\pm0.01^{\rm bc}$	$21.02\pm0.28^{\rm b}$
Drone brood (5%) + Protinex (5%)	$39.43\pm0.11^{\rm b}$	$1.71\pm0.00^{\rm b}$	$0.36 \pm 0.00^{\mathrm{b}}$	$1.35\pm0.01^{\rm b}$	$21.05\pm0.41^{\rm b}$
Control	$31.33\pm0.12^{\text{a}}$	1.56 ± 0.01^{a}	0.30 ± 0.00^{a}	1.26 ± 0.01^{a}	$19.23\pm0.07^{\text{a}}$

Table 2: Effect of mulberry leaves fortified with different proteins on economic traits of silkworm, B. mori

Each value a mean \pm standard error of three replications

Figures followed by same letter in column are non significant by Tukey's HSD test

weight. Similarly, Horie and Watanabe (1983) showed that the supplementation of soyabean protein increased body and fresh silk gland weights in the silkworm larvae. However, Bhatti *et al.* (2019) also reported statistically significant difference in larval weight between honey fortified groups and the control batch. Similar results were also recorded by Manimegalai *et al.* (2002) and Shivkumar *et al.* (2020).

The cocoon weight ranged from 1.56 to 2.26g. In this study, the maximum weight (2.26g) of the cocoon was obtained for the batch in which the silkworm larvae were fed on mulberry leaves fortified with bee pollen at 2 per cent concentration. However, at protinex (10%), drone brood (6%) and bee pollen (5%) + protinex (5%), the cocoon weight was 1.94, 1.83 and 1.76g, respectively. Next to it, bee pollen (3%) + drone brood (3%) and drone brood (5%) + protinex (5%) recorded the cocoon weight of 1.71g which was found at par with each other whereas in control batch 1.56g of cocoon weight was recorded (Table 2). The increased cocoon weight in protein fortified batches may be attributed to the increased synthesis of DNA, RNA, proteins and nucleic acids in the silkworm. Further, the proteins might have increased metabolic activities and absorption by midgut epithelial cells followed by different body cells and transformation to cellular structure. These results are in agreement with Rani et al. (2011), who reported that Amway protein at 10 per cent concentration recorded maximum cocoon weight over the control batch. The results are also in accordance with those reported by Mahmoud (2013), that the larvae fed on semi-artificial diet containing soyabean gave the highest records on larval duration, larval weight, silk gland, pupal, cocoon and cocoon shell weight as well as number of deposited eggs. Kumar and Prashanth (2018) also reported that silkworm breeds reared on fortified mulberry leaves with soyabean flour at varied concentrations exhibited significant improvement in cocoon weight.

Shell weight is the indicator of shell yield and it is positively correlated with the length of the shell filament and it ranged from 0.30 to 0.52g. The fortification of mulberry leaves with different proteins resulted in shell weight of 0.52, 0.44, 0.39, 0.37, 0.36, 0.36 and 0.30g, in bee pollen (2%), protinex (10%), drone brood (6%), bee pollen (5%) + protinex (5%), bee pollen (3%) + drone brood (3%), drone brood (5%) + protinex (5%)and control, respectively. However, the shell weight of bee pollen (3%) + drone brood (3%) and drone brood (5%) + protinex (5%) were found at par with each other whereas between treatments and control significant difference was recorded with respect to shell weight (Table 2). The increase in shell weight might be due to additional supplementation of different proteins which enhanced the biosynthesis of silkworm protein.It has been reported by several workers that fortification of mulberry leaves with different supplements resulted in a significant increase in the fat body and haemolymph protein and consequently the weight of the silk gland, cocoon weight and shell weight significantly increased. These results are in agreement with those of Krishnan et al. (1995), who have reported enhanced shell weight when silkworms were fed with hydrolysed soya protein (2-2.5%). Similarly, Abdel-Rahman (2018) found that the highest mean of shell weight (0.221, 0.216 and 0.203g) were recorded at concentration 4, 6 and 8 per cent for liquid whey protein, respectively. Kumar and Prashanth, (2018) also reported that larvae reared on soyabean flour at 4 and 6 per cent, expressed higher shell weight (0.410 and 0.390g) in CSR_2 and CSR_4 , respectively over control.

The pupal weight ranged from 1.26 to 1.74g. The descending order of pupal weight recorded was bee pollen (2%), protinex (10%), drone brood (6%), bee pollen (5%) + protinex (5%), bee pollen (3%) + drone brood (3%), drone brood (5%) + protinex (5%) and control with 1.74, 1.50, 1.44, 1.39, 1.35, 1.35 and 1.26g, respectively. However, the pupal weight of bee pollen (3%) + drone brood (3%) and drone brood (5%) + protinex (5%) was found at par with each other whereas all treatments showed significantly better results than control batch (Table 2). The significant increase in the pupal weight may be due to increase in metabolism leading to gain in pupal weight. The results are in agreement with the earlier observations of Kumar and Prashanth (2018), who reported that mulberry leaves fortified with soyabean flour at 4 and 6 per cent exerted highest pupal weight (1.410 and 1.403g) in CSR, and CSR₄ breeds, respectively over control batch. Similar results were observed by Abdel-Rahman (2018), who has recorded the highest (0.860g) mean weight of pupa at 4 per cent concentration of liquid whey protein. The results are also in agreement with the observations of Hamzah et al. (2016), who have recorded the maximum (0.639g) pupal weight for female in case of feeding on royal jelly followed by pollen grains 0.632g.

The shell ratio of the cocoon ranged from 19.23 to 22.86 per cent. The maximum shell ratio (22.86%) was achieved with bee pollen at 2 per cent concentration which was found at par with protinex at 10 per cent. Next to it, at drone brood (6%), bee pollen (3%) + drone brood (3%), bee pollen (5%) + protinex (5%) and drone brood (5%) + protinex (5%) recorded shell ratio of 21.31, 21.05, 21.02 and 21.05 per cent, respectively which were found statistically at par with each other whereas in control batch a shell ratio of 19.23 per cent was recorded. There was significant difference was recorded between treatments and control batch (Table 2). Increase in the shell ratio might be due to enhanced silk productivity by additional supplementation of different proteins. Almost similar findings have been recorded by Kumar and Prashanth (2018), who reported that at 4 per cent concentration of soyabean flour significantly higher shell ratio of 22.52 per cent in CSR_2 , whereas (21.66%) in CSR_4 at 6 per cent was obtained. Khedr *et al.* (2013) reported that at 1 and 3 per cent of pharovit iron significantly highest (23.48 and 23.44%) shell ratio was recorded when compared to other concentrations and control. The results are also supported by the observations of Sundarraj *et al.* (2000) in the silkworm breed NB₄D₂ reared on mulberry leaf supplemented with soyabean flour recorded significantly higher shell percentage (21.02%) when compared to control (19.35%).

CONCLUSION

Significant differences were recorded between treatments and the control batch with respect to economic parameters of silkworm. The bee pollen (2%) recorded significantly lowest disease incidence of 2.00 per cent which was found at par with other treatments. However, highest disease incidence to the tune of 7.00 per cent was recorded in control. All the treatments were found statistically at par with each other with respect to larval survival percentage, whereas the significant lowest larval survival percentage to the tune of 93.00 per cent was found in control batch. Maximum larval weight (43.43g), cocoon weight (2.26g), shell weight (0.516g), pupal weight (1.74g) and shell ratio (22.86%) was recorded in bee pollen (2%) followed by protinex (10%), bee pollen (5%) + protinex (5%) and drone brood (6%), whereas the significant lowest values were recorded in control batch.

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Research Article

Impact of Participatory Mode of Frontline Demonstration of Pigeon pea on Yield Gaps and Profitability under North Alluvial Plain of Bihar

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ABSTRACT

Cluster Front Line Demonstration is a unique approach and plays an indispensable role in promtion of pulses thereby enhancing production potential and socio-economic status of the farmers by using improved technologies. KVK, Birauli, Samastipur under Dr. Rajendra Prasad Central Agricultural University, Pusa conducted 80 demonstrations on Pigeon pea in 30 hectare during *Kharif* season, 2019-20 to 2021-22. Demonstration was provided with latest technologies like improved variety (Rajendra Arhar-1), optimum seed rate, sowing technique, seed treatment, weed management and application of integrated pest and disease management for better production. Results indicated that CFLD gives an average productivity of pigeon pea with improved technologies that ranged from 15.85 to 18.23 q/ha which was 52.08% more over farmer's practice. The study also showed average technology gap of 11.02 q/ha, average extension gap of 5.76 q/ha and average technology index of 39.87%. The study concluded that average net income of Rs. 74,652, mean additional return of Rs. 34,452, mean effective gain of Rs. 32,903 and B:C ratio of 2.97 were obtained with the inclusion of improved technology as compared to farmers' practice. Thus, adoption of improved practices through CFLD of proven technologies enhance the economic returns to a great extent for small and marginal farmers.

Keywords: Pigeon pea, CFLD, Extension gap, Technology gap, B:C ratio

INTRODUCTION

Pigeon pea or Red gram (*Cajanas cajan* L.) is one of the most important *kharif* pulse crop that is cultivated in India. Pigeon pea grains are rich in protein (21.7%), carbohydrates (63g/100g), fibre (15g/100g) and minerals. It is grown across the country for grain, green manuring and fodder either as sole of intercrop. Being a leguminous crop, pigeon pea plant fixes 40 kg nitrogen per hectare in a cropping season. It also aids valuable organic matter to the soil with the fallen leaves. Considering the benefit, pigeon pea became an ideal crop for a sustainable agriculture. In India, pigeon pea is cultivated in an acreage of 4.80 mha with production of 4.28 million tonnes and the average productivity of 892 kg/ha (Directorate of Economics and Statistics, DA&FW, 2021). While in the state of Bihar, it is cultivated over an acreage of 0.014 mha with a total production of 0.023 million tonnes and average productivity of 1606 kg/ha (Directorate of Economics and Statistics, Govt. of Bihar, 2021). The major pigeon pea cultivating states in India are Madhya Pradesh, Gujarat, Karnataka, Tamil Nadu, Maharashtra and Bihar.

Pigeon pea production is very low in Bihar because of its sub-optimum technologies at farmer's field. The production and spreadness of area can be increased by adoption of better crop management practices (Kumar, 2014). Gap in between recommended technogloy and farmers practice is one of the reason for low production at farmers level. To reduce these gaps, an approach has been introduced by ICAR, New Delhi under National Food Security Mission with the

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objective to demonstrate new crop produciton techniques, plant protection measures at farmer's field with the involvment of Krishi Vigyan Kendras. Steps like farmers selection, site selection, farmer's participation, group meeting, trainings etc. were followed for conducting the frontline demonstration in cluster mode.

Keeping this in view, to evaluate the performance of frontline demonstration, KVK, Samastipur, RPCAU, Pusa conducted CFLD on pigeon pea in different villages of Samastipur district.

MATERIALS AND METHODS

The study was executed during *kharif* season of 2019-20 to 2021-22 (03 consecutive years) in six blocks *viz.*, Morwa, Kalyanpur, Khanpur, Patori, Pusa & Dalsinghsarai of Samastipur district that are clasiffied under North Alluvial Plains of Bihar as per the agroclimatic zones. A total of 80 demonstrations were conducted in an area of 30 ha during the three years with the latest technologies (Table 1).

The soil is calcareous in nature $(28\% \text{ CaCO}_3)$ with pH 8.35 and the major area is low in organic carbon (0.13% to 0.38%), available nitrogen (119 to 162 kg/ha), and low to medium in phosphorous (20 to 48 kg/ha) and potassium (112 to 270 kg/ha). Under the cluster frontline demonstration approach, 0.4 ha area is alloted to each farmer along with the adjoining area of 0.4 ha as farmers' practice for comparison of the

study. Critical inputs were provide to the selected farmers with high yielding variety of pigeon pea (Rajendra Arhar-1). Seed were treated with fungicides followed by bio-inoculum with suitable strain for pigeon pea. Herbicides & insectides were provided along with the seeds from the budget allocated under CFLD. Trainings were provided during the inputs distribution programme and seed rate of 20 kg/ha was recommended. Line sowing with 45 cm x 15 cm was promoted among the farmers. Fertilizers with recommended doze viz., N:P2O5:K2O:S @ 20:40:20:20 kg/ha were applied as basal to the crop followed by sowing. KVK scientists visited the demontration unit to ensure proper advisory to the farmers. Field days were organized along with non-beneficiary farmers to promote the cultivation of pulses and its importance in human diet as well as the profitability.

Observations were recorded from the improved practices and farmer's practice. Parameters like yield, technology gap, extension gap and technology index were calculated for gap analysis as mentioned by Kumar (2014):

Technology gap = Potential yield (q/ha) – Yield of improved technology (q/ha)

Extension gap = Yield of improved technology (q/ha) – Yield of farmer's practice (q/ha)

Technology Index = (Potential yield – Yield of improved technology) / (Potential yield) x 100

 Table 1: Details of technology intervnetions and farmer's practice under CFLD on pigeon pea in Samastipur district

 of Bihar

Technology components	Improved technology	Farmer's Practice	Technology gap
Farming situation	Irrigated	Irrigated	No gap
Land preparation	One disc plough followed by two harrow	One disc plough followed by two harrow	No gap
Variety	Rajendra Arhar-1 (High yielding)	Local/old variety	Full gap
Time of sowing	2^{nd} fortnight of June to 1^{st} week of July	2 nd fortnight of July to 1 st week of August	Full gap
Seed rate (kg/ha)	20	35-40	Full gap
Seed treatment	Fungicide & Rhizobium	No seed treatment	Full gap
Sowing method	Line sowing	Broadcasted	Full gap
Fertilizer dose (kg/ha)	$20 \text{ N}, 40 \text{ P}_2\text{O}_5, 20 \text{ K}_2\text{O} \& 20 \text{ S}$	Injudicious use	Partial gap
Weed management	Imazethapyr 10% SL @ 100 g/ha	One time hand weeding	Partial
Plant protection	Profenophos 50% EC @ 1 ml/l of water	Non-judicious use	Partial
Disease management	Carbendazim @ 2 g/l of water	Non-judicious use of fungicide	Partial

Additional cost (Rs/ha) = Improved technology cost – Farmer's practice cost

Additional return (Rs/ha) = Improved technology returns – Farmers practice return

Effective gains (Rs/ha) = Additional returns – Additional cost

RESULTS AND DISCUSSION

Technological gap in terms of variety, seed rate, seed treatment, integrated pest management, weed management etc. have been observed during the demonstration period (Table 1). Farmers in general used very old varieties or local in lieu of improved varieties. This might be due to lack of awareness, lack of quality seed availability in proper time. Seed treatment is also neglected in the farming practices for any disease or pest infestation due to lack of awareness among farmers in this area. The data presented in Table 3 showed that the technology gap in demonstrated yield against potential yield ranged from 9.77 to 16.55 q/ha during the study. Similar findings were also observed by Kumari *et al.* (2020) and Kumar *et al.* (2022).

The data pertaining to Table 3 indicated that there lies the extension gap between improved technology and farmer's practice during the period of study. Extension gap indicates the yield difference between demonstration plot and check plot. Cluster demonstration, farmers awareness, training programme etc. help reduce this gap (Kumar *et al.*, 2022). Highest exension yield gap of 7.11 q/ha was recorded during the year 2021-22 and lowest during the year 2019-20 (4.98 q/ha). Similar findings corroborated the results of Nain *et al.* (2015) and Dubey *et al.* (2022).

The technology index measures how feasible a technology is at farmers field (Table 3). In general, a lower technology index means that the technology is more feasible and better able to perform its intended purpose. In the present study, technology index varied from 34.89 to 43.39%. A variety of reasons may contribute to this, including variations in weather conditions, soil fertility, disease or infestation by insects or pests. Similar results have also been obtained by Jha *et al.* (2020).

Economics of the demonstrated technology and farmer's practices are presented in Table 4, based on the prevaling market price.

During the study period, improved technology recorded higher average gross return (Rs. 1,18,495.00/ ha), average net return (Rs. 74,652.00/ha) and average effective gain (Rs. 32,903.00/ha) compared to farmer's

Season and year	Number of demonstration	Area (ha)	IT average yield (q/ha)	FP average yield (q/ha)	% increase in yield over FP
<i>Kharif</i> , 2019-20	27	10.0	16.43	11.45	43.49
Kharif, 2020-21	28	10.0	15.85	10.65	48.83
Kharif, 2021-22	25	10.0	18.23	11.12	63.94
Total/Mean	80	30.0	16.84	11.07	52.08

Table 2: Yield performance and yield analysis of demonstrated variety in Samastipur district of Bihar

*IT: Improved Technology & FP: Farmer's Practice

Table 3: G	ap analysis in	pigeon pea	under demonstrated	technology and	l farmer's practice
	1 2	10 1			1

Season and year	Variety	Potential yield (q/ha)	IT yield (q/ha)	FP yield (q/ha)	Technology yield gap (q/ha)	Extension yield gap (q/ha)	Technology index (%)
Kharif, 2019-20	Rajendra Arhar-1	28.0	16.43	11.45	11.57	4.98	41.32
Kharif, 2020-21	Rajendra Arhar-1	28.0	15.85	10.65	12.15	5.20	43.39
Kharif, 2021-22	Rajendra Arhar-1	28.0	18.23	11.12	9.77	7.11	34.89
Mean	-	28.0	16.84	11.07	11.02	5.76	39.87

*IT: Improved Technology & FP: Farmer's Practice

Table: 4. Econom	ic analysis of	f CFLD on P	igeon pea in S	amastipur	district of Bil	har						
Season and year	Cost of	cultivation	Additional	Sale	Gross	return	Additional	Net 1	teturn	Effective	Benef	it:
	(R	(s/ha)	cost in IT	price	(Rs	/ha)	gross return	(Rs	/ha)	gain	cost ra	tio
	IT	FP	(Rs/ha)	(Rs/ha)	IT	FP	(Rs/ha)	IT	FP	(Rs/ha)	IT	ΕP
Kharif, 2019-20	23,150.00	21,680.00	1470.00	5000.00	82,150.00	57,250.00	24,900.00	59,000.00	35,570.00	23,430.00	2.55	1.64
Kharif, 2020-21	24,970.00	23,315.00	1655.00	6200.00	98,270.00	66,030.00	32,240.00	73,300.00	42,715.00	30,585.00	2.94	1.83
Kharif, 2021-22	26,840.00	25,320.00	1520.00	6500.00	1,18,495.00	72,280.00	46,215.00	91,655.00	46,960.00	44,695.00	3.41	1.85
Mean	24,987.00	23,438.00	1548.00	ı	99,638.00	65,187.00	34,452.00	74,652.00	41,748.00	32,903.00	2.97	1.77
*IT: Improved Tech	mology & FP.	: Farmer's Prac	ctice									

practice. However, average net return in farmer's practice ranged from Rs. 35,570.00 to Rs. 46,960.00/ ha. Effective gain return of Rs. 32,903.00/ha was obtained in demonstrated technology under cluster front line demonstration. Similar results were also reported by Jha *et al.* (2020). The average benefit: cost ratio was maximum (2.97) in demonstrated technology and was minimum (1.77) in farmer's practice. Higher benefit cost ratio in demonstrated technology might be due to higher yield with quality grains as compared to farmer's practice. Singh and Singh (2020) also reported the similar findings under cluster front line demonstration on pigeon pea.

CONCLUSION

Cluster Front Line Demontration of Pigeon pea conducted in different blocks of Samastipur district of Bihar showed that cultivation of pigeon pea with improved technologies motivated the beneficiary farmers as well as non-beneficiary farmers to adopt the suitable technology. It resulted in gaining higher productivity and maximum benefit: cost ratio thereby make-up the technology gap and extension gap. Thus, it may be advocated that demonstrated technology with improved practices in pigeon pea results in long term impact on uplifting the livelihood of the farmer's in Samastipur district.

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Conflicts of Interest: The authors declare no conflict of interest.

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Research Article



Unveiling the Social Ecology of Migration in Darjeeling: A Critical Analysis Through Mental Modeling

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ABSTRACT

This research employs Fuzzy-logic Cognitive Mapping (FCM) to study migration in Darjeeling, India, representing stakeholder perceptions through Mental Modeler software. Aggregated cognitive maps form shared models, revealing migration drivers, ordinary factors, and recipients. The pandemic heightened challenges due to tourism dependence. FCM identifies significant drivers like social instability and industry gaps, with livelihood and income as key elements. Scenarios show that enhancing job opportunities, income, and healthcare can mitigate migration. FCM illuminates human behavior complexity, unraveling migration influencers. Mental modeling provides insights into migration motivations, aiding policy decisions for a comprehensive understanding.

Keywords: Fuzzy-logic cognitive mapping, Livelihood, Mental modeler, Migration, Social instability

INTRODUCTION

Migration is a complex phenomenon (Castelli, 2018) that has influenced societies and human history for many years. In search of better prospects, safety, or a different way of life, it entails the transfer of people from one location to another, typically across national or international boundaries. (UN IOM, 2023a). As per the report of UN IOM (2023b) research data, there was about 281 million number of international migrants in the world in 2020 which is almost 3.6 per cent of total global population. The same data claimed that the total remittances transferred globally in 2020 by migrants and diaspora was USD 702 Billion. Contrary to forecasts indicating a substantial decline in international remittances due to COVID-19, the year 2020 witnessed a minor dip (2.4%) compared to the global sum of 2019. For July, 2020 to June, 2021 the all India migration rate was 87.50, 11.80 and 0.70 per cent, respectively for intra-state, inter-states and other countries (PIB Delhi, 2022).

In migration, 'macro', 'meso', and 'micro' elements work in conjunction to influence each individual's decision to migrate, incorporating the basic push and Darjeeling area is so insecure. The reason being there is no established agricultural system. It is economically dependent on tourism. But the tourism industry has already been disrupted due to COVID-19 pandemic. The reconstruction of the tourism economy is yet on the way. The dilapidation of the tea garden economy and surrounding agriculture has had

pull theory (Lee, 1966). Demographic, Political, and socioeconomic factors are among the "macro-factors" that significantly impact migration (Figure 1). These are the main causes of forced migration, whether it be domestic or international. The "meso-factors" include things like diasporic ties, land grabs, and communication technologies. Age, sex, marital status, wealth, religion etc. fall under the "micro-factors" (Castelli, 2018). The discipline of social ecology is concerned with the dynamic interactions between people, society, and their environments (Fischer-Kowalski, 2015). The social ecology of migration is one theoretical paradigm which is based on the understanding that migration is a social phenomenon entangled in a complex web of connections, structures, and systems.

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Figure 1: Different factors responsible for migration

an appalling effect on the overall economy of Darjeeling. When surrounding agriculture is suffering and disrupted, it has a terrible impact on food security. The tourism hotspot, Darjeeling in Bengal anticipated a loss of nearly Rs 350 crore during the holiday season after losing almost all of its summer business during the pandemic (Sarkar, 2020). Moreover, for the youths of India, globalisation has created new avenues for mobility (Brown, 2015). Relatively few attempts have been made to identify the different factors or variables responsible for migration and relationship between them in the Darjeeling region.

In this study we applied a Fuzzy-logic Cognitive Mapping (FCM) approach to assess reasons and perceptions of different stakeholders behind migration by using Mental Modeler software (Gray et al., 2013). According to Gray et al. (2014), FCM is a "mental modelling" method for developing a map of a person's cognition in relation to a certain problem space. Mental models denote internally constructed cognitive frameworks representing external reality. These constructs reside within the human psyche, thus rendering them impervious to direct scrutiny or quantitative assessment (Jones et al., 2011). So, in this study, basically a qualitative exploration was conducted to map (Malzer and von Schrader, 2014) the intricate phenomenon of how an individual's thought process evolves when deciding to migrate. Thus, using the delineated system elements, we developed a shared mental model of the various stakeholders regarding the perceived causes of migration. We evaluated the

network attributes of these cognitive frameworks. At last, our objective encompassed comprehending projected system results amid varied arrays of system intervention strategies through the application of scenario analysis.

MATERIALS AND METHODS

Total 4 villages of Darjeeling-Pulbazar CD block, Jorebunglow-Sukhia Pokhri CD block in Darjeeling district in West Bengal were selected for the study. Purposive sampling techniques were used for the selection of the state, district, block, and villages since the location was perfect for the problem. A total of 60 respondents were personally interviewed by taking 10 respondents from each village and 3 focus group discussion were conducted. The non-random snowball sampling method was followed to select the respondents. The authors used FCM approach to evaluate the reasons and perceptions behind migration by using Mental Modeler software (https:// www.mentalmodeler.com/; Gray et al., 2013). FCM comes from concept and cognitive mapping. Concept maps are like pictures that show how things are connected in a topic. It use lines to connect ideas, making it easy to see how things relate to each other. It's like creating a map that helps us understand how things relate to each other within a topic (Novak and Canas, 2008).

Firstly, the initial respondents were identified. Prior to beginning the actual research, a pilot study was carried out to understand better the regions, their inhabitants, institutions, and activities associated with the migration process and to identify the system elements. Based on the pilot study results, a preliminary interview schedule was created with the aid of literature and by discussion with the experts. A multi-stage method was applied to create a mental model envisaging the social ecology of migration (Goswami et al., 2021). The data were collected during the puja vacation of 2022 and the summer vacation of 2023. The identified system elements were entered into a matrix to assess the connections between pairs of system elements. The qualitative analysis unearthed system elements, which then served as the building blocks for the subsequent fuzzy cognitive mapping exercise, engaging diverse stakeholders (those who are recipients of impacts of migration) in the process. Under FCM, a comprehensive network analysis was done on the developed mental model. It was complemented by a scenario analysis to investigate the potential changes in system outcomes arising from alterations in one or multiple components of the system.

RESULTS AND DISCUSSION

Migration, a historical driver of change, involves individuals or groups crossing boundaries in pursuit of improved opportunities, safety, and new lifestyles. The causes of migration vary, ranging from monetary factors and political unrest to alterations in the environment and social dynamics. Migration, along with fertility and mortality, is a crucial indicator of shifts in the social and economic domains. It encompasses the movement of people between different regions within a country and across international borders. The historical roots of both types of migration in India can be traced back to the nineteenth century, if not even earlier (Chattopadhyaya, 1987).

Here, we tried to study the social ecology of migration in Darjeeling district of West Bengal using the Mental Modeler software. We have created mental models about migration through FCM in the research area. Then a single map was generated by conglomerating each stakeholder's distinct cognitive maps (Figure 2) to understand migration in nearby villages. The node and network properties of the shared mental map were examined lastly. We were able to isolate the drivers, ordinaries and receivers by examining the indegree, outdegree and centrality values of each element (Table 1). The elements only having outward flow were the 'drivers', only having the inward flow were the 'receivers' and having both the outward and inward flow were the 'ordinary' of the system (social ecology of migration).

From the viewpoint of each stakeholder, a Fuzzy Cognitive map of Migration is shown in Figure 2. This map combines all the separate maps made by various stakeholders. We obtained a clear picture because all the possible elements are present in this map. There



Figure 2: Shared mental map of different stakeholders regarding migration

Τ	abl	e 1:	Se	lect	ed	det	ermir	nants	of	M	igration	accord	ling	to	multi	ple	stal	ceh	olo	lers
_									~ -				B				~		~	

Network property

Total component	Total connection	Density	Connections/ component	No. of driver component	No. of receiver component	No. of ordinary component	Complexity score	
20	60	0.1578947368	3	7	1	12	0.1428571429	
Node proper	rty							
Components	8		Indegree	Outdegree	Centr	ality	Туре	
Poverty			2.31	3.3	5.6	1	ordinary	
Insecurity and	d risk		5.62	0.83	6.4	5	ordinary	
Livelihood			8.61	0.74	9.3	5	ordinary	
Job opportur	nities		3.48	4.74	8.2	2	ordinary	
Educational	opportunities		0.46	4.5	4.9	4.96		
Social network			1.41	2.60	4.0	4.01		
Entrepreneur	rial opportuniti	es	0	3.61	3.6	1	driver	
Healthcare fac	cilities		0.64	2.77	3.4	1	ordinary	
Lifestyle			6.12	0.73	6.8	5	ordinary	
Social instabil	lity		0	3.37	3.3	7	driver	
Status			1.47	1.57	3.0	4	ordinary	
Income			1.05	4.09	5.1	4	ordinary	
Low net retur	rn from Agricul	lture	1.55	3.49	5.0	4	ordinary	
Economic sat	tisfaction		1.5	0.65	2.1	5	ordinary	
Perceived ber	nefits of migrat	ion	0	0.52	0.5	2	driver	
Lack of Industries			0	3.18	3.18		driver	
Unfavourable agricultural condition			0	0.75	0.7	5	driver	
Lack of resou	rces		0	1.45	1.4	5	driver	
Distance from	n home		0	0.7	0.7	7	driver	
Migration			0.38	0	0.3	8	receiver	

Note: Provided are the mean values for Indegree, Outdegree, and Centrality. **Outdegree** pertains to the aggregate weight of outgoing connections from the element, while **indegree** represents the cumulative weight of incoming connections to the same element. **Centrality**, in turn, encompasses the combined value of both Indegree and Outdegree metrics.

are 20 elements and 60 connections between them (Table 1). The blue and red lines show positive (+) and negative (-) relationship between the system elements, respectively.

If we compare Figure 2 and Table 1 we can see that social instability, entrepreneurial opportunities and lack of industries have significant outdegree value with zero indegree value thus making them system drivers. So, these two driver elements contribute significantly as drivers for migration in the study area. Software detected perceived benefits of migration, unfavorable agricultural conditions, lack of resources, distance from home in migration as drivers, but these micro-elements should not be considered as drivers because of low outdegree value. So, these micro-elements are the other reasons that contribute to the migration process. On the other hand, the elements like insecurity and risk, livelihood, job opportunities, lifestyle all have remarkable indegree value with certain outdegree value and they are connected to other factors such as educational opportunities, poverty, social instability, lack of industries, healthcare facilities, status, job opportunities, low net return from agriculture, perceived benefits of migration, entrepreneurial opportunities, social network, income, low net return from agriculture. These are the ordinary elements of migration.

Livelihood has the highest indegree and centrality value among ordinary elements because it is linked to many elements. Livelihood is a major component of migration that controls the process of migration (Awumbila, 2017). On the other hand, job opportunities, income, low net return from agriculture and poverty have significant outdegree value with certain indegree value. Kim (2017) also found in the factor analysis of his research that higher income as well as wider job opportunities in destination were the strongest factors of migration. Other crucial elements like social network and status, have significant indegree and outdegree value resulting in more centrality value.

Software detected migration as receiver of the system because it has significant indegree value, with zero outdegree value. As our study was focused on investigating the reasons and perception behind migration, so it has been found that migration was caused by some other elements. Hence, it has significant indegree with zero outdegree value. The paper delves into an intriguing approach termed 'scenario analysis,' a strategic methodology that fuses the collective insight of stakeholders into a shared mental model. In a bid to unveil detailed as well as more predictable scenario outcomes, the authors employed the scenario analysis (Figure 3 & 4) (Goswami et al., 2021). The scenario interface shows how much the model's individual components have changed in relation to one another. This variation is determined by the edge relationships outlined in the Concept Mapping interface specific to the selected scenario. Users have the option to select scenarios featuring realistic, improbable, gradual, or sweeping alterations to the system. In order to execute a scenario, each variable must be set to a value between -1 (substantial negative change) and +1 (substantial positive change). The relative change in the system is represented as a bar graph to show how various components might respond to a specific scenario in real-time (Gray et al., 2013). The scenarios were:

We simulated 2 distinct scenarios (Figure 3 & 4) using Mental Modeler's Scenario Module, taking into account the current situation and the viewpoint of stakeholders. Either positive or negative impacts were



Figure 3: Scenario 1: We reduced poverty, insecurity and risk and enhanced livelihood



Figure 4: Scenario 2: In addition to Scenario 1, we enhanced job opportunities, educational opportunities, and entrepreneurial opportunities

observed on the elements of migration after simulation. Under scenario-1, Job opportunities, social network, lifestyle, status, and economic satisfaction were increased, and migration showed a decline. Under Scenario-2, income showed a noticeable increase and migration declined significantly. Additionally, healthcare facilities also increased. When the economy gets belligerent, jobs are created. Then quite logically, migration will be reduced. It is a kind of redox process. If one is reduced, the other is isochronously increasedan elegant ballet between economic dynamism and migratory patterns. In essence, this paper exemplifies scenario analysis as a compass to navigate through the myriad landscapes of change. Through shared mental models and meticulous scenario construction, it uncovers the hidden rhythms that govern complex systems, offering us a glimpse into the dance between transformation and stability.

CONCLUSION

Human behaviour by nature is complex, and sometimes goes humongously unpredictable. In extension science, human behaviour reigns as the epicentre of perception, decision, execution and adaptation. The present study has taken FCM as to study the cause, effect and perception of migration from Darjeeling to elsewhere or within Darjeeling from one occupation to another occupation in a response to push and pull factors. Most of the time we predict and analyze the cause and impact of migration as an external actor in the form of a researcher or observer. This has got intrinsic limitation to any person; whenever basket of choices is offered, he/she suffers from a plethora of confusions. Fuzzy logic helps to understand the interpretation of such confusion or inadequate understanding over the crux of the text for consideration. This is basically a perception analysis in a participatory mode by both extracting and extrapolating the respondents' psycho behavioural response to a cause or any event, and here it is migration. The application of mental modeling has got a wide range of areas, including migration, customer behaviour, system analysis, technology socialization, purchase behvaiour, and market responses.

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Research Article

Financial Inclusion Among Agricultural Households in Punjab and Uttarakhand

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ABSTRACT

The present study has been undertaken to examine the extent of financial inclusion and its determinants among 120 sampled agricultural households in Punjab and Uttarakhand. It was found that almost all sample households possess a bank account, still the dependence on non-institutional sources was quite high. Insurance coverage was found to be limited. Usage of modern financial services like internet banking, mobile banking, and UPI was found to be very low. Regression analysis showed that the education status, size of holding, family size, annual income, credit availed from non-institutional sources and state were significantly affecting the financial inclusion of sample households. Thus, increasing literacy, discouraging the use of non-institutional credit, and promoting insurance coverage will enhance the level of financial inclusion among agricultural households.

Keywords: Financial inclusion, Financial services, Agricultural households, Punjab, Uttarakhand

INTRODUCTION

Financial inclusion encompasses various aspects of financial development, aiming to provide individuals and households with access to fundamental financial services such as savings, credit, insurance, and transaction services at a reasonable cost. In the absence of these services, households or individuals revert to high-cost non-institutional sources of finance which negatively affects lower-income groups like small and marginal farm households. Therefore, financial inclusion plays an important role in poverty alleviation and reducing income inequalities (Beck and Levine, 2007).

The Committee on financial inclusion defines it as "the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and lowincome groups at an affordable cost" (Rangarajan, 2008). Financial exclusion is not random but rather focused on underprivileged sections of society. The financial sector excludes several groups and minorities, including small and marginal farmers, the selfemployed, pensioners, artisans, women, and dependents on the informal sector (Dev, 2006; Solo, 2008).

According to the national population census, just 58.7 per cent of households in India use banking services (GOI, 2011). Sarma (2008) conducted a crosscountry analysis that established an index of financial inclusion using three dimensions and India ranked 29th among 100 countries in the study. The Reserve Bank of India (RBI) developed a Financial Inclusion Index that considers 97 indicators and the score increased from 53.9 in 2021 to 56.4 in 2022 (RBI, 2022). As per the All India Rural Financial Inclusion Survey undertaken by NABARD, only 55 per cent of agricultural households actively save with institutions such as banks, post offices and self-help groups (SHGs). In addition, around 60 per cent of agricultural households in India obtain credit exclusively from institutional sources (NABARD, 2018).

The primary challenge is to ensure the outreach and penetration of formal financial services to a wider

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range of sub-sectors of the economy. So, this study was designed to examine the extent of financial inclusion and its determinants among agricultural households in the states of Punjab and Uttarakhand.

MATERIALS AND METHODS

The present study was undertaken in Punjab and Tarai region of Uttarakhand state during the year 2021-22. Ludhiana district from Punjab and Udham Singh Nagar were purposively selected due to the similarity in the cropping pattern. Villages were then randomly selected, and data from 60 sample agricultural households in each district were collected comprising 40 marginal and small agricultural households (with landholdings of 5 acres or less) and 20 medium and large agricultural households (with landholdings greater than 5 acres) based on their operational landholdings in the selected districts of each state. Thus, a total of 120 agricultural households were selected for the study. It was supplemented with secondary data obtained from reports of State Level Bankers' Committee (SLBC) of respective states.

To measure the extent of financial inclusion, Financial Inclusion Index (FII) has been constructed using a bank of account holding (P), the credit availed (Q), insurance coverage (R) and usage of digital financial services (S) as indicators. Each indicator has been assigned an equal weight.

 $Financial inclusion index = \frac{(P \ge 0.25) + (Q \ge 0.25) + (R \ge 0.25) + (S \ge 0.25)}{(P \ge 0.25) + (P \ge 0.25)}$

4

FII <0.3 = Low financial inclusion FII 0.3 to 0.6 = Medium financial inclusion FII >0.6 = High financial inclusion

Tobit model as a corner solution has been used in the study to determine factors affecting financial inclusion. FII scores have been used as a dependent variable. The standard equation of the Censored Tobit Model has been given below:

 $\begin{array}{l} y_{i}^{*} = x_{i}\beta + v_{i} \\ y_{i} = c, \mbox{ if } y_{i}^{*} \leq c \\ y_{i} = y_{i}^{*} \mbox{ if } y_{i}^{*} > c \\ \mbox{ Where, } y_{i}^{*} : \mbox{ Latent variable} \\ \box{\dot{i} 1,2,3,...N} \\ x_{i}: \mbox{ P-dimensional vector of independent variables} \end{array}$

- β: P-dimensional parametric vector
- v: Residual error
- *c* : Censoring point
- y: Dependent variable

RESULTS AND DISCUSSION

The number of institutional branches indicates the availability of financial tools and services to the population. The branch density per 1000 square kilometres in Punjab was approximately three times that of Uttarakhand. The population served per branch is about 4000 in both states. Agricultural credit accounts per lakh population were higher in Punjab. Automated teller machine (ATMs) were more prevalent in Punjab, but both states have 26 ATMs per lakh of population. Credit-deposit ratio was found to be higher in Punjab (Table 1).

The majority of the respondents in both states belonged to the age group 45 to 60 years, were educated up to the primary level. Small sized families were more common in Punjab. The average size of operational landholding among sample households was 9.76 and 7.64 acres in Punjab and Uttarakhand, respectively.

An account is the basic financial service offered by an institutions to avail and utilize other financial

Table 1: Overview	of financial	inclusion in	Punjab a	nd
Uttarakhand				

Particulars	Punjab	Uttarakhand
Number of branches		
Rural	3152 (44.78)	1160 (48.49)
Semi-urban	1994 (28.33)	547 (22.87)
Urban	1893 (26.89)	685 (28.64)
Total	7039 (100.00)	2392 (100.00)
Number of accounts		
Saving a/c per lakh population	221204	238324
Current a/c per lakh populatio	n 29062	21742
Agricultural credit a/c per lakh population	35	8
Branches per 1000 sq. km	140	45
Population served per branch	3941	4217
Number of ATM	7277	2623
Credit-Deposit ratio	59.74	46.95

Source: SLBC Punjab (2022), SLBC Uttarakhand (2022) *Note:* Figures in the parenthesis are percentages of the institution's branches

Particulars	Punja	ıb	Uttarakhand		
	Number	%	Number	%	
Age (years)					
<u><</u> 30	6	10.00	10	16.67	
>30 to 45	18	30.00	13	21.67	
>45 to 60	20	33.33	23	38.33	
>60	16	26.67	14	23.33	
Average age	49.48		48.55		
Education					
Illiterate	9	15.00	12	20.00	
Up to primary	19	31.67	21	35.00	
6 th to high School	15	25.00	13	21.67	
10 + 2	9	15.00	7	11.67	
Graduation & above	8	13.33	7	11.67	
Family size (Numbe	er)				
<u><</u> 5	43	71.67	21	35.00	
6 to 10	17	28.33	36	60.00	
>10	-	-	3	5.00	
Average family Size	4.65		6.63	-	
Average landholding	g size (acre	s)			
Owned	4.91		5.63		
Leased in	4.85		2.01		
Operational	9.76		7.64		

Table 2: Socio-economic profile of the respondents/
households in Punjab and Uttarakhand, 2021-22

instruments. All households possess at least one bank account per household in both the states, except one in Punjab. In Punjab, around 46 per cent of households have one bank account, 22 per cent have two bank accounts, and 33 per cent have three or more bank accounts. The percentage of households with one, two, and three or more accounts holding household in Uttarakhand is about 28, 37 and 35 per cent, respectively. Among small and marginal agricultural households two accounts per household were more pronounced in Uttarakhand. The larger size of families in Uttarakhand may be the reason for it.

The majority of households in Punjab have been associated with banks for more than five years, while in Uttarakhand, most households opened their bank account in the last two to five years under schemes like Pradhan Mantri Jan Dhan Yojana (PMJDY) and Direct Benefit Transfer (DBT). Availing credit and to keep savings were the prime factors for opening an account. Receiving MNREGA payment and benefits from other schemes was more of a reason in Uttarakhand (Table 4).

Availing Credit is the basic financial service for agricultural households. In Punjab, 78 per cent of sample households obtain loans from institutional sources, and 32 per cent rely on non-institutional sources. In Uttarakhand, 72 per cent of sample households access credit from institutional sources,

Table 3: Number of bank accounts per sample agricultur	ral household in Punjab and Uttarakhand, 2021-2
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Bank accounts per	Small and	lmarginal	Medium	and large	Overall		
household	Number	Per cent	Number	Per cent	Number	Per cent	
Punjab							
One a/c	19	48.72	8	40.00	27	45.76	
Two a/c	9	23.08	4	20.00	13	22.03	
Three and above a/c	11	28.21	8	40.00	19	32.20	
Total	39	100.00	20	100.00	59	100.00	
Average a/c			2.27				
Uttarakhand							
One a/c	12	30.00	5	25.00	17	28.33	
Two a/c	16	40.00	6	30.00	22	36.67	
Three and above a/c	12	30.00	9	45.00	21	35.00	
Total	40	100.00	20	100.00	60	100.00	
Average a/c			2.40				

Table 4: Other details related to bank accounts among sample agricultural households in Punjab and Uttarakhan	d,
2021-22	

Particulars	Pu	njab	Uttarakhand		
	Number	Per cent	Number	Per cent	
Time period since opening of the first account					
Up to 2 years	-	-	1	1.67	
>2 to 5 years	24	40.00	39	65.00	
>5 years	35	59.32	30	33.33	
Purpose of opening bank accounts (Multiple responses)					
Saving purpose	31	52.54	40	60.00	
Availing credit	44	74.58	29	48.33	
Under PMJDY	9	15.25	14	23.33	
Payments from other government schemes and DBT	7	11.86	13	21.67	
MNREGA payments	6	10.17	8	13.33	
Receiving remittances	3	5.08	2	3.33	

Table 5: Credit details of sample agricultural households in Punjab and Uttarakhand, 2021-22

Credit particulars	Pun	ijab	Uttarakhand		
	Number	Per cent	Number	Per cent	
Source					
Institutional	47	78.33	42	72.00	
Non-institutional	19	31.67	13	21.67	
Both	16	26.67	5	8.33	
Type of loan					
Agriculture purpose	45	75.00	41	68.33	
Education purpose	2	3.33	3	5.00	
Personal consumption and social ceremonies	4	6.67	1	1.67	

while 22 per cent still depend on non-institutional sources. A significant number of households in the states have taken loans from both the sources despite having access to formal institutions. Majority of institutional credit has been availed for agriculture and allied activities, in both states.

The households use insurance as a strategy to manage risk and compensate for any loss or damage. Table 6 showed only 20 per cent of insurance coverage in Punjab that too only life insurance, while in Uttarakhand, it was 55 per cent. Life insurance was taken by about 27 per cent in Uttarakhand and health insurance by 37 per cent due to penetration of the Pradhan Mantri Jan Arogya Yojana (PM-JAY) scheme. Crop insurance cover has been availed by 7 per cent and livestock insurance by 12 per cent of the households. The possession of a bank account provides access to various financial services including traditional and modern options such as cash deposits and withdrawals, debit and credit cards, and mobile banking etc. The

Table 6: Details of insurance coverage among sample
agricultural households in Punjab and Uttarakhand,
2021-22 (Multiple responses)

Particulars	Pu	injab	Uttarakhand	
	No.	%	No.	%
Insurance availed	12	20.00	33	55.00
Type of insurance				
Life insurance	12	20.00	16	26.67
Health insurance	-	-	22	36.67
Crop insurance	-	-	4	6.67
Livestock insurance	-	-	7	11.67

Table 7: Details of other financial services availed by sample agricultural households in Punjab and Uttarakhand, 2021-22 (Multiple responses)

Services	Punjab		Uttarakhand	
	No.	%	No.	%
Depositing/withdrawing cash	59	98.33	60	100.00
Cheque book	48	80.00	41	68.33
ATM/ Debit card	35	58.33	29	48.33
UPI/Mobile/Internet banking	10	16.67	9	15.00
NEFT/RTGS/IMPS	6	10.00	5	8.33
Credit card	2	3.33	-	-

present study reported that most households use their bank accounts for cash deposits and withdrawals. Not all households that have bank accounts possess debit cards or cheque books. A smaller percentage of households use modern financial tools like mobile banking, internet banking and UPI, and transfer money through NEFT/RTGS/IMPS. Credit card possessing households has been found only in the Punjab.

Households belonging to different levels of financial inclusion in each state have been shown in Table 8. In Punjab, 57 per cent of households belong to the medium inclusion category followed by 22 per cent each in the high and low inclusion categories. For small and marginal agricultural households in Punjab, 55 per cent are at a medium level of financial inclusion, while 30 per cent and 15 per cent are at low and high levels, respectively. In Uttarakhand, the majority of households are in the high inclusion category (53%), followed by the medium (38%) and low (8%) inclusion categories. Small and marginal farm households in Uttarakhand have a higher level of financial inclusion (47.5% at medium and 40% at high) compared to those in Punjab. The difference in levels of financial inclusion can be attributed to a higher level of insurance coverage in Uttarakhand's sample villages.

Descriptive statistics for the explanatory variables used in the analysis have been presented in Table 9. The results indicate a positive correlation between financial inclusion and variables such as educational attainment, size of operational landholding, family size and annual income. On the other hand, a negative relationship is observed between financial inclusion and age, suggesting that younger individuals are more financially included than their older counterparts. There is a negative association between financial inclusion and general category respondents as well as households that choose to exclude themselves from institutional credit due to their lesser dependence on financial institutions. In addition, people living in Uttarakhand are more financially included compared to those residing in Punjab.

The results of Tobit regression analysis undertaken to determine the degree to which factors affect financial inclusion have been shown in Table 10. The log likelihood value was 71.65 and the chi-square was significant at the one percent level of significance indicating a good fit for the selected regression model.

An increase in educational qualifications results in a higher level of financial inclusion (Demirguc-Kunt and Klapper, 2012; Devlin, 2005; Cnaan *et al.*, 2012; Dar and Ahmed, 2021; Bakhshi and Agarwal, 2020). The present study also found that a unit (1 year) increase in education years increases the chance of a household being financially included by about one per cent while

Intensity of financial	Small and	l marginal	narginal Medium and lar		Overall		
inclusion	Number	Per cent	Number	Per cent	Number	Per cent	
Punjab							
High inclusion	6	15.00	7	35.00	13	21.67	
Medium inclusion	22	55.00	12	60.00	34	56.67	
Low inclusion	12	30.00	1	5.00	13	21.67	
Uttarakhand							
High inclusion	16	40.00	16	80.00	32	53.33	
Medium inclusion	19	47.50	4	20.00	23	38.33	
Low inclusion	5	12.50	-	-	5	8.33	

Table 8: Different levels of financial inclusion among sample households in Punjab and Uttarakhand, 2021-22

Small and marginal: <5 acres; Medium and large: >5 acres

Variables	Units	Group 1	Group 2	Group 3	Overall
Age	Years	47.36	49.70	51.00	49.02
Caste	1 if general, 0 otherwise	0.69	0.72	0.78	0.72
Education status	Years	9.40	8.14	4.72	8.10
Size of operational land	Acres	14.90	6.08	2.08	8.79
Family size	Numbers	6.87	5.19	4.00	5.64
Annual income	Lakh Rs.	5.11	3.54	1.44	3.81
Non-institutional credit	1 if availed, 0 if not	0.02	0.11	0.22	0.09
Type of bank	1 if public sector bank, 0 otherwise	0.69	0.49	0.83	0.62
State	1 if Punjab, 0 otherwise	0.29	0.60	0.72	0.50

Table 9: Descriptive statistics of sample agricultural households in Punjab and Uttarakhand, 2021-22

Group 1: High inclusion; Group 2: Medium inclusion; Group 3: Low inclusion

an increase in one unit (1 acre) of the operational land area of a household increases its chance of being more financially included by 0.4 per cent. The reason can be traced to increased return and thus, financial soundness (Kumar *et al.*, 2010; Laha *et al.*, 2011). Larger family size has a positive and significant impact on the utilization of financial services (Pal and Pal, 2012). An increase in one member in the family enhances the chance of increasing the level of financial inclusion by about 2.2 per cent as a larger family size can lead to more number of accounts per household.

Past studies have shown the positive effect of income level on financial inclusion (Laha *et al.*, 2011; Iqbal and Sami, 2017; Dar and Ahmed, 2021). In the present study also a unit (Rs. 1 lakh) increase in annual

Table 10: Estimates of Tobit regression

Variables	Coefficients	Standard
		errors
Age	0.0006	0.0010
Caste	-0.0098	0.0347
Educational years	0.0105***	0.0032
Size of operational land	0.0042***	0.0011
Family size	0.0223***	0.0060
Annual Income	0.0090*	0.0052
Informal credit	-0.0998**	0.0430
Type of bank	-0.0180	0.0260
State	-0.0984***	0.0315
Constant	0.3383***	0.0855
LR Chi-square	92.95***	
Log likelihood	71.65	

***,** and * denotes 1%, 5% and 10% level of significance, respectively

income of a household increases its probability to be financially included by about 1 per cent. Noninstitutional sources of finance lend at high rates of interest but are easily accessible in case of emergency (Ramji, 2009). Likelihood of households availing only non-institutional credit being financially included was lesser by about 10 per cent. The difference in the level of financial inclusion across the states can be due to various factors The results revealed that households in Punjab have comparatively 9.8 per cent less chance of being financially included than households in Uttarakhand. Higher coverage of insurance in Uttarakhand can be the reason for the same.

CONCLUSION

The study found that all households except one in Punjab were having bank accounts. Despite access to institutional credit, a considerable proportion of households resort to non-institutional sources. Life insurance coverage was low in both the states. Due to PMJAY, Uttarakhand has substantial health insurance coverage. The use of digital financial services was found to be limited. Majority of small and marginal farmers are at low and medium financial inclusion level in Punjab while at medium and high levels in Uttarakhand. Years of schooling, size of operational landholding, family size and annual income significantly and positively affect the level of financial inclusion. Incorporating financial education in formal education to increase awareness, a targeted approach with relevant financial products and promoting insurance will enhance the level of financial inclusion among agricultural households.

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Research Article

Impact of Occupational Stress on Working Women and Home Environment

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ABSTRACT

Women who are working in various fields in different parts of India, faces problems at the workplace just by virtue of being women. Thus women find employment such as nurses, doctors, teachers, secretaries or on the assembly line easily suiting with their lives as working married women. The working married women have to accomplice their duties at two levels i.e., as working women as well as wives in their home. They have to face multiple responsibilities of work, the regular responsibilities at home front, taking care of family members and children along with the concentration at workplace and time punctuality at work. This automatically arise conflicts between the two. Looking at the rising number of stress among women an attempt was made to study the impact of occupational stress on working women and their home environment. A total sample of 150 women respondents belonging to nuclear families were selected which was categorized into three groups with respect to their profession i.e., 50 respondents each from private school teachers, private bank employees and nurses from private hospitals respectively. Impact of stress on working women and home environment was studied and they were grouped as psychological; physiological; effect on work performance, children's performance, husband and household affairs. Among the respondents the impact on physiological health is the most as compared to others followed by impact on maintaining the house.

Keywords: Environment, Impact, Occupational, Women

INTRODUCTION

Life today is becoming increasingly complex, tension ridden and a great source of stress. Stress is the sum total of all comprehensive biological phenomenon evolved by conflicting external influences. It has developed into a part of today's life, with expanding complications of life, stress is likely to increase. Stress is fabricated in the perception of role, which is visualized as the position an individual takes up in a system. The impact of stress immobilizes and lowers the productivity levels, and fails to operate successfully in many aspects of life. But it is difficult to generalize about stress because what is a satisfactory level of stress in an individual may have great impact in another. Employed women work equivalent of two full time jobs since women in today's world are still dutybounded for majority of the household work and

management, child care and elder care (DeMeis et al., 1996). According to Williams et al. (1991), the more juggling incidents women has per day the more her chances for having less achievement and disappointment at the end of the day and also the chances for experiencing stress buffering effects increases. Moreover, women who do not get support from their partner in household work also endure high level of stress (Repetti et al., 1989). Sulleret (1971) found out that not accomplishing household activities effectively and poor academic performance of children haunted working women with the feeling of guilt which in turn lead to tension and prevented many women from feeling of fulfillment. While many investigations has been conducted on the occupational stress in men, only a meager amount of study has investigated the occupational stress in working women especially of nuclear families and the impact of these stresses on

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their families. The current study mainly aims at studying impact of job stress on the working women from nuclear families as well as their home environment.

MATERIALS AND METHODS

The study was conducted on 150 sample of young working women in the age group of 25-40 years belonging to different professional groups namely, private school teachers, nurses from private hospitals and private bank employees. This age group had been selected because the work load is more in this as compared to other age group. For selection of sample, a list of private schools, banks and hospitals were procured from Education Department, Health Department and Lead Bank. For the selection of school teachers a list of five schools were randomly selected and 10 teachers from each school from nuclear families were further selected purposively thus making a sample of 50 school teachers. For selection of private bank employees, five banks were selected randomly and further 10 women employees belonging to nuclear families from each bank were purposively selected. Similarly, from five private hospitals selected randomly, ten nurses from each hospital from nuclear families were selected from this list purposively thus making a total sample of 50 nurses. Thus in all a total sample of 150 young working women from nuclear families i.e. 50 private school teachers, 50 private bank employees and 50 nurses were selected for the present study. An interview schedule was prepared for collection of requisite data from the selected respondents to meet the specific objectives. Appropriate statistical tests were applied for the analysis of data.

RESULTS AND DISCUSSION

The data in Table 1 shows the impact of stress on psychological health of the respondents. Maximum score was given to the statement "suicidal thoughts" i.e. 2.94 which show that the respondents did not have suicidal thoughts. The least score was given to the statement "remain worried and tensed" with 2 as mean score which is followed by "feel irritated over minor things" of mean score 2.05. This shows that stress has some impact on the life of the respondents and they feel irritated and remain worried sometimes. The statement "frustrated over failure of work" was given a mean score of 2.21 and the statement "suffer from urge to cry or hide and run" with a mean score of 2.35 followed by "confused while doing work" with 2.44 as mean score. It was further observed that among the three categories of respondents bank employees have got the minimum score of 1.82 and 1.86 respectively for the statements "feel irritated over minor things" and "remain worried over minor things". Statistically significant difference was seen for statements; "feel irritated over minor things", "frustrated over failure of work" and "confused while doing work" respectively.

Table 2 shows the information on impacts of stress on physiological health. Data reveals that "headache" gets the mean score of 1.67 followed by "backache" with score of 1.77 and "gastric problems" with mean score of 1.79 which means that the respondents always had these health problems due to the impact of stress. In further observation it was observed that "neck ache"

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Statements	Teachers	Bank employees	Nurses	Total	F-ratio
	(n = 50)	(n = 50)	(n = 50)	(n = 150)	
Remain worried and tensed	2.02±0.51	1.86 ± 0.57	2.12±0.48	2.00 ± 0.53	2.41
Feel irritated over minor things	2.08 ± 0.49	1.82 ± 0.44	2.26 ± 0.53	2.05 ± 0.52	10.37**
Frustrated over failure of work	2.04 ± 0.49	2.18 ± 0.48	2.42 ± 0.50	2.21±0.51	7.65**
Feel powerless and inability todo anything	2.56 ± 0.50	2.36±0.60	2.52 ± 0.50	2.48 ± 0.54	1.95
Confused while doing work	2.58 ± 0.50	2.30±0.46	2.44 ± 0.50	2.44±0.50	4.12*
Tendency to do move about without any reason i.e. hypermobility	2.78±0.42	2.60±0.53	2.58±0.50	2.65±0.49	2.57
Suffer from urge to cry or run and hide	2.46 ± 0.50	2.22 ± 0.58	2.38±0.60	2.35 ± 0.57	2.35
Suicidal thoughts	2.94±0.24	2.94 ± 0.24	2.94±0.24	2.94±0.24	0.00

Table 1: Mean	score of	impact of	stress on	nsvcholog	ical health
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Always - 1, Sometimes - 2, Never - 3

*significant at 5% level of significance; **significant at 1% level of significance

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Statements	Teachers	Bank employees	Nurses	Total	F-ratio
	(n = 50)	(n = 50)	(n = 50)	(n = 150)	
Headache	1.68 ± 0.55	1.54 ± 0.50	1.78 ± 0.51	1.67 ± 0.53	2.68
Back ache	1.80 ± 0.61	1.76 ± 0.56	1.76 ± 0.59	1.77 ± 0.58	0.08
Body ache	1.94 ± 0.24	1.76 ± 0.62	1.88 ± 0.52	1.86 ± 0.49	1.75
Neck ache	1.92 ± 0.53	1.94 ± 0.68	1.72 ± 0.54	1.86 ± 0.59	2.15
Pain in lower limb	2.28 ± 0.61	2.40 ± 0.57	2.08 ± 0.60	2.25 ± 0.60	3.71*
High blood pressure	2.66 ± 0.48	2.84 ± 0.37	2.76 ± 0.43	2.75 ± 0.43	2.21
Loss of weight	2.78 ± 0.51	2.66 ± 0.48	2.62 ± 0.49	2.69 ± 0.49	1.43
Stroke	3.00 ± 0.00	3.00±0.00	3.00 ± 0.00	3.00 ± 0.00	0.00
Diabetes	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	0.00
Frequent sweating and trembling	2.80 ± 0.40	2.28 ± 0.57	2.52 ± 0.50	2.53 ± 0.54	13.62**
Gastric problems	1.74±0.66	1.68 ± 0.51	1.94 ± 0.59	1.79 ± 0.60	2.65
Breathing problems/asthma	2.76 ± 0.43	2.86 ± 0.35	$2.80 \pm .40$	2.81±0.40	0.81
Tensed or tight muscles	2.28 ± 0.57	2.58 ± 0.50	2.60 ± 0.49	2.49 ± 0.54	5.87**
Suffer from eating disorder	2.92±0.27	2.88 ± 0.33	2.80 ± 0.40	2.87 ± 0.34	1.62
Heart disease	$3.00 \pm .00$	3.00±0.00	3.00 ± 0.00	3.00 ± 0.00	0.00
Prone to various sicknesses	2.90±0.30	2.84±0.37	2.84	2.86 ± 0.35	0.49

Table 2: Mean scores of impact of stress on physiological health

Always - 1, Sometimes - 2, Never - 3

*significant at 5% level of significance; **significant at 1% level of significance

and "body ache" were given mean score of 1.86 and 1.88 respectively. All the three categories of respondents gave "stroke", "diabetes" and "heart disease" with maximum score of 3 which means that they did not faced these types of health problems. Difference was statistically significant for; "pain in lower limb", "frequent sweating and trembling" and "tensed or tight muscle". These may be due to the difference in amount of stress received by the three categories of respondents and the type of work they performed.

Table 3 deals with the information on impact of stress on work performance. The statement "absenteeism" was given mean score of 2.31 and "argument with supervisors and co-workers" with mean score of 2.33; this shows that the respondents sometimes had these effects on their work due to stress. Maximum score was given to the statement "unnecessarily being present at workplace for job insecurity" followed by "feel to quit the job" and "less productivity/working capacity decreases" with mean score of 2.70, 2.57 and 2.56 respectively. Statistical significance in difference was found in the statements; "argument with supervisors and co-workers", "absenteeism" and "unnecessarily being present at workplace for job insecurity". This result is also supported by Younkin (2010) saying that having to juggle multiple roles and effect of the pressures from work on one's attitude and behaviour within the family may lead to 'work-family spill over'.

Data given in the Table 4 shows information about impact of stress on children's performance. Maximum score was given to the statement "decrease in love and affection from children" and "children's health is affected" with mean score of 2.70. This shows that despite being busy working women, the respondents took care of their children's well being and looked after them. The statement "children's academic performance affected" was given mean score of 2.57 followed with "not able to attend their school meetings and spend time with them" and "kids complain of less attention" both getting mean score of 2.46. Minimum score was given to "take out misery and frustration on children" i.e. 2.31 which shows that the respondents sometimes take out their stress and frustration over their children. Baker et al. (2012) also found out the relationship between parenting stress and

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Statements	Teachers	Bank employees	Nurses	Total	F-ratio
	(n = 50)	(n = 50)	(n = 50)	(n = 150)	
Arguments with supervisors & co-workers	2.40±0.49	2.20±0.40	2.42 ± 0.50	2.34±0.48	3.38*
Absenteeism	2.26 ± 0.56	2.20 ± 0.40	2.48 ± 0.50	2.31±0.51	4.43*
Unnecessarily being present at workplace for jobinsecurity	2.78±0.42	2.52±0.50	2.80±0.40	2.70±0.46	6.17**
Less productivity/ working capacity decreases	2.54 ± 0.50	2.60 ± 0.49	2.54 ± 0.50	2.56 ± 0.50	0.24
Feels to quit the job	2.54 ± 0.50	2.62±0.49	2.56 ± 0.50	2.57±0.50	0.35

Always - 1, Sometimes - 2, Never - 3

*significant at 5% level of significance; **significant at 1% level of significance

Statements	Teachers $(n = 50)$	Bank employees (n = 50)	Nurses $(n = 50)$	Total (n = 150)	F-ratio
Take out misery and frustration on children	2.36±0.48	2.33±0.78	2.24±0.53	2.31±0.46	14.95**
Children's academic performance affected	2.62 ± 0.49	2.52 ± 0.84	2.55 ± 0.61	2.57 ± 0.50	2.56
Decrease in love & affection from children	2.80±0.40	2.63 ± 0.86	2.71 ± 0.59	2.72±0.45	1.75
Not able to attend their school meetings and spend time withthem	2.28±0.54	2.65±0.86	2.47±0.61	2.46±0.53	0.57
Kids complain of less attention	2.34±0.56	2.43 ± 0.82	2.61±0.61	2.46 ± 0.53	6.44**
Children's health is affected	2.76±0.43	2.61±0.86	2.71±0.59	2.70±0.46	8.61**

Always - 1, Sometimes - 2, Never -3

**significant at 1% level of significance

Table 5: Mean score of impact of stress on husbands

Statements	Teachers (n = 50)	Bank employees (n = 50)	Nurses $(n = 50)$	Total (n = 150)	F-ratio
Argue with husband due to job pressure	$2.06 \pm .24$	2.36 ± 0.48	2.52 ± 0.50	2.31±0.47	5.12**
Too busy to accompany him for socialization & entertainment on working days	2.36±0.48	2.48±0.58	2.22±0.65	2.35±0.58	3.70*
Decrease in love & affection from husband	2.78 ± 0.42	2.62±0.49	2.64 ± 0.48	2.68 ± 0.47	0.07
Husband complains of in adequate attention	2.54 ± 0.50	2.56 ± 0.50	2.64 ± 0.48	2.58 ± 0.50	4.43*

Always - 1, Sometimes - 2, Never - 3

*significant at 5% level of significance; **significant at 1% level of significance

behaviour problems; and high parenting stress contributed to a worsening in child behaviour problems over time. Statistically significant difference was shown in the statements; "take out misery and frustration on children", "kids complain of less attention" and "children's performance is affected".

The data in the Table 5 presents the information on impact of stress on husbands of the respondents. Maximum score was given to the statement "decrease in love and affection from husband" i.e. 2.68 followed by "husband complains of inadequate attention" which shows that even if there is stress of work among the respondents they never fail to be with their husbands and take care for them. Minimum score was given to the statement "argue with husband due to their job pressure" with mean score of 2.31 and the statement "too busy to accompany him for socialization and entertainment on working days" with mean score of 2.35 that shows that the respondents sometimes take out their pressure of stress to their husbands and due

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Statements	Teachers (n = 50)	Bank employees $(n = 50)$	Nurses (n = 50)	Total (n = 150)	F-ratio
Difficulty in maintainingorderly home	2.08±0.49	2.02±0.59	2.38±0.53	2.16±0.56	2.16
Difficulty to keep houseneed and clean	1.94 ± 0.59	2.08 ± 0.63	2.44±0.64	2.15±0.65	2.73
Too busy to visit relativesand guests	1.98 ± 0.62	2.18±0.60	2.36 ± 0.56	2.17±0.61	3.53*
Dependency on servantshas not changed	1.86 ± 0.76	1.68 ± 0.78	1.96 ± 1.08	1.82±0.64	0.62
Not able to keep eye over kitchen needs like refilling of gas cylinderor repairing utensils	2.36±0.56	2.42±0.50	2.64±0.56	2.47±0.55	0.72

Table 6: Mean score of impact of stress on household affairs

Always - 1, Sometimes - 2, Never - 3

*significant at 5% level of significance

to the long working hours and job pressure they did not accompany them in socialization on working days. Statistically significant difference was seen in the statements; "argue with husband due to job pressure", "too busy to accompany him for socialization and entertainment on working days" and "husband complains of inadequate attention".

The Table 6 reveals the information regarding impact of stress on household affairs of the respondents. The statement "dependency on servant has not changed" was given mean score of 1.82 which shows that because of the job pressure the respondents depended on servants to take care of the household work. In further observation it can be observed that the statement "difficulty to keep house need and clean was given mean score of 2.15 followed by the statement "difficulty in maintaining orderly homes" with mean score of 2.16 and "too busy to visit relatives and guests" which means that due to the long working hours and occupational stress the respondents were not able to keep their house clean and in order. Moreover it can be seen that they did not get enough time to visit their relatives and friends. Maximum score was given in "not able to keep eye over kitchen needs like refilling of gas cylinder or repairing utensils" i.e. 2.47. Statistically significant difference was found in the statement "too busy to visit relatives and guests".

CONCLUSION

It was concluded from the study that the impact on physiological health of the working women was the most followed by impact on maintaining the house and Children's performance. The findings also revealed that working women from nuclear family encountered extremely more stress This was mainly due to double pressure of work and lack of support from their partners which in turn lead to stress and anxiety in them and prevent them from feeling of fulfillment.

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Research Article

Constraints Faced by Members of FPOs in Telangana and Andhra Pradesh

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ABSTRACT

To tackle the various challenges faced by small and marginal farmers, the collectivization of farmers into Farmer Producer Organizations (FPOs) is considered to be one of the best approaches. For improving the performance of FPOs in India, analyzing the constraints is a necessity. Hence, a study was conducted in the Telangana and Andhra Pradesh states of India. Data were collected from 200 members of twenty FPOs using a well-structured interview schedule and analyzed using the Garrett ranking technique. Results revealed that the major constraints were lack of processing facilities, lack of storage facilities, fewer external linkages, lack of coordination among the members, lack of enough capital, inadequate supply of inputs, lack of latest market information, and low procurement capacity. The study recommends that the constraints can be overcome by improving value addition facilities, greater external linkages, government funding, transport facilities, and storage facilities at the FPO level.

Keywords: Farmer producer organisations, Constraints, Garrett ranking

INTRODUCTION

Agriculture is the main source of livelihood for more than 50 percent of the Indian population and one of the main income-generating sources. Small and marginal farmers account for 86.08 per cent of the total holdings while their share in the operated area stood at 46.94 per cent (Agriculture Census, 2015-16). To address the various challenges faced by small and marginal farmers, different approaches have been developed. One of the most effective approaches is to collectivize the producers, especially small and marginal farmers, into producer organizations.

NABARD (2015) defined Farmer Producer Organizations (FPOs) as one type of producer organization (the legal entity formed by primary producers viz. farmers, fishermen, weavers, etc.) where the members are farmers. In India, FPOs can be registered under the Cooperative Society Act or Indian Companies Act or Indian Trust Act, or Society Registration Act. NABARD, NCDC, and SFAC are the nodal institutions for the promotion of FPOs. The Government of India is giving more emphasis on the promotion of Farmer Producer Organizations (FPOs) for doubling the income of farmers. It has set a target to form 10,000 new FPOs by 2027-2028 (The Economic Times, 2022).

Currently, India has 7,059 FPOs, of which 3094 have been promoted by NABARD, 898 by SFAC, and 2257 by implementing agencies [(North Eastern Regional Agricultural Marketing Corporation Limited (NERAMAC), Tamil Nadu-Small Farmers Agri-Business Consortium (TN-SFAC), etc,.) under the

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central sector scheme for the formation and promotion of 10,000 FPOs (GoI, 2022). But the number of FPOs and the situation of existing FPOs is not similar in all states and they are in various stages of formation. Most of the FPOs are in the formation stage and some are struggling to survive.

Few studies were conducted in the past (viz. study on 8 different FPCs across India by Mukherjee (2018), a study on Mahagrapes in Maharashtra by Nikam (2014), etc.). But still, further in-depth investigation regarding constraints faced by members of FPOs in these two states i.e. Telangana and Andhra Pradesh is needed. Identifying the constraints which hinder the effective performance of farmer producer organizations yields socio-economic benefits. Keeping this in view, a research study was proposed to analyze the various constraints related to infrastructure, organization, economic, and marketing that will provide suitable strategies to guide the newly formed FPOs in a progressive direction.

MATERIALS AND METHODS

The study was carried out in Khammam and Nalgonda districts of Telangana and Krishna and West Godavari districts of Andhra Pradesh state of India. Telangana state, in general, experiences a tropical climate and is geographically located in a semi-arid area, and has a predominantly hot and dry climate. The important crops grown are Rice, Maize, Pulses, Groundnut, Cotton, Chillies, and Sugarcane. The climate of Andhra Pradesh state is generally hot and humid. The major Kharif crops viz. paddy, cereals maize, jowar, bajra, ragi, and pulses are produced in the state known for their rich nutrient content and are the staple diet of millions of people.

Telangana has the fourth-largest number of FPOs (460 which is 6.5% of the country's total) and similarly, Andhra Pradesh has 399 FPOs which is about 5.6 percent of the country's FPOs (GoI, 2022). The FPOs in these two states are in different phases of formation. But these states have enough potential to make all the existing farmer producer organizations viable and organize more farmers to join them. Hence, the research study has been taken in these states.

A multi-stage sampling procedure was used in the present study. Krishna and West Godavari districts

from Andhra Pradesh and Khammam and Nalgonda districts from Telangana were selected randomly for the study. From each selected district, five FPOs were selected randomly with three inclusion criteria- firstly, the FPO is working for more than 3 years, secondly, the FPO having more than 300 members and thirdly the FPO providing more than one type of service (knowledge services, economic and advisory services, input supply services, processing services, financial services, training and capacity building services, networking services, procurement, and packaging services). From each selected FPO, ten members were selected randomly. Thus, 200 respondents and 20 FPO staff (i.e. one from each FPO) were selected for the study.

A triangulation approach using a mix of qualitative and quantitative data; primary and secondary data were used in the overall study. Primary Data was collected by interviewing members and officials of FPOs. In addition to these officials from ATMA and KVK were also interviewed and Focused Group Discussions (FGD) were organized to gather more qualitative information for supporting the findings. Different official documents, reports, and other publications by different organizations were referred for the collection of secondary data. Farmers were interviewed with the help of a well-structured interview schedule to analyze the constraints faced by members of FPOs.

A total of seventeen constraints were identified based on the review of the literature and a pilot study. These constraints were divided into four categories viz. Constraints related to infrastructure, organization, economic, and marketing. Members of FPOs were asked to rank the constraints of each category. Farmers' response in terms of ranks was analyzed using the Garrett ranking technique.

Under the Infrastructure constraints, the following constraints were identified: lack of transport facilities for marketing, lack of storage facilities, lack of proper office building, and lack of processing facilities. Fewer external linkages, lack of transparency, lack of coordination among the members, and lack of good leadership were identified under Organizational Constraints. Under Economic Constraints, high tax liabilities, lack of enough capital, lack of policy support from the government, lack of willingness of members to contribute to raising capital, and inadequate supply of inputs were identified. Low procurement capacity, delayed payment, lack of latest market information, and fewer prices compared to local traders were all identified as marketing constraints.

Garrett's Ranking Technique was used to identify the final ranks of the constraints. The percent position for each constraint was calculated by using the following formula

Percent position = $100 \text{ x} (\text{R}_{\text{ii}} - 0.5)/\text{N}_{\text{i}}$

Where, $R_{ij} = Rank$ given for i th constraint by j th individual

and N_j = Number of constraints ranked by j th individual

Then, the percent positions were converted into the Garrett values by referring to the Garrett ranking conversion table given by Garret and Woodswordh (1969). For each constraint, the scores of individual respondents were added together, and mean values were calculated. The final ranking was based on the mean values. The constraint with the highest mean value was assigned the highest rank.

RESULTS AND DISCUSSION

The results revealed that (Table 1) lack of processing facilities was the major constraint faced by members under infrastructure constraints with Garrett's mean score of 66.35. This was because of the lack of funds, less awareness of the FPO officials, and lack of adequate staff. Similarly, Verma *et al.* (2021), in their study in Uttar Pradesh, also found that the lack of well-developed processing facilities and lack of welldeveloped storage facilities were perceived as the most serious constraints and were ranked as 1st by both members and non-members. Lack of storage facilities was ranked as the second major constraint with Garrett's score of 50.35. It was also because of less capital availability with FPOs. The above findings get support from the studies of Pathania *et al.* (2020) and Krishna (2018). This was followed by a lack of proper office building and lack of transport facilities.

In Organization constraints (Table 2), fewer external linkages was ranked first with Garrett's mean score of 68.4. It may be because the FPOs were not having greater linkages with input and output companies, government, private organisations, and other civil service organisations; due to a lack of awareness and interaction. Lack of coordination among the members was ranked the next major constraint by farmers with Garrett's mean score of 52.9. This was mainly because of a lack of we feeling and a lack of effective communication. This was followed by a lack of good leadership and lack of transparency. Kavin and Divya (2019) in their study on farmer producer organizations in the western region of Tamil Nadu also found that the majority of the respondents reported fewer external linkages and lack of coordination among the members as the major constraints. Chopade et al. (2019) in their study in Maharashtra found that the non-inclusion of local leaders in FPCs and lack of coordination for different group activities were the major constraints. Lack of transparency was ranked as the least because mostly the activities done by FPOs are transparent to the members of the FPOs.

Economic constraints faced by Members of FPOs are depicted in (Table 3) Lack of enough capital ranked first by the majority of farmers. It may be because a few schemes of the government were limited to the FPOs having 500 membership sizes. The finding is supported by Pathania *et al.* (2020). In his study on

 Table 1: Infrastructure constraints faced by members of FPOs

S.	Constraints Telangan		gana	Andhra Pradesh		Pooled sample		
No.		Garrett	Rank	Garrett	Rank	Garrett	Rank	
		mean score		mean score		mean score		
1	Lack of Processing facilities	68.4	Ι	64.3	Ι	66.35	Ι	
2	Lack of storage facilities	51.2	II	49.5	II	50.35	II	
3	Lack of Proper office building	47.6	III	39.6	IV	43.6	III	
4	Lack of transport facilities	32.8	IV	46.6	III	39.7	IV	

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<u>S.</u>	Constraints	Telangana		Andhra Pradesh		Pooled sample	
No.		Garrett mean score	Rank	Garrett mean score	Rank	Garrett mean score	Ran
1	Less external linkages	65.5	Ι	71.3	Ι	68.4	Ι
2	Lack of coordination among the members	54.6	II	51.2	II	52.9	II
3	Lack of good leadership	52.9	III	44.2	III	48.55	III
4	Lack of transparency	27	IV	33.3	IV	30.15	IV

Table 2: Organization constraints faced by members of FPOs

Table 3: Economic constraints faced by members of FPOs

S.	Constraints	Telan	gana	Andhra Pradesh		Pooled sample		
No.		Garrett	Rank	Garrett	Rank	Garrett	Rank	
		mean score		mean score		mean score		
1	Lack of enough capital	63.5	Ι	67	Ι	65.25	Ι	
2	Inadequate supply of inputs	48	IV	53.5	II	50.75	II	
3	Lack of policy support from the government	53	Π	48.5	IV	50.75	V	
4	Lack of willingness of members to contribute to raising capital	49.5	III	49.5	III	49.5	III	
5	High tax liabilities	36	V	31.5	V	33.75	IV	

Producer Organisations (Pos) and their role in transforming agribusiness in India, he found that an immense issue for building robust FPOs is inadequate access to cheap credit. Inadequate supply of inputs and lack of policy support from the government were ranked as the next major constraints by farmers with Garrett's mean score of 50.75. This was because FPOs were not willing to maintain input outlets due to the risk involved by the officials in recovering money from the farmers for the inputs purchased and the difficulty in getting dealerships from the input companies. The officials also reported that there is huge competition from the local fertilizers shops and Primary Agricultural Co-operative Credit Societies (PACS). The above research findings are supported by the studies of Verma et al. (2021); Mukherjee (2018) and Manaswi (2018). The lack of willingness of members to contribute to raising capital and high tax liabilities were ranked as the least major constraints.

During the present study, it was observed that related to marketing constraints, low procurement capacity was a major constraint faced by farmers (Table 4). Few FPOs officials opined that the procurement capacity of the FPOs was low as farmers are habituated to selling to the local traders and input shops, and also licenses were not provided by the government to few FPOs. Apart from low procurement capacity, the lack of the latest market information was ranked second. These findings are supported by Dewangan (2018). In her study on the Socio-Economic Impact of Farmer Producer Organisations (FPOs) in the Bastar District of Chhattisgarh, she found that most of the problems related to marketing constraint is lack of the latest market information. The delayed payment was ranked as a less severe constraint because most of the FPOs were giving payments timely (i.e. between a week to 15 days). As FPOs were involved in giving more or equal prices compared to local traders, farmers perceived this as a less severe constraint.

Rank

III IV

The other constraints noted during the study were the untimely disbursement of the salaries to the CEOs of the FPOs. Custom hiring centers' establishment was hindered due to a lack of capital. The incidence of pest attacks and diseases in the particular area was also observed as a major constraint. Because of this, the most successful and actively performing FPO leaned back to the inactive stage. The misconception among the farmers about the concept of the FPOs, lack of

S.	Constraints	ints Telangana Andhra Pradesh		radesh	Pooled sample		
No.		Garrett	Rank	Garrett Rank		Garrett	Rank
		mean score		mean score		mean score	
1	Low procurement capacity	73	Ι	73	Ι	73	Ι
2	Lack of latest market information	40	III	50	II	45.55	II
3	Delayed payment	38.5	IV	43.7	III	41.38	III
4	Less price compared to local trader	rs 48.5	II	33.3	IV	40.05	IV

Table 4: Marketing constraints faced by members of FPOs

NGO support for a few FPOs, misunderstandings among the officials and between the officials and farmers, lack of motivation of the staff, lack of trained staff, and difficulty in changing the attitude of the farmers were also observed as constraints. Many of the FPOs are not involved in the provision of credit supply due to a lack of capital and a low recovery rate from the farmers.

CONCLUSION

The most important constraints identified are lack of processing facilities, lack of storage facilities, fewer external linkages, lack of coordination among the members, lack of enough capital, inadequate supply of inputs, lack of procurement capacity, and lack of market information. Thus, there is a need to improve infrastructure facilities that facilitate taking up value addition activities by the FPOs. Government funding to all the FPOs can be provided for basic infrastructure development through schemes like agriculture infrastructure schemes and adequate training must be given to the FPOs officials. A few concerns regarding constructing warehouses should be considered. The FPOs must be linked with ATMA, KVKs, or nearby research institutes to get the information and diversify input and market linkages for enhanced benefits. The team spirit among the members of the FPOs must be increased by adequate measures. Financial support from the GOI, SFAC, NABARD, and Producer Organization Promoting Institutes (POPI) may be implemented to the fullest extent possible. The FPOs should have easy access to get dealerships for inputs that help the organizations to maintain input outlets at the village level. The licenses should be given to the FPOs for procurement of the produce and the farmers must be given few benefits if sold out to the FPOs (i.e. high price to produce, disbursing crop loans, providing extension and advisory services). Staff should

be trained to use e-NAM and other marketing-related apps and portals for accessing market information. Farmer Producer Organizations have the power to significantly alter the present situation of small and marginal farmers and contribute to the goal of doubling farm income by employing effective techniques to overcome challenges. Therefore, the identification of constraints hindering their performance and effectiveness is necessary to provide solutions to their problems.

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Research Article

Construction and Validation of Farmer's Attitude Scale towards Social Networking

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ABSTRACT

Understanding farmers' attitude is influential in initiating/formulating any strategy to promote the adoption of technology. A scale was developed to assess the attitude of farmers towards social networking. A comprehensive list of 70 statements encompassing both positive and negative statements were collated and refined considering the opinions of experts and Edward's 14-point framework and 37 statements were retained for administering to farmers from non-sampling area for further analysis. Finally, "t" value for each statement was analyzed and found that 14 statements were having "t" value greater than 1.75. Based on the "t" value, 14 statements comprising 9 positive statements and 5 negative statements were chosen to construct a scale that would measure the attitude of farmers towards social networking. The 14 statements were retained for the final scale and administered for testing the reliability and validity. Cronbach alpha coefficient of 0.76 confirmed the internal consistency of the developed scale. The content validity of the scale was ascertained based on the experts' judgment. The final developed scale can be used to assess the attitude of farmers on social networking in the present context and beyond the study area with modifications.

Keywords: Attitude, Scale, Social networking, Likert's summated rating method, Item analysis, Reliability

INTRODUCTION

Agriculture contributes significantly to India's economic growth. Agriculture's contribution to GDP has dropped dramatically during the last 50 years. Agriculture growth has been varying widely and Farmers income remained low due to lower levels of productivity brought about by lower levels of adoption of scientific technologies by farmers. Hence, facilitating the adoption of innovation by farmers is the need of hour to sustain agricultural productivity. With this information related to agricultural practices (such as crop management, input sourcing, financing, marketing and so on) is the crucial input of this coping and allied activities. To provide reliable information to farmers, an effective and efficient information delivery

system is crucial. Information dissemination role is now being played by public and private extension agencies mediated by information and communication technologies. But, considering formal channels as the only source of information to farmers may mask the reality as farmers heavily rely on informal interpersonal communication networks. These diverse information needs of farmer are satisfied by the fellow farmers, extension personnel, agricultural research and education establishment and agricultural extension organizations through an unseen interconnected path of communication, called 'Agricultural information Network'. Thus, Social networks can act as powerful channels for knowledge diffusion and the adoption of innovative farming practices. Identifying farmers' attitudes towards social networking can reveal the

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potential barriers or facilitators for the adoption of new techniques, technologies, and sustainable practices. This knowledge can aid in designing strategies to accelerate the adoption of beneficial innovations within the agricultural community. Studying farmers' attitudes towards these social networking can shed light on their willingness to participate in group activities, engage in peer learning. We can understand how these social networks impact their decision-making processes, access to resources, and overall well-being potentially leading to increased market access and financial inclusion for small-scale farmers. Understanding farmers' attitudes towards social networking can aid in assessing the effectiveness of such communication channels in times of emergency and improve disaster preparedness and response measures.

In summary, studying the attitude of farmers on social networking helps us comprehend their behavior, preferences, and needs in the digital age. This knowledge is vital for designing more effective agricultural policies, improving technology adoption, enhancing market access, and promoting sustainable agricultural practices. In custody of the important role played by social networks in the agriculture farming, it is imperious to understand the attitude of farmers towards social networking. In view of this aspect, the researcher has decided to develop the scale to measure attitude of farmers towards Social Networking.

MATERIALS AND METHODS

Attitude is a psychological construct that refers to an individual's overall evaluation, disposition, or feelings toward a person, object, event, situation, or concept. It encompasses a range of emotions, beliefs, and behaviors that shape a person's approach to and interaction with the world around them. Attitudes can be positive, negative, or neutral and can influence a person's thoughts, actions, and decisions. The method of summated rating scale suggested by Likert (1932) was followed in the development of scale. Likert scale is a commonly used method for measuring attitudes, opinions, perceptions, or beliefs, where respondents are asked to rate their level of agreement or disagreement with a series of statements. Overall methodology summarized in Figure 1.

Development of the item pool of the "attitude" scale: In order to understand how farmers felt about their social networks, 84 statements about Attitude of farmers towards social networking were gathered from review of the existing literature books, research articles, journals, academic attainments, expertise of intellectuals in extension, research, teaching, selfintuitions and own experiences. From all these sources a tentative list of 84 statements was prepared keeping in sight of the applicability of statements suited to the field of research.



Figure 1: Summary of methodology followed to develop attitude scale

Editing of statements: The 84 statements collected were carefully edited by using experts' judgment and Edward's 14 point principles. The following criteria were used to edit the 84 draft statements.

- Avoided statements that refer to the past rather than to the present.
- Avoided factual statements.
- Avoided statements that may be interpreted in more than one way.
- Avoided statements that are unrelated to the psychological item being examined.
- Avoided statements that are likely to be endorsed by almost everyone or by almost no one.
- Selected the statements that are believed to cover the entire range of the affective scale of interest.
- Maintained the language of the statements simple, clear, and direct.
- Statements were made as short as possible, rarely exceeding 20 words.
- Each statement contained only one complete thought.
- Statements containing universals such as all, always, none and never often introduce ambiguity were avoided.
- Words such as only, just, merely and others of a similar nature were used with care and moderation was also carried out in writing statements.
- Almost all the, statements were framed in the form of simple sentences rather than in the form of compound or complex sentences.
- Avoided the use of words that may not be understood by those who are to be given the completed scale.
- Avoided the use of double negatives.

After editing, the 84 statements 14 statements were deleted, thus making a total of 70 statements.

Testing the statements for relevancy: It's possible that not all of the statements gathered are equally pertinent for assessing farmers' attitudes towards social networking. As a result, the statements were examined by judges to ascertain their relevance and to screen them for inclusion in the final scale. For this purpose, a

pool of 70 statements that are relevant and cover different aspects of the construct which aims for a diverse set of statements to capture the full range of responses were generated and administered to a panel of experts review to ensure they are relevant, comprehensive and clear. Experts included were subject matter experts, faculty and scientists working in various ICAR institutes, researchers or professionals with experience in the domain of interest.

The statements were distributed to 100 specialists and were requested to critically assess each one for its applicability in gauging farmers' attitudes towards social networking. They were asked to rate their responses on a four-point scale, viz., Most relevant, Relevant, Somewhat Relevant, and Not relevant with scores 4, 3, 2 and 1. They were also requested to feel free to add some more statements, if they feel important and also delete unrelated statements.

The responses obtained from judges were subjected to Standard Normal Deviate test (z test). After giving the scores to the statements, 'z' values were calculated for each statement.

$$Z = (X - \mu) / \sigma$$

- z = Average of score obtained by each statement.
- μ = The Mean score on each statement.
- σ = Standard deviation of each statement.

Finally, the grand 'z' values of all the 70 statements were obtained and 'z' was calculated. All the statements with 'z' values above z (0.02) were selected as the scalable statements of attitude of farmers towards social networking. The statements with 'z' values below 'z' were eliminated. Thus, 37 statements out of 70 were selected through relevancy testing.

Calculation of "t" value: The selected statements were then administered to a small sample of 40 farmers from the non- sampling area. Then the top 25 per cent of the respondents with the highest scores and the bottom 25 per cent of the respondents with the lowest scores were considered as criterion groups to calculate the critical ratio i.e. 't' value for each statement. The calculated 't' value for each statement will measure the extent to which the statement differentiates between the respondents of high group and low group. The 't' values were determined using the formula suggested by Edwards (1969).

$$t = \frac{(\overline{X}_{H} - \overline{X}_{L})}{\sqrt{\frac{\sum (\overline{X}_{H} - \overline{X}_{H})^{2} + (\overline{X}_{L} - \overline{X}_{L})^{2}}{N(n-1)}}}$$

 \overline{X}_{H} = Mean score on a given statement for high group \overline{X}_{L} = Mean score on a given statement for low group $\Sigma \overline{X}_{H}^{2}$ = Sum of squares of individual score on a given statement for high group

 $\Sigma \overline{X}_{L}^{2}$ = Sum of squares of individual score on a given statement for low group

 $\Sigma \overline{X}_{H}$ = Summation of scores on a given statement for high group

 $\Sigma \overline{X}_{L}$ = Summation of scores on a given statement for low group

n = Number of respondents in each group

 $\Sigma =$ Summation

Selection of attitude statements for the final scale: After computing 't' values for all the 37 statements, they were arranged in the order of highest 't' value to lowest 't' value. The statements with 't' values more than 1.75 were selected for the final scale. Thus out of 30 statements, 14 statements with 't' value more than 1.75 were selected in the scale and were presented in the table 1. The final scale to measure the attitude of farmers towards social networking comprised of 14 statements, out of which were 9 positive statements and 5 negative statements was standardized.

Testing the reliability and validity of the scale: Reliability and validity of the final scale was established through appropriate procedures. The internal consistency (Cronbach alpha) coefficient was used to assess the measuring tool's reliability. The Cronbach alfa coefficient was determined using an SPSS programme, and the resultant value of 0.76 was good enough to prove the reliability of the scale. The optimum Cronbach alpha value in research is greater than or equal to 0.7, yet in some circumstances a Cronbach coefficient of 0.6 or more is also considered to be sufficient to prove the reliability of the measuring instrument (Nunnally and Bernstein, 1994).

Testing the validity of the scale: The validity of the scale on attitude of farmers towards social networking was obtained through content validity by



Figure 2: Selection of statements for attitude scale construction

taking the judge's opinion. The statements selected for the scale were evaluated individually and as a whole by the judges. These were again checked by experts in Acharya N.G. Ranga Agricultural University for their relevance and coverage. As the content of the scale was borne out by the method of collecting statements within the universe of attitude of farmers towards social networking, it may reasonably be assumed that the attitude of farmers towards social networking scale has content validity.

RESULTS AND DISCUSSION

A total of 37 items that were pertinent to the construct were retained based on the opinion of experts. Finally, the 37 statements were administered to 40 farmers from a non-sampling area and their replies were recorded on a five-point scale i.e., Strongly agree, Agree, Undecided, Disagree and Strongly disagree with scores 5, 4, 3, 2 and 1 respectively for affirmative statements and vice-versa for the negative statements. Scores of all the respondents were summed up to get a total score across all the statements with values ranging from 37 to 185 and then respondents were arranged in descending order. The top 25 per cent and bottom per cent of respondents were chosen as the criterion groups for the t-value computation. Each statement's t value was determined. Any 't' value equal to or greater

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S. No	Statements	t- value	t- Degree of favourab lue or unfavourable expressed by t statements		irable blene by the nts	leness iess he	
			SA	Α	UN	DA	SD
1	Neighbours, friends and fellow farmers are better sources for agri based information	4.02					
2	It is possible to discuss in detail on farm related topics through social networks	2.21					
3	Agricultural information through social networks is good for awareness but applying it is difficult*	3.26					
4	Information through social networks creates more confusion in minds	1.99					
5	I feel the information received through social networks as credible	4.92					
6	I can travel a reasonable distance to scientists or extension personnel to seek farm based information than rely on fellow farmers*	1.87					
7	I prefer to have more external social contacts	3.41					
8	Social networks can create specific interest groups in agriculture*	1.98					
9	Sometimes social networks leads to substantial wastage of time for me*						
10	Social networks provide local agricultural information round the clock	1.83					
11	There is an opportunity to learn new techniques and practices from others in networks	3.52					
12	Social networks influences the perceptions and decision making of individuals	2.35					
13	Technology adoption can be facilitated through social networks	3.67					
14	Discussions in social networks can easily lose its focus and divert from main topic under discussion*	2.15					

Table 1: t-values of the statements that represent the attitude of farmers towards social networking

Note: SA: Strongly Agree, A: Agree, UN: Undecided, DA: Disagree and SD: Strongly Disagree

* Negative statements

than 1.75 may be regarded as adequate as a quick and rough guideline. Through item analysis, it was shown that 14 statements had "t" values more than or equal to 1.75, indicating that they could distinguish between favourable and unfavourable attitudes. As a result, the final scale to assess farmers' attitudes towards social networking was standardised using the 14 statements of which 9 are positive and 5 are negative—as shown in (Table 1). With few modifications, the final standardised scale can be used to assess farmers' attitudes towards social networking in the current context and beyond the study area.

CONCLUSION

In summary, this study delved into a crucial aspect of scale construction on the attitude of farmers toward social networking which aids to gain valuable insights into how farmers perceive and engage with others in the context of agriculture. In conclusion, understanding farmers' attitudes toward social networking is not just a glimpse into their digital interactions but an exploration of the evolving dynamics within the farming community. It is vital for extension personnel and policy makers to study the attitude of farmers towards social networking and provides insights on how to improve future services to the agricultural community.

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Research Article

Orobanche Infestation in Tobacco: Farmers' Knowledge and Constraints

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ABSTRACT

Orobanche is the major production constraint affecting the income of Flue Cured Virginia (FCV) tobacco farmers. The present study is an attempt to analyze the knowledge level and identify the constraints faced by the respondents in orobanche management in FCV tobacco. Expost facto research design and random sampling procedure has been adopted in selection of respondents. To collect the data from the respondents in totally, 60 farmers from two tobacco growing regions viz., Southern Light Soils (SLS) & Southern Black Soils (SBS) in Prakasam district of Andhra Pradesh (30) and Karnataka Light Soils (KLS) region in Mysuru district of Karnataka (30) were sampled. The primary data was collected during 2021-22 based on field survey and interaction with FCV tobacco farmers. The results revealed that farmers knowledge on orobanche management practices is low in both the study areas. Correlation studies showed that there is a positive and significant relationship between level of education, farming experience, trainings attended and information seeking behaviour with the knowledge level of the respondents. For analyzing the constraints faced by the farmers in parasite management, Henry Garrett ranking technique was employed. Results revealed that the most serious constraints perceived by the majority of the farmers among all were problematic soils, favourable weather condition, easy spread of the parasite, physical removal after flowering, low credibility on extension personnel, lack of know-how on biology of the parasite, small and marginal land holdings, tenancy ownership, lack of strict quarantine measures and lack of compensation to the farmers in case of crop failure caused by orobanche.

Keywords: Constraints, Farmers, FCV tobacco, Knowledge, Management and Orobanche

INTRODUCTION

Each of the agro-ecological zones and crops cultivated has distinct weed problems. Weeds were reported to cause yield loss of 5 per cent in commercial agriculture, 10 per cent in semi commercial agriculture, 20 per cent in subsistence agriculture and 37–79 per cent in dry land agriculture (Rao *et al.*, 2018). Among the parasitic weeds, *orobanche* is the troublesome root parasite which totally depends on the host plant to complete its life cycle. This parasite is most difficult to control because of its underground position, late appearance of parasitic shoots, lack of photosynthesis, intricate mechanisms of seed dispersal, germination, and longevity in the soil for decades. The different species of *orobanche* attacks and parasitize on cultivated crops like potato, tomato, tobacco, brinjal, fababean, groundnut, safflower, niger, lettuce, sunflower, rapeseed and mustard, cabbage and linseed. Among which, *Orobanche cernua* is considered as major threat in commercial crop like FCV (Flue Cured Virginia) tobacco.

Tobacco is an important commercial crop grown in India and is often referred as golden crop. India stands at second position in tobacco production (761

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M kg) after China (2135 M kg) in world. The extent of tobacco production in India has significantly increased from 719 M kg in 2014 to 761 M kg in 2020 (FAOSTAT, 2020). During 2020-21 period, Indian exports of tobacco and tobacco products were to the tune of 2,11,631 M. Tons valued at Rs 6,305.94 crores. Among which, FCV tobacco exports accounted to 1,05,406 Metric Tons valued Rs 2,726.91 crores (Tobacco Board, 2021). Studies shown that FCV tobacco cultivation have profound influence on economic and social well-being of farmers in Andhra Pradesh and Karnataka (Hema et al., 2019, 2021). As orobanche is also the most devasting parasite in FCV tobacco areas and threatening the livelihood of farmers, this calls for analyzing the knowledge level and identifying the constraints perceived by the farmers in its management. Therefore, in view of the economic importance of FCV tobacco in terms of farmers net income and national economy, the present study was undertaken with a specific objective to analyze the knowledge level and identify the constraints faced by the respondents in orobanche management.

MATERIALS AND METHODS

The study was conducted in the districts of Prakasam in Andhra Pradesh and Mysuru in Karnataka. These states were purposively selected as these are the major FCV tobacco growing areas of the country. Expost facto research design and random sampling technique was employed in selection of respondents. The study was based on analysis of primary data collected during 2021-22 from 30 randomly selected FCV (Flue Cured Virginia) tobacco farmers in each of the two tobacco growing regions viz., Southern Light Soils (SLS) & Southern Black Soils (SBS) in Prakasam district of Andhra Pradesh and Karnataka Light Soils (KLS) region in Mysuru district of Karnataka thus making total sample size of 60 respondents. To analyze the knowledge level and identify the constraints faced by the respondents in orobanche management, a suitable semi structured interview schedule was developed based on the discussion with experts, farmers and through data from relevant review of literature. The data collected were coded, tabulated and to measure the knowledge level, correlation was computed and for severity of constraints hindering orobanche management, Henry Garrett constraint technique was employed for statistical analysis.

Henry Garrett constraint analysis: As per this analysis, the respondents of the present study have been put to assign the rank for all the constraints and the per cent position is computed with the following formula.

 N_i

Where, $R_{ij} = Rank$ given for the ith variable by jth respondents

 $N_i =$ Number of variable ranked by jth respondents

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

RESULTS AND DISCUSSION

Data on knowledge level were collected using interview schedule developed for the study. Based on obtained score, the respondents were grouped into low, medium and high knowledge categories and the results are presented below in Figure 1.

From Figure 1, it can be perceived that majority of the respondents had low level of knowledge in SLS &SBS of AP (64%) and KLS regions of Karnataka (50%). Most of the farmers strongly felt that knowledge on pests and diseases is more important as they are the



Figure 1: Farmers knowledge on Orobanche management

major obstacles for crop production than weeds particularly parasites. It is also felt by the respondents that hand weeding is the only option for parasite control. The biology and complex spread mechanisms are also difficult to understand until the parasite emerges from the underground, but as and when the shoots of *orobanche* are visible to the farmers, most of the damage already occurred to the host plant. Whereas in case of pests and diseases, the symptoms are distinct and clearly visible on the plants. This results in low level of knowledge in both the study areas.

In order to study the relationship between the level of knowledge on *orobanche* management and the profile characteristics of farmers, the correlation coefficient (r) values were computed and the results given below in Table 1.

Results of correlation from Table 1 showed that education, farming experience, trainings attended and information seeking behaviour of the respondents showed positive and significant relationship between level of knowledge of respondents and management practices. More the education, experience in farming, trainings received and information seeking behaviour, the more opportunity a farmer can have to acquire more knowledge. Especially FCV tobacco being commercial crop, Central Tobacco Research Institute and Tobacco Board regularly conducts training programmes to the farmers.

The major constraints confronted by the FCV tobacco farmers in *orobanche* management were

Table 1: Relationship between knowledge level of respondents and independent variables (N=60)

Independent variables	Pearson correlation coefficient (r)
Age	0.299 ^{NS}
Family type	-0.073 ^{NS}
Education	0.614*
Farming experience	0.426**
Land holding	0.114 ^{NS}
Annual income	0.367 ^{NS}
Trainings attended	0.445**
Labour availability	0.083^{NS}
Farm mechanization status	0.023^{NS}
Information seeking behaviour	0.685**

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

collected through semi-structured interview schedule. Based on their perception, the constraints were categorized into five groups *viz*, resource, production, technical, social and policy constraints. Further all the data were analyzed by Garrett ranking technique to ascertain the severity of the constraints and the results are presented below.

Majorly, six challenges related to resources faced by the farmers were enlisted and ranked on the basis of Garrett mean scores. It is apparent from Table 2 that problematic soils was observed as the most severe constraint. Farmers strongly feel that whatever management practices they follow, their fields are prone to *orobanche* incidence. The parasite aggressiveness with the host plants and widespread occurrence in FCV tobacco growing fields since many years resulted in difficulty in controlling with normal weed management practices. The findings are in accordance with Rathore *et al.* (2014) mentioned that lack of effective management measures of the parasite hastens its spread and makes soil sick within a short period.

In the study conducted by Punia *et al.* (2014), reported that higher infestation of the parasite is noticed in inherently poor fertile soils. It was followed by favourable weather condition to the parasite which triggers germination and non-availability of labour during peak season for hand pulling. According to Das *et al.* (2019), the Optimum temperature for germination of the parasite is 20-25°C and high pH (alkaline range) may inactivate the germination stimulant and reduce *Orobanche* germination. Presently, *orobanche* is controlled by hand pulling by the labour. Shortage of labour during the peak season of agricultural operations will have greater impact on management. The study

Table 2: Constraints perceived by the respondents related to resources (N=60)

. ,		
Resource constraints	Garrett's	Rank
	mean score	
Problematic soils	59.45	Ι
Lack of recommended chemicals	43.21	IV
Lack of irrigation facilities	33.65	VI
Repeated sowings/gap fillings	41.76	V
Favourable weather condition to the parasite	55.56	Π
Non-availability/high wages of labour	49.34	III

conducted by Yaduraju (2012) made a mention on the impact of Mahatma Gandhi National Rural Employment Gurantee scheme on the labor shortage and increase in wages for agricultural operations in rural India.

Results presented in Table 3 highlights that easy spread of the parasite is the severe constraint encountered by the farmers in production aspects. Often, human practices are responsible for disseminating *orobanche* seeds through farm vehicles, agricultural implements and used produce containers either by direct seed contamination or through clinging of contaminated soil from the infested fields. The second major constraint is physical removal of the parasite after flowering by the farmers. It is known fact that when the parasite completes its flowering stage, some of the seeds fell on the ground and much of the damage has already been occurred and control would be futile.

Parker *et al.* (1993) stated that the extremely tiny seeds of the parasite are produced in vast numbers and seed longevity in fields is up to 13 years. Monocropping practice followed by the farmers is another major concern. FCV tobacco farmers often follow monocropping of tobacco in the same fields

Table 3: Constra	aints perceived by th	he respondents	related
to production ((N=60)		

Production constraints	Garrett's mean	Rank
	score	
Easy spread of the parasite	48.22	Ι
Alteration in planting dates	30.89	VI
Monocropping practice	35.78	III
Poor intercultural operations	33.44	IV
Physical removal after flowering	46.54	II
Aberrant climate conditions	31.23	V

for the years. Crop rotation with non-host crops especially with trap or catch crops in rotation is of great advantage. Acharya *et al.* (2002) have used toria as a catch crop for *Orobanche* control and observed 33.35 per cent reduction in seed bank of the parasite in the soil. However, reports also indicated that heavily infested fields of the parasite should be planted with trap crops species for 2 or 3 years to wipe out parasite seed bank (Qasem, 2021).

Data depicted in Table 4 reveals constraints related to technical aspects. Among these, low credibility on extension personnel seemed to be the important constraint. It is the general tendency of the farmers to often relay on fellow farmers for the farm related information. In the study carried out by Kabir et al. (2014) indicated that almost 53 per cent of the respondents gather agriculture information from their friends and neighbours. This is again controversy with the finding of Kumar et al. (2012), mentioned that 60 per cent of the farmers do not access any source of information for advanced agricultural technologies. The data also reflects lack of know-how on biology of the parasite to the farmers is the other major limitation. There are many reports on biology of the orobanche parasite. Each capsule of the plant contains 600-800 seeds, and a single plant may yield more than one lakh seeds depending upon species. The seeds can arise from as deep as 15 cm below the soil surface. According to Brenchley (1920), seed generally remains viable in soil for 10 to 13 years period, but the viability can be maximum up to 20 years (Puzilli, 1983). The next subsequent challenge was biased attitude in capacity building programmes to same group of farmers. At one side, there are strong evidences from the study reports that the number of extension personnel is decreasing. In India, of the required 1.3 million to 1.5 million extension personnel, there are only about 0.1 million in the service (Kumar et al., 2012).

Table 4: Constraints perceived by the respondents related to technical aspects (N=60)

Technical constraints	Garrett's mean score	Rank
Lack of infrastructure for research and extension	37.77	IV
Lack of awareness on neem cake application	35.26	V
Low credibility on extension personnel	49.99	Ι
Lack of know-how on biology of the parasite	48.28	II
Lack of timely supervision by grass root workers/farmers	33.45	VI
Biased attitude in capacity building to same group of farmers	41.45	III
In case of social constraints depicted in Table 5, it could be observed that small and marginal land holdings is the most serious problem in the FCV tobacco growing areas. Resources are limited for small farmers as they are not able to pay high wages to the labour. There are many systematic studies conducted in India on labour requirement and affordability of small farmers, one such study by Rao et al. (2018) proved that with estimated labor requirement of 20 man-days/ha for weeding operations, India requires around 5 billion man-days of labor. It is also revealed that tenancy ownership adds in the woo. It is noticed from the study area that tenant farmers generally leave the pulled over orobanche shoots on the field bunds which encourages parasite seed dispersal between the fields. The next subsequent constraint is poor rate of participation by the farmers in extension activities. This observation is in consonance with the findings of Mansour et al. (2022) mentioned that 85 per cent farmers lack confidence in the farm advisory recommendations of orobanche integrated control techniques by extension personnel. Another study by Shanabhoga et al. (2021) also mentioned about the constraints perceived by the respondents in using public extension services.

Table 5: Constraints perceived by the respondents related to social aspects (N=60)

Social constraints	Garrett's mean score	Rank
Small and marginal land holdings	49.67	Ι
Poor rate of participation in extension activities	34.87	III
Attitude of the farmers	32.56	V
Illiteracy and poor economic condition of the farm family	33.11	IV
Tenancy ownership	48.22	Π
Lack of consensus in decision making among farmer groups	30.80	VI

Data in Table 6 showed that there are no strict quarantine measures for minimizing the production of new parasite seeds and their dispersal to new sites is the major hindrance to management. Above findings are in line with the observations made by Anand *et al.* (2018). Data further indicated that there are no compensation guidelines from the government to the farmers in case of any crop damage or complete failure due to *orobanche* infestation. This finding is in

Table 6: Constraints perceived by the respondents related	d
to policy aspects (N=60)	

Policy constraints	Garrett's	Rank
	mean score	
Unavailability of funds	32.56	V
Lack of compensation measures in case of crop failure	45.69	II
Lack of strict quarantine measures	46.78	Ι
No community approach/large scale	37.65	IV
No systematic base line data on occurrence / damage	44.28	III
Lack of institutional convergence	24.57	VI

similar lines reported by Singh *et al.* (2018). It is followed by another significant concern *viz.*, lack of systematic data on parasite extent of damage. Reports also showed that till date, there is no systematic data reported on weed damage estimates. The study conducted by Rao *et al.* (2018) about two decades ago stated that the economic impact of weeds on the Indian economy estimated ranged from Rs. 20 to 28 billion. The statistics reported in 'Geographical Atlas of World Weeds' by Holm *et al.* (1979) showed that there are 975 weeds in various parts of the world which have not been recorded or reported in India so far. Another study on constraint analysis by Gupta *et al.*, (2019) also mentioned on lack of research data on efficacy of complete package application to all the beneficiaries.

CONCLUSION

Orobanche is the devastating root parasite that represent a major challenge for farmers growing FCV tobacco in Andhra Pradesh and Karnataka. Based on the present study findings, it is concluded that the most serious constraints perceived by the farmers in resource related challenges were problematic soils and favourable weather condition to the parasite. Similarly, easy spread of the parasite and physical removal after flowering were major limitations in production related constraints. Major technical related problems were low credibility on extension personnel and lack of know-how on biology of the parasite to the farmers. In case of social constraints, small and marginal land holdings and tenancy ownership were the major hindrances. Whereas lack of strict quarantine measures and lack of compensation to the farmers in case of crop failure caused by orobanche are the severe policy constraints.

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Research Article

Farmers' Participation and Perception in Sustainable Agro-Ecosystem Management for Conservation and Stewardship

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ABSTRACT

Natural resource management, conservation agriculture, and stewardship are nothing more than a socioecological continuum that unites nature and mankind. The ecological system is now at a dangerously disruptive level because of the depletive nature of conventional agriculture. The present study aims to identify and characterize the variables responsible for ecological functions and deliverables in small farms, as practiced by farmers. Elucidating the factors, impacts and perceptions of farmers, 150 respondents were selected from three villages namely Panchkahaniya, Bhabanipur, Satyapul of Nadia district by systematic random sampling for the study. The responses were collected through a structured interview schedule. The study envisaged that the size of homestead land, land under irrigation, consumption of coal, fuel wood, fire wood etc. and production of cow dung/poultry litter/goat/biogas slurry variables has been found to exert strong and determining contribution to the application of organic manure whereas age, size of family members, size of holding, size of homestead land, marketed surplus, cropping intensity, total amount of chemical fertilizer applied has come out with stronger determining character on the soil conservation level. The study suggests that Indian farmers should prioritize ecological restoration and conservation through stewardship functions to ensure their well-being and sustainability.

Keywords: Stewardship, Organic manure, Soil conservation level, Ecological restoration, Natural resource management

INTRODUCTION

Soils are forms natural capital of enormous importance that provides the foundation for food production and forms the base of all tropic chain (Sofo et al., 2022). The excessive use of mechanical and chemical inputs raises compaction, erosion, and soil salinization, lowers the amount of organic matter and soil nutrients, and generally has a detrimental impact on the productivity and long-term sustainability of the soil (Cárceles Rodríguez et al., 2022). As soil is a non-renewable resource, stewardship of our current domesticated soil is essential for long-term human prosperity for a growing population of between 9.6 and 12.3 billion in 2100 (Amundson et al., 2015; Lutz et al., 2017). Stewardship in agriculture entails managing ecosystems, natural resources, and farms in an ethical and sustainable way to preserve their long-term production and viability (Roesch-McNally *et al.*, 2018; McLennon *et al.*, 2021).

Agricultural activity has resulted in the homogeneity of biodiversity and landscapes as well as the depletion of natural capital (Keith *et al.*, 2016). The adverse effects of conventional agriculture not only threaten food security but also the overall well-being of ecosystems and communities dependent on it. Both the status of soil organisms and crops must be taken into consideration for cropping systems to be long-term sustainable (De Vries and Wallenstein, 2017; Pelosi and Römbke, 2018). Through conservation agriculture and soil stewardship, farmers can reverse these detrimental trends and promote agricultural practices that align with the natural environment (Chatterjee *et al.*, 2021).

Embracing soil stewardship means safeguarding soil fertility with techniques like crop rotation and cover

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crops, preventing soil erosion with erosion-control measures like contour plowing, and enhancing soil health by refraining from using excessive amount of chemicals (Amundson et al., 2015). Healthy soil serves as a valuable carbon sink, capturing carbon dioxide from the atmosphere and mitigating climate change (Amundson and Biardeau, 2018). Additionally, it improves water infiltration and retention, mitigating the risks of both floods and droughts (Cárceles Rodríguez et al., 2022). Soil biodiversity is equally vital as it supports a diverse range of organisms crucial for nutrient cycling, pest control, and overall ecosystem health (Bünemann et al., 2018). Prioritizing soil stewardship, farmers actively contribute to biodiversity conservation and maintain the delicate balance of nature (McBratney et al., 2014). The goal of the current study is to restore ecological resilience by examining how farmers apply organic manure and use other soil conservation techniques in their crop fields. The study also attempted to comprehend the function and value of organic matter from the perspective of farmers in order to improve soil stewardship.

MATERIALS AND METHODS

The study was carried out in Nadia district of West Bengal. Sampling techniques adopted for the study were both purposive and simple random sampling (Ray and Mondal, 2014). 150 farmers were included in the study sample and were chosen at random (Cochran, 2007) from the purposively selected block, Haringhata. Three villages namely Panchkahaniya, Bhabanipur, Satyapul of the aforesaid block were selected randomly. The area has been selected for the study because of a) there is sample scope for collecting relevant data for the present study, b) the concern area was very easily accessible to the researcher in terms of place of residence, c) the area was very easily accessible to the researcher in terms of transportation and d) the closer familiarities of the student researchers with the area, people, officials and local dialects. A score of fifty respondents-who are fairly representative of the village farm families-were chosen at random from each village. Two sets of variables (i) independent variables (x_1-x_{22}) and (ii) dependent variables (y_1-y_2) were used to operationalize the study on Farmers' participation and perception in sustainable agro-ecosystem management. Before beginning the actual fieldwork, a pilot study was carried out to better understand the region, its people, institutions, communication networks, social systems, and the people's knowledge, perceptions, and attitudes regarding the significance of using organic manures to restore ecological resilience and improve stewardship practices. Application of organic manure (y_1) and soil conservation level (y_2) by the farmers are recorded using a pre-tested structured interview schedule, and the relationships between a subset of twenty-two variables are examined using quantitative methods such as coefficient of correlation, stepwise regression and path analysis using IBM SPSS 20.0 and the web-based program OPSTAT (Sheoran *et al.*, 1998).

Empirical measurements of the dependent variables (determinants of stewardship) are as follows: Application of organic manure (AOM; y_1): Organic manurehas been perceived as organic source of plant nutrient called manure either produced at domestic level or produced from elsewhere. It is measured in terms of kg/ha applied in the field.

Soil conservation level (SOL; y_2): Soil conservation level is an input indicator for estimating stewardship level. Soil may be conserved by traditional community practices or by institutional practices in the form of recommendation. Here it has been measured as Percentage of area under Mulching, land shaping, contour bunds, paira cropping divided by area under cultivation.

RESULTS AND DISCUSSION

Table 1 represents the distribution of 22 independent variables (x_1-x_{22}) mean, standard deviation and coefficient of variance.

For Panchkahaniya village the above table depicts that the coefficient of variance (CV) of variables age (x_1) , family size (x_4) , mean distance between two fragments (x_8) , size of homestead land (x_9) , yield of crop (x_{10}) , marketed surplus (x_{11}) , cropping intensity (x_{14}) , total amount of seed used (x_{15}) , total hours of irrigation given (x_{16}) , total amount of chemical fertilizer applied (x_{17}) , on farm income (x_{19}) , consumption of coal, fuel wood, fire wood etc. (x_{21}) are less than or equal to 0.30, which indicates that the distribution pattern of the variables are highly consistent. The coefficient of variance (CV) of variables size of holding (x_5) , number of fragment (x_6) , average size of fragment

Table 1: Description of the selected independen	t variables of	respondents	s of study lo	cale					
Independent variable	Panch	ıkahaniya vill	age	Bha	banipur villa	ge	Sa	tyapul village	
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
Age (x_i)	49.09	7.37	0.15	39.01	8.23	0.21	44.95	9.85	0.22
Education (x_2)	6.08	3.22	0.53	9.48	1.67	0.18	9.5	2.62	0.28
Functional education (x_3)	11.68	7.59	0.65	9.58	5.96	0.62	9.56	4.72	0.49
Size of family members (x_4)	5.16	0.87	0.17	6.62	2.58	0.39	3.94	0.98	0.25
Size of holding (x_2)	0.12	0.05	0.43	0.10	0.04	0.40	0.16	0.07	0.42
Number of fragment (x_c)	9.62	3.37	0.35	5.04	0.9	0.18	4.32	1.68	0.39
Average size of fragment (x_{γ})	0.06	0.02	0.31	0.12	0.03	0.27	0.14	0.05	0.38
Mean distance between two fragments $(\mathbf{x}_{\mathrm{s}})$	0.71	0.13	0.18	0.59	0.17	0.29	0.4	0.23	0.56
Size of homestead land (x_9)	12.18	1.93	0.16	0.10	0.07	0.74	0.07	0.03	0.42
Yield of $\operatorname{crop}(x_{10})$	54668.25	5364.15	0.10	27197.25	3968.44	0.15	41807.25	7424.56	0.18
Marketed surplus (x_{11})	49065.98	5299.42	0.11	3157.68	524.52	0.17	37443.9	6987.14	0.19
Land under irrigation (x_{12})	0.53	0.18	0.35	0.49	0.12	0.24	0.45	0.19	0.42
Rainfed area (x_{13})	0.09	0.09	0.99	0.10	0.08	0.81	0.14	0.13	0.97
Cropping intensity (x_{14})	261.23	25.96	0.10	277.48	13.88	0.05	267.13	16.41	0.06
Total amount of seed used (\mathbf{x}_{15})	98.68	10.67	0.11	82.85	9.44	0.11	101.68	18.54	0.18
Total hours of irrigation given (x_{1_0})	9.67	0.94	0.10	9.77	1.42	0.15	11.18	4.45	0.40
Total amount of chemical fertilizer applied $(x_{l\gamma})$	986.7	57.5	0.06	703.35	101.07	0.14	1255.35	266.88	0.21
Count of livestock (x_{18})	3.22	1.14	0.35	1.43	0.8	0.56	1.62	1.41	0.87
On farm income (x_{19})	5734	909.27	0.16	6668	984.46	0.15	5200	2106.84	0.41
Communication variable $(x_{2\nu})$	74.82	26.44	0.35	93.6	23.21	0.25	115.8	51.62	0.45
Consumption of coal, fuel wood, fire wood $\left(x_{2l}\right)$	139.23	42.44	0.30	44.45	7.39	0.17	20.66	5.2	0.25
Production of cow dung/poultry litter/goat/ biogas slurry (\mathbf{x}_{22})	51.69	30.7	0.59	55.39	20.53	0.37	13.05	8.74	0.67

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 (x_7) , land under irrigation (x_{12}) , count of livestock (x_{18}) , communication variable (x_{20}) are between 0.30 to 0.50, which indicates that the distribution pattern of the variables are fairly consistent. The coefficient of variance (CV) of variables education (x_2) , functional education (x_3) , rainfed area (x_{13}) , production of cow dung/ poultry liter/goat/biogas slurry (x_{22}) are greater than 0.50, which indicates that the distribution pattern of the variables are inconsistent.

For Bhabanipur village the above table depicts that the coefficient of variance (CV) of variables age (x_1) , education (x_2) , number of fragment (x_2) , average size of fragment (x_{τ}) , mean distance between two fragments (x_s) , yield of crop (x_{10}) , marketed surplus (x_{11}) , land under irrigation (x_{12}) , cropping intensity (x_{14}) , total amount of seed used (x_{15}) , total hours of irrigation given (x_{16}) , total amount of chemical fertilizer applied (x_{17}) , on farm income (x_{19}) , communication variable (x_{20}) , consumption of coal, fuel wood, fire wood etc. (x_{21}) are less than or equal to 0.30, which indicates that the distribution pattern of the variables are highly consistent. The coefficient of variance (CV) of variables family size (x_{4}) , size of holding (x_{5}) , production of cow dung/poultry liter/goat/biogas slurry (x_{22}) are between 0.30 to 0.50, which indicates that the distribution pattern of the variables are fairly consistent. The coefficient of variance (CV) of variables functional education (x_3) , size of homestead land (x_0) , rainfed area (x_1) , count of livestock (x_1) are greater than 0.50, which indicates that the distribution pattern of the variables are inconsistent.

For Satyapul village the above table depicts that the coefficient of variance (CV) of variables age (x_1) , education (x_2) , family size (x_4) , yield of crop (x_{10}) , marketed surplus (x_{11}) , cropping intensity (x_{14}) , total amount of seed used (x_{15}) , total amount of chemical fertilizer applied (x_{17}) , consumption of coal, fuel wood, fire wood etc. (x_{21}) are less than or equal to 0.30, which indicates that the distribution pattern of the variables are highly consistent. The coefficient of variance (CV) of variables functional education (x_3) , size of holding (x_5) , number of fragment (x_6) , average size of fragment (x_{γ}) , size of homestead land (x_{γ}) , land under irrigation (x_{12}) , total hours of irrigation given (x_{16}) , on farm income (x_{10}) , communication variable (x_{20}) are between 0.30 to 0.50, which indicates that the distribution pattern of the variables are fairly consistent. The coefficient of variance (CV) of variables mean distance between two fragments (x_8) , rainfed area (x_{13}) , count of livestock (x_{18}) , production of cow dung/poultry liter/goat/ biogas slurry (x_{22}) are greater than 0.50, which indicates that the distribution pattern of the variables are inconsistent.

Table 2 presents the coefficient of correlation between determinants of stewardship (i.e. application of organic manure (y_1) and soil conservation level (y_2) and 22 independent variables. It has been found that the following variables age (x_1) , number of fragment (x_{s}) , mean distance between two fragments (x_{s}) , size of homestead land (x_0) , yield of crop (x_{10}) , marketed surplus (x_{11}) , count of livestock (x_{18}) , communication variable (x_{20}) , consumption of coal, fuel wood, fire wood etc. (x_{21}) , production of cow dung/, poultry liter /goat/biogas slurry (x_{22}) have been recorded significant and positive correlation with the dependent variable application of organic manure (y_1) , while the other variable education (x_2) , average size of fragment (x_7) have recorded significant but negative correlation with the dependent variable application of organic manure (y_1) . It is discernible that the number of fragments (x_i) and the mean distance between two fragments (x_{a}) , homestead land (x_{a}) , have gone positively significant and the application of organic manures (y_1) . When a size of holding undergoes a process of fragmentation it triggers another process moving in a complex manner with a resultant ramification of input used and its prodigal application. It also helps increasing cost of management as well as decline in input use efficiency thereafter. Count of livestock and production of cow dung, poultry litter and biogas slurry have rightly contributed to the application of higher organic manures. The stewardship function here has got two basic things to do- i) can there be further integration of farm management function and ii) whether this integrations can be ecologically effective efficient when it dovetails higher use of organic manures. Average size of fragments, as the result suggest, the smaller the size of fragments, the bigger will be the volumes of land resources and logically the higher will be application of organic manure. The policy implication for this analysis can wait for further results to come, one direction is more apparent to suggest that fragmentation of holding however have boosted the higher application of

Independent variables	r va	alue
	AOM	SCL
$\overline{\text{Age}(\mathbf{x}_1)}$	0.305*	0.010
Education (x_2)	-0.484**	-0.190
Functional education (x_3)	0.110	0.026
Size of family members (x_4)	0.049	-0.311*
Size of holding (x_5)	-0.126	-0.237
Number of fragment (x_0)	0.589**	-0.226
Average size of fragment (x_7)	-0.560**	-0.144
Mean distance between two fragments (x_s)	0.418**	-0.253
Size of homestead land (x_{9})	0.833**	0.101
Yield of crop (x_{10})	0.588**	0.398**
Marketed surplus (x ₁₁)	0.500**	0.487**
Land under irrigation (x_{12})	0.085	-0.530
Rainfed area (x ₁₃)	-0.113	-0.255
Cropping intensity (x_{14})	-0.143	0.181
Total amount of seed used (x_{15})	0.116	0.309
Total hours of irrigation given (x_{16})	-0.152	0.266
Total amount of chemical fertilizer applied (x_{17})	-0.079	0.487**
Count of livestock (x ₁₈)	0.521**	0.031
On farm income (x_{19})	0.001	-0.241
Communication variable (x_{20})	-0.341*	0.073
Consumption of coal, fuel wood, fire wood (x_{21})	0.813**	0.006
Production of cow dung/poultry litter /goat/biogas slurry (x ₂₂)	0.418**	-0.333*

Table 2: Association between the determinants of stewardship and selected independent variables (x_1-x_{22})

NB: Application of organic manure (y_{1}) - AOM, Soil conservation level (y_{2}) - SCL, *significant at 0.05 level, **significant at 0.01 level

organic when associated with consumption of fire woods and count of livestock.

It has been found that the following variablesyield of crop (x_{10}) , marketed surplus (x_{11}) , total amount of seed used (x_{15}) , total amount of chemical fertilizer applied (x_{17}) have been recorded significant and positive correlation with the dependent variablesoil conservation level (y_2) , while the other variable size of family members (x_4) , land under irrigation (x_{12}) , production of cowdung/,poultry liter /goat/biogas slurry (x_{22}) have recorded significant but negative correlation with

the dependent variable soil conservation level (y_2) . The soil conservation interventions, mostly traditional and based on community learning made by the farmers, have been highly effective in maintaining soil health and intrinsic production functions. This community learning, as being perceived, has been refined further with modern soil conservation techniques as well. These include mulching, land shaping, seepage tanks or conservation tanks etc. So, it's discernible that having this ecological intervention in place, the yield of crop vis a vis marketed surplus, seeds applied and chemical input used, could have performed productively. This kind of stewardship functions have been effective well for the farm family with small size surrounded by irrigated small sized agro ecosystem and livestock enterprises as well.

Table 3 presents the step down regression analysis and path analysis between application of organic manure (y_1) and 22 causal variables.

The stepwise regression analysis elicits four casual variables size of homestead land (x_0) , land under irrigation (x_{12}) , consumption of coal, fuel wood, fire wood etc. (x_{21}) and production of cow dung/poultry litter/goat/biogas slurry (x_{22}) has come out with stronger determining character on the application of organic manure (y_1) . The R square value stands 74.4 per cent can be inferred that the combination of 4 variables has been quite justified, effective and able to explain 74.4 per cent of variance in the consequent variable application of organic manure. It has been supported by the adjusted R square value 73.6 per cent as well. This indicates that the area of land and production of bio fuels or its consumption either here functionally critical in ushering the application of organic manure and ultimately goes to scale up stewardship functions for the land under cultivation. This also indicates a need for switching over from inorganic agriculture to organic farming, even for the owner of the small and fragmented holdings.

Table 3 also presents the path analysis wherein the total effect of the exogenous variable on the consequent variable has been decomposed into direct, indirect and residual effects. Here the variables retained at the last step of step wise regression analysis have been considered and the respective β -values are counted for direct effect exerted by the respective causal variable.

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Table 3: Stepwise regression analysis and path analysis of application of organic manure (Y1) and 22 causal variables

independent variable	AOM					
	Ster	owise regres	sion]	Path analysis	5
	beta	t	Sig.	TE	DE	IE
Size of homestead land(x ₉)	0.589	6.528	0.001	0.833	0.589	0.244
Land under irrigation (x_{12})	-0.092	-2.145	0.034	0.085	-0.092	0.177
Consumption of coal, fuel wood, fire wood etc. $(\mathbf{x}_{_{21}})$	0.255	2.550	0.012	0.813	0.255	0.558
Production of cow dung/poultry litter /goat/ biogas slurry (x_{22})	0.129	2.502	0.013	0.418	0.129	0.289
$\overline{\mathbb{R}^2}$		0.744				
Adjusted R ²		0.736				
Residual Effect					25.6 %	

NB: TE = Total effect, DE = Direct effect, IE = Indirect effect

Table 4: Step down regression analysis and path analysis of soil conservation level (Y_4) and 22 causal variables Independent variable

	JCL					
	Step	pwise regres	sion]	Path analysi	- S
	beta	t	Sig.	TE	DE	IE
$Age(x_1)$	-0.099	-1.959	0.052	0.010	-0.099	0.109
Size of family members (x_4)	-0.401	-6.276	0.001	-0.311	-0.401	0.090
Size of holding (x_5)	-0.687	-111.13	0.001	-0.237	-0.687	0.450
Size of homestead $land(x_9)$	-0.223	2.796	0.006	0.101	-0.223	0.324
Marketed surplus (x ₁₁)	0.542	5.501	0.001	0.487	0.542	-0.055
Cropping intensity (x_{14})	0.146	2.883	0.005	0.181	0.146	0.035
Total amount of chemical fertilizer applied (x_{17})	0.309	4.353	0.001	0.487	0.309	0.178
\mathbb{R}^2		0.705				
Adjusted R ²		0.690				
Residual Effect					29.5%	

NB: TE = Total effect, DE = Direct effect, IE = Indirect effect

The table reveals that the variable consumption of coal, fuel wood, fire wood etc. (x_{21}) has got higher indirect effect exerted by the rest other variables on it and it is higher than its direct effect. So, energy consumption and its behaviour is mostly characterized by the associational effect of other variables. So, also is happening for another variable production of cow dung/poultry liter /goat/biogas slurry (x_{22}) where in the contribution of other variables speaks a lot than the variable itself speaks. So far as Application of organic manure (y_1) is concerned. So stewardship function through application of organic manure (y_1) has been well predicted by these four variables but the direct effect of at least two variables are less than the indirect effect exerted by other variables on this two. A similar study also reveals that the socialization of proper cognitive adoption of organic among the farmers for restoring ecological resilience is the need of the hour (Bera *et al.*, 2022).

Table 4 presents the step down regression analysis and path analysis between soil conservation level (y_2) and 22 causal variables.

The stepwise regression analysis elicits seven casual variables age (x_1) , size of family members (x_4) , size of holding (x_5) , size of homestead land (x_9) , marketed surplus (x_{11}) , cropping intensity (x_{14}) , total amount of chemical fertilizer applied (x_{17}) has come out with stronger determining character on the soil conservation level (y_2) . The R square value stands 70.5 per cent can

be inferred that the combination of 7 variables has been quite justified, effective and able to explain 70.5 per cent of variance in the consequent variable soil conservation level. It has been supported by the adjusted R square value 69 per cent as well. These causal variables can be clubbed into three categories that are 1) Socio-economic by nature, 2) Biodiversity index, 3) Input management in nature. When combination of causal variables encompasses three vital aspects of stewardship function no wonder the variance explained will go up substantially. Yiridoe et al. (2010) in regression analysis found that farm characteristics (i.e., farm type, farm size, farm income) and farmer capacity variables (i.e., specialized training and knowledge from EFP (Nova Scotia's Environmental Farm Plan) program information sessions and workshops, and on-farm stewardship demonstrations) were significant determinants of environmental farm planning. Soil conservation level, being a critical stewardship function, has to go beyond conservation itself. Crop biodiversity, soil moisture retention, invisible microbial metabolic function, yield behavior of crop and quality, land shaping and landscaping are all important deliverables out of soil conservation, keep on directing and maneuvering ecological functions to support both human and non-human life forms.

Table 4 also presents the path analysis wherein the total effect of the exogenous variable on the consequent variable has been decomposed into direct, indirect and residual effect. Here, the variables retained at the last step of the step wise regression analysis have been considered and the respective β -values are counted for direct effect exerted by the respective causal variable. The table reveals that the variable size of homestead land (x_0) has got higher indirect effect exerted by the rest other variables on it and it is higher than its direct effect. So, size of homestead land and its attribution is mostly characterized by the associational effect of other variables. The same also is happening for another two variablesage (x_1) , size of holding (x_5) where in the contribution of other variables speaks a lot than the variable itself speaks so far as soil conservation level (y_{4}) is concerned. Therefore, stewardship function through soil conservation level (y_A) has been well predicted by these seven variables but the direct effect of at least four variables are less than the indirect effect exerted by other variables on these four.

CONCLUSION

The present study highlights the critical importance of soil stewardship in agricultural practices, emphasizing the need to preserve and enhance our soil resources for the long-term sustainability of food production and ecosystems. Soil, as a non-renewable resource, plays a crucial role in supporting life and agriculture. The application of organic manure is influenced by various factors, with the size of homestead land, land under irrigation, consumption of biofuels, and the production of organic matter playing significant roles. Farmers who have larger homesteads and access to irrigation are more likely to apply organic manure, contributing to better soil stewardship practices. Factors such as farm size, cropping intensity, and the use of chemical fertilizers are linked to higher soil conservation levels. These findings emphasize the multifaceted nature of stewardship, where both ecological and economic factors play essential roles. The study underscores the complexity of soil stewardship and the need for integrated approaches that consider ecological, economic, and social factors. It also provides valuable insights for policymakers and agricultural practitioners seeking to promote sustainable farming practices that preserve soil health, enhance biodiversity, and contribute to the long-term well-being of both ecosystems and communities. As the global population continues to grow, responsible soil stewardship is essential to ensure food security and environmental sustainability for future generations.

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Research Article

Stakeholder's Perception of the Odisha Millet Mission: A Case Study in Koraput

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ABSTRACT

The study was undertaken in Koraput district of Odisha, India in 2022 with the aim to assess the impact of the Odisha Millet Mission (OMM) on tribal farmers. A purposive sampling method was used to select Koraput district as it is one of the first seven districts where the OMM was implemented. The study utilized a structured interview schedule to collect data from 120 respondents selected through random sampling from two blocks and four villages. The perception of farmers and beneficiaries regarding the Odisha Millet Mission (OMM) was assessed through four tables presenting the frequency and percentage of respondents' perceptions about the objectives, activities, approaches, and promotion of improved agronomic practices of OMM. Overall, farmers and beneficiaries had a positive perception of OMM, with the promotion of household-level consumption and improved availability of quality seeds being the most highly ranked objectives and activities, respectively. These results suggest that OMM is seen as a positive initiative to promote millet cultivation and improve income and food security in Odisha.

Keywords: Odisha millet mission, Tribal farmers, Impact assessment, Perception

INTRODUCTION

Millets were prominently grown crops in the rainfed regions of Odisha. They played a very important role in the diet of tribal communities. Millets are climateresilient crops and have high nutritive values (Bera and Mohanty, 2022). They helped to mitigate dry spells and address nutrition security of the tribal communities. Perception of beneficiaries regarding objectives, activities, approaches, and promotion of improved agronomic practices of Odisha Millet Mission is a crucial research topic that aims to explore the impact of a government initiative aimed at promoting millet cultivation in the state of Odisha, India (Dey and Pal, 2020).

In this context, The Odisha Millet Mission was launched in 2017 with the objective of promoting the cultivation of millets, which are highly nutritious and drought-resistant crops that can help address food security and nutritional challenges in the state (Gathala *et al.*, 2019). The success of the Odisha Millet Mission depends on the acceptance and adoption of improved agronomic practices by the beneficiaries of the program. These beneficiaries include smallholder farmers, women, and marginalized communities who are the primary producers and consumers of millets in the state (Jat *et al.*, 2018). The research seeks to understand the perception of these beneficiaries regarding the objectives, activities, approaches, and promotion of improved agronomic practices of the Odisha Millet Mission (Kumar *et al.*, 2018).

The study will utilize both qualitative and quantitative research methods to collect and analyse data. The research will use a combination of survey questionnaires and in-depth interviews to gather information from the beneficiaries of the program. The survey questionnaires will be used to collect data on the socio-economic characteristics of the beneficiaries, their perception of the program's objectives, activities, approaches, and promotion of improved agronomic practices (Lenka, 2019). The in-

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depth interviews will be conducted with a subset of the beneficiaries to gather detailed information about their experiences and challenges in adopting the improved agronomic practices promoted by the program (Mishra and Mohapatra, 2021).

The findings of this research will be of significant value to the Odisha government, policymakers, and stakeholders involved in the implementation of the Odisha Millet Mission (Patnaik and Dash, 2020). The research will provide insights into the perception of the beneficiaries regarding the program's objectives, activities, approaches, and promotion of improved agronomic practices (Singh and Singh, 2019). The findings will also help identify the challenges faced by the beneficiaries in adopting the improved agronomic practices promoted by the program and provide recommendations on how to overcome these challenges (Sahoo and Swain, 2019).

In conclusion, this research paper will contribute to the existing literature on government initiatives aimed at promoting agriculture in developing countries. The study will provide valuable insights into the perception of beneficiaries regarding the objectives, activities, approaches, and promotion of improved agronomic practices of the Odisha Millet Mission. The research findings will also be useful in informing policy decisions and program implementation strategies aimed at promoting millet cultivation and improving food security and nutrition in the state of Odisha, India.

MATERIALS AND METHODS

The study was conducted in the Koraput district of Odisha, India, with the aim of exploring the millet cultivation practices of tribal farmers in the region. The district was chosen through purposive sampling due to its status as one of the first seven districts where the Odisha Millet Mission was implemented and its high contribution to millet procurement. Two blocks, Nandapur and Semiliguda, were selected through purposive sampling, with the highest number of millet cultivators. Two villages from each block were then randomly selected for data collection. The sample consisted of 120 tribal farmer respondents, with 30 respondents from each village. The study used an expost facto research design, which is appropriate for investigating events that have already occurred, based on a thorough consideration of relevant literature and

research aims. Primary data was collected using a wellstructured and pre-tested interview schedule that included both open-ended and close-ended questions. The data were analysed by following several parametric and non-parametric tools like frequency, percentage, mean, standard deviation, mean scale value, correlation co-efficient. In the present study, thirteen independent variables viz. age, education, family type, family size, land holding, average annual income, social participation, extension contact, extension participation, mass media exposure, social media exposure whereas perception of farmers regarding Odisha millet mission as dependent variable were taken.

To measure the perception of farmers regarding Odisha millet mission an index was developed. Perception statements were constructed with the help of available literature reviews and by consulting the experts/scientists from the relevant fields. The index consisted of 26 final statements which were selected after conducting a relevancy test for the statements by administrating it to the experts from agricultural extension, agronomy and other concerned departments. The final perception index was used in the interview schedule to identify the perception of farmers regarding OMM. The respondents were asked to rate each of the statements on a three-point continuum i.e., 'agree', 'undecided' and 'disagree' and the numerical values of 3, 2 and 1 was assigned to the positive statements whereas 1, 2 and 3 was assigned to the negative statement. t. Further by analysing the scores, the respondents were divided into three categories viz. farmers with poor perception, moderate perception and good perception regarding OMM on the basis of calculated mean and standard deviation. Mean scale value (MSV) score was calculated for all the statements and ranking of statements was done on its basis. MSV is the total sum of the intended scores obtained by multiplying the frequency with the category's given scores and dividing the results by the total number of respondents. It has been used to convert each preference's frequency into a comparative level. The following formula was used to determine the mean scale value:

Mean scale value = $P1 \times 3 + P2 \times 2 + P3 \times 1 /N$ Where, P1= Frequency of respondents indicating first preference P2= Frequency of respondents indicating second preference

P3= Frequency of respondents indicating third preference

N= Total number of respondents

A statistical tool of Karl Pearson's simple correlation coefficient (r) was followed to estimate the nature of relationship between the selected variables leading to a comprehensive understanding of the farmer's perception regarding OMM.

Major objectives of OMM includes promotes household-level consumption, setting up of decentralized processing units, improvement in the productivity of millet crops etc. Perception of the tribal farmers regarding these objectives measured in the scale of strongly agree, agree and disagree. Further categorisation of the respondents into low, medium, high category as per the mean score and standard deviation analysis.

Activities like massive awareness campaigns, food festivals, rallies, facilities for processing and value addition, formation of FPOs for marketing and procurement of produce are carried out under OMM. Following table shows the categorisation of the respondents according to their perception regarding these activities.

Approaches of Odisha Millet Mission includes three-year incentive support through DBT in reduced manner, bio input enterprises etc. According to the perception of the respondents about approaches of OMM, they are categorised into low, medium and high level of perception using mean and standard deviation. Summation of mean and standard deviation categorised into high category, deduction of standard deviation from mean categorised into low category.

Handi khat preparation, standard size seed bed preparation, furrow preparation before transplanting, use of cycle weeder is some of the major agronomic activates carried out under OMM. Perception of beneficiaries is measured in scale of strongly agree, agree and disagree.

RESULTS AND DISCUSSION

Perception of the farmers regarding Odisha millet mission was assessed and the data on Table 1, 2, 3 & 4

Table 1: Distribution of respondents according to their Perception regarding objectives of Odisha Millet Mission (n = 120)

Perception	Frequency	Percentage
Low (up to 11)	11	9.17
Medium (11-14)	88	73.33
High (14 & above)	21	17.50

represents the perception of farmers regarding objectives, activities, approaches and about promotion of improved agronomic practices of OMM.

Table 1 revealed that majority (73.33%) of respondents have medium level of perception regarding the objectives of OMM. 17.50 per cent of respondents have high level of perception and only 9.17 per cent of respondents have low level of perception about the objectives of OMM. The findings of the study get the support by Behera *et al.* (2021).

Table 2: Distribution of respondents according to their perception regarding activities under Odisha Millet Mission (n = 120)

Perception	Frequency	Percentage
Low (up to 11)	15	12.50
Medium (11-14)	77	64.17
High (14 & above)	28	23.33

Table 2 revealed that majority (64.17%) of respondents have medium level of perception about the activities carried out under OMM. 23.33 per cent of the respondents have high level of perception about the activities carried out under OMM. Only 12.50 per cent of the tribal farmers have low level of perception regarding these activities.

According to Table 3, 60.00 per cent of the respondents have medium level of perception about different approaches of Odisha Millet Mission followed by 23.33 per cent of respondents have high

Table 3: Distribution of respondents according to their Perception about approaches of Odisha Millet Mission (n = 120)

Perception	Frequency	Percentage
Low (up to 22)	20	16.67
Medium (22-28)	72	60.00
High (28 & above)	28	23.33

$\frac{M_{15510n} (n = 120)}{2}$				
Perception	Frequency	Percentage		
Low (up to 13)	18	15.00		
Medium (13-17)	73	60.83		
High (17 & above)	29	24.17		

Table 4: Distribution of respondents about promotion of improved agronomic practices through Odisha Millet Mission (n = 120)

level of perception and 16.67 per cent have low level of perception regarding approaches of Odisha Millet Mission.

As per Table 4 majority (60.83%) of respondents have perceived at medium level that OMM promotes improved organic practices followed by 24.17 per cent of respondents who have high level of perception and only 15.00 per cent of them have low level of perception. The findings of the study get the support by Pradhan and Parida (2021).

Farmers have a positive perception of the objectives of the Odisha Millet Mission (OMM), with the promotion of household-level consumption being the most highly ranked objective. Other objectives such as setting up decentralized processing units, improving millet crop productivity, promoting farmer producer

Table 5: Perception of beneficiaries regardingobjectives of OMM

Item	MSV Score	Rank
Promotes household-level consumption	3.00	Ι
Sets up decentralized Processing Unit	2.89	II
Improvement in the Productivity of Millet Crops	2.83	III
Promotes FPOs for marketing	2.76	IV
Inclusion of millets in ICDS, Mid-day Meals and Public Distribution System	2.58	V

organizations for marketing, and inclusion of millets in government schemes are also well-received by farmers. These results suggest that the OMM is seen as a positive initiative to promote millet cultivation and improve income and food security. The findings of the study get the support by Rout *et al.* (2020).

The perception of beneficiaries regarding the activities under the Odisha Millet Mission is positive, with the improved availability of quality seeds being the most important activity. Beneficiaries also value awareness campaigns to popularize millet cultivation and the inclusion of millets in government schemes. The results highlight the need for continued support to improve processing and value addition facilities and the formation of farmer producer organizations and women self-help groups for marketing and procurement.

The survey results indicate that beneficiaries have a positive perception of several approaches of the Organic Farming Mission, with the provision of 3year incentive support through Direct Benefit Transfer being the most highly ranked. Other highly ranked approaches include promoting important agronomic practices and promoting bio input enterprises. The results suggest that these approaches are effective in promoting organic farming practices among beneficiaries. The findings of the study get the support by Patra *et al.* (2020).

The survey results show that beneficiaries perceive several improved agronomic practices promoted through the Organic Farming Mission (OMM) positively. The most positively perceived practices include the preparation of Handi Khat (organic manure), standard size seed beds, and furrow preparation before transplanting. The least positively perceived practice was weeding using a cycle weeder.

Table 6: Perception of beneficiaries regarding activities under OMM

Item		Rank
Improved PoP & availability of quality Seeds led to increase in yield	3.23	Ι
Massive Awareness Campaigns, Food Festivals, Rallies, etc. are carried out to popularise millet cultivation	2.88	II
Inclusion in Supplementary Nutrition Programme-ICDS, MDM & PDS	2.43	III
Facilities for Processing & Value addition available at GP/Block through WSHGs and FPOs	1.76	IV
Formation of FPOs/WSHGs for Marketing & Procurement of produce	1.58	V

Item	MSV Score	Rank
3-year incentive support through DBT in reduced manner is provided	3.12	Ι
Three important agronomic practices (SMI, LT &LS) are promoted through farmer's choice	3.05	Π
Bio input enterprises are promoted for easy availability of organic products	3.00	III
Local indigenous varieties promoted through incentive to the farmer	2.98	IV
Establishment of community managed seed centres for strengthening access of farmers to local varieties	2.88	V
Focus on promoting organic practices and extending support through the scheme	2.76	VI
Local consumption is focused	2.34	VII
Land record (patta) is not mandatory for availing benefits from scheme	2.22	VIII
NGO partners at block level are included to support effective implementation of programme	1.87	IX
FPOs and cooperatives are promoted as implementation partners at block level	1.64	Х

Table 7: Perception of beneficiaries about approaches of OMM

Table 8: Perception of beneficiaries about promotionof improved agronomic practices through OMM

Item	MSV	Rank
	Score	
Handi Khat (Organic Manure) is prepared	2.56	Ι
Standard size seed beds are prepared	2.35	II
Furrow Preparation before transplanting	2.20	III
Wooden marker is used for SMI planting	2.18	IV
Transplanting under SMI method using rope marker	1.88	V
Weeding using cycle weeder	1.39	VI

 Table 9: Relationship of profile characteristics with perception of farmers regarding OMM

Independent variables	Correlation coefficient value 'r'
Age	0.289*
Education qualification	-0.243 ^{NS}
Family type	-0.194 ^{NS}
Family size	-0.185 ^{NS}
Land holding	0.234*
Average annual income	0.256*
Social participation	0.089^{NS}
Extension contacts	0.223*
Extension participation	0.349**
Mass media exposure	0.214*
Social media exposure	-0.167 ^{NS}

(* Significant at the 0.05 level of probability, ** Significant at the 0.01 level of probability, NS- non-significant)

Karl Pearson's Correlation coefficient (r) was calculated to find out the relationship about perception of farmers regarding OMM with the socio-personal, economic, communication and psychological profile of farmers by considering perception of farmers. The results depicted in the table 9 revealed that the value of the correlation coefficient of the independent variables namely age (r=0.289*), land holding (r=0.234*), Average annual income (r=0.256*), Extension contacts (r=0.223*), Extension participation (r=0.349**) and Mass media exposure of OMM (r=0.214*) were positive and significantly related with perception of farmers regarding OMM at 0.01 per cent. Similar findings were reported by Kalagi (2018); Naik (2019) and Mishra *et al.* (2020); Singh *et al.* (2020).

The correlation analysis reveals that some independent variables related to farmers' profiles have a significant positive relationship with their perception of the Organic Farming Mission (OMM), such as age, landholding, and average annual income. In contrast, education qualification, family type, family size, social participation, and social media exposure were found to have a non-significant or negative relationship with their perception of OMM.

The study also found that extension contacts and participation and mass media exposure had a significant positive correlation with farmers' perception of OMM. These results suggest that the success of OMM's implementation and its impact on farmers' perception may depend on several socio-economic factors, including education, income, and social networks. Such insights may help policymakers and stakeholders in designing more effective strategies for promoting organic farming practices among smallholder farmers.

CONCLUSION

The present study explored the perception of smallholder farmers regarding the Organic Farming Mission (OMM) and its promotion of improved agronomic practices in the state of Kerala, India. The study found that farmers had a generally positive perception of OMM's various approaches, including the promotion of improved agronomic practices and bio-input enterprises, incentives for promoting local varieties, and establishing community-managed seed centres. However, the study also revealed that some aspects of OMM, such as the focus on local consumption, NGO partner involvement, and promotion of FPOs and cooperatives, were not as well-perceived by the farmers. Overall, the study suggests that OMM has the potential to promote organic farming practices and improve farmers' livelihoods. However, there is a need for continued efforts to promote the program's various approaches and to address the concerns and needs of smallholder farmers to achieve the program's intended goals.

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Research Article

Analysis of Time Utilization Pattern of Farm Women of Punjab

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ABSTRACT

The study was carried out from five agro–climatic zones of Punjab. Ten districts were selected from five agro climatic zones. This research consisted sample of 500 farm women. In the present study, time utilization pattern of the respondent for various household and agricultural livestock activities was recorded for 24 hours by using the recall method. Findings of the study revealed that most of the farm women were housewives and had no personal income. They spent their maximum amount of time on kitchen work (4.15 hours/day) and other household work (2.40 hours/day) and minimum amount of time on care of children/elderly and community related work. They spent medium time on kitchen work, teaching children and occupational work followed by spent less time on community related work and agricultural and livestock work. Farm women spent medium time i.e. 466.8-690.2 hours/month on different household activities.

Keywords: Different activities, Farm women, Time utilization pattern

INTRODUCTION

In these days of rapid change, time is an exclusive, valuable and precious resource not only for women but for each and every human being. Infact of all the resources, time is one of the easiest to measure but one of the most difficult to understand and manage. Its acceptance as a resource has ever been questioned. Its present independent right as a resource is, a matter of practical acceptance and usage. Warren, after considering pros and cons, accepts it as a resource. Hall says, "Time with us is handled much like a material; we earn it, spend it." Materials are resources. When we ask "What's the time?" we usually indicate the need for synchronizing our activity with that of others, whether for food, work, rest, or entertainment.

George and Bafna (1982) stated that home-maker meets the demands of responsibilities associated with her role as a homemaker along with other demands on her time and thus distributes her time over the three general uses such as work, leisure and sleep and rest. Rural women spend their time in household's activities and also manage their time to work in farms and animals. They fully involve during the whole day in domestic activities like looking after the children, cleaning the house, cooking, washing and the many other activities. Demand for time management increases if women are to perform dual role. Many rural women often consume their time by performing complex household and multiple agricultural activities. Sowing, transplanting, weeding, irrigation, plant protection, harvesting, winnowing, storing, working for wages in agricultural or other rural enterprises, and activities in household include collecting fuel and water, fodder collection, preparing food, caring for family members and maintaining their homes etc. are some agricultural and household activities which are mainly performed by women. Whether they work in fields or not, their role in allied agricultural works like kitchen-gardening, poultry, milking cattle, washing cattle, cleaning cattle shed and taking care of sick cattle cannot be ignored (Chanoria et al., 2019). And each activity demands more time. Srivastava (1985) argues that although farm women's family have land status but still they provide 14-18 hours of productive physical labor in different activities, which shows the load of work shouldered by them in day-to- day activities. On the whole, life and pleasure of women revolved round the well being

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of her husband, children and in laws. Whatever type of role a woman in agricultural families play in agriculture, their role as producer, care taker, nurture, and home manager creates double burden for her. As each of her responsibility is time demanding, she has to manage her time effectively.

MATERIALS AND METHODS

The study was carried out from five agro-climatic zones of Punjab. Ten districts were proportionately selected from five agro-climatic zones. This research consisted sample of 500 farm women with the age of 25-50 years. Farm women with this age group were selected on the assumption that women with this age group is actively participating in household and agricultural activities and also shouldering all the household responsibilities. Data were collected by interview schedule. All the respondents were interviewed personally by the investigator which enabled her to get the first hand information. Time utilization pattern on various household activities and agricultural and livestock was studied by recall method. The time utilization pattern was studied for last three consecutive days at the time of data collection which was converted into mean time. The collected data were also analyzed by using frequency, percentage, mean score and category interval method.

RESULTS AND DISCUSSION

General profile of respondents: The socio-personal characteristics of selected respondents in respect of their age, caste, education, occupation and income were studied and data pertaining to these are presented in Table 1. The findings have been explained and discussed as following:

Age: Age is an important personal variable as it influences the attitude and values of an individual to a great extent. For present study, farm women in the age group of 25-50 years were taken on the assumption that women of this group are actively participating in agricultural and household activities and shouldering all the household responsibilities. It was categorized into three categories such as 25-33 years, 34-42 years and 43-50 years. The data presented in the Table 1 reveals that nearly half (48.60%) of the respondents belonged to age category of 34-42 years, followed by 30.80 per cent who were between 25 to 33 years of

Table 1: Distribution of respondents according to their socio personal profile (n=500)

Characteristics	Frequency	Percentage		
Age (years)				
25-33	154	30.80		
34-42	243	48.60		
43-50	103	20.60		
Caste				
General	421	84.20		
Other backward class	79	15.80		
Education				
Illiterate	8	1.60		
Can read and write	1	0.20		
Primary	31	6.20		
Middle	61	12.20		
Matriculation	180	36.00		
10+2	139	27.80		
Graduation	59	11.80		
Post-graduation	21	4.20		
Occupation				
Housewife	424	84.80		
Business	2	0.40		
Govt./private service	25	5.00		
Self employed	49	9.80		
Respondents' annual income (Rs.)				
No income	424	84.80		
<rs 1,00,000<="" td=""><td>35</td><td>7.00</td></rs>	35	7.00		
>1,00,000-2,00,000	23	4.60		
>2,00,000-3,00,000	18	3.60		

age. Only 20.60 per cent respondents were in the age group of 43-50 years.

Caste: For the present study, respondents were categorized into two categories namely general caste and other backward class. The data presented in the table shows that majority of respondents (84.20%) were from general caste. Data is in line with Pathak (2020) where majority of the respondents belonged to general caste. Whereas, remaining 15.80 per cent respondents were from other backward classes.

Education: Education enables the person to get knowledge and information from various sources. In this study the respondents were categorized as illiterate,

can read and write, primary, middle, matriculation, 10+2, graduation and post-graduation. The result showed that more than one third of the respondents i.e. 36.00 per cent were matriculate, followed by more than one forth respondents (27.80%) who were educated up to senior secondary. Whereas 12.20 per cent farm women were educated up to middle level and only 11.80 per cent and 4.20 per cent had done graduation and post graduation respectively. Few (6.20%) farm women had done schooling up to primary level. Less than two per cent (1.60%) were completely illiterate while 0.20 per cent was able to read and write.

Occupation: Farm women were categorized into four groups, viz. housewife, business, govt./private service and self-employed. Data highlight that large majority of respondents (84.80%) were housewives. Out of those occupied, 9.80 per cent were self employed (boutique, parlor, preservation etc.) 5.00 per cent respondents had govt. /private service and rest 0.40 per cent were occupied in businesses of shops etc. Similar result was also reported by Bhalla (2018); Shukla (2018) and Singh and Midha (2019) who also found that large majority of farm women were housewives.

Respondent' income: Table 1 further highlights that majority of the respondents (84.80%) had no personal income. Seven per cent of the respondents had annual income less than Rs. 1 lakhs while 4.60 per cent of the respondents had income from ranging from Rs. 1 to 2 lakhs. Only 3.60 per cent of respondents had income between Rs. 2 to 3 lakhs. Overall, majority of the farm women were from general caste, housewives and had no income. A large percentage of them were in age group of 34 to 42 years and were educated up to matriculation level.

Family profile: Table 2 showcases the family profile of the respondents. Family profile included information related to family type, family size, family education, family occupation as primary and secondary, annual family income, land holding and herd size.

Family type: Regarding family type, it is evident from the data that more than half of the respondents (51.20%) belonged to the nuclear family while 48.80 per cent respondents belonged to joint family. Makkar (2018), Rai (2016) and Partiksha (2020) also reported similar findings while conducting studies in Punjab. Similar

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Table 2: Distribution of respondents according to their family profile (n=500)

	г	D (
Characteristics	Frequency	Percentage
Family type		
Nuclear	256	51.20
Joint	244	48.80
Family size (number)		
Small (< 4)	201	40.20
Medium (5-8)	262	52.40
Large (> 8)	37	7.40
Family educational level		
Low (< 2)	14	2.80
Medium (3-5)	426	85.20
High (>5)	60	12.0
Primary occupation		
Farming	416	83.20
Business	7	1.40
Govt./private service	63	12.60
Self Employed	12	2.40
Labour	2	0.40
Secondary occupation		
Farming	84	16.80
Business	218	43.60
Govt./private service	42	8.40
Self Employed	30	6.00
Family annual income (Rs.)		
2 lakhs – 13.33 lakhs	458	91.6
13.34 – 24.66 lakhs	32	6.40
24.67 lakhs – 36 lakhs	10	2.00
Land holding (acres)		
Marginal (<2.5)	107	21.40
Small (2.5-5)	219	43.80
Semi medium (>5-10)	102	20.40
Medium (>10-25)	49	9.80
Large (>25)	23	4.60
Herd size (no.)		
No animal	131	26.20
< 2	114	22.80
3-4	120	24.00
>4	135	27.00

trend was reported by Nayar and Niranjan (2020) from Haryana, Reddy and Ravishankar (2020) in Tamil Nadu. This clearly points towards a shift from joint family to nuclear families even among farming families.

Family size: The table further reveals that more than half of the respondents (52.40%) had five to eight members in the family whereas 40.20 per cent families had small size family with up to 4 members. Only 7.40 per cent of the families had large family size with more than 8 members. Similar result was also reported by Kaur (2016) who found that half of the farm families had 5-8 members in their family in Punjab.

Family education: As already discussed in methodology, family education was calculated as average formal education and was categorized into three categories i.e. low, medium and high. The findings in the table 5.2 reveals that majority of the farm families i.e. 85.20 per cent had medium level of education followed by 12.00 per cent farm families who had high level of education. Only 2.80 percent farm families had low level of education. Data is in line with Kaur (2016) in Punjab where a large proportion of farm families had medium level of education.

Family occupation: It referred to any activity that served as one's regular source of livelihood. The respondents were asked to give information about their family occupation, which was categorized into two categories: primary occupation and secondary occupation. Data in Table 2 highlighted that farming was primary occupation for large majority (83.20 %) of farm families followed by 12.6 per cent who were in govt./ private service. Only 2.40 per cent farm families were self-employed as electrician, mechanic, driver, milkman, DJ man etc. while1.40 per cent farm families had business (dairy, shops, atta chakki, grocery store etc.) as primary occupation. Only 0.40 per cent farm families belonged to labor class. Rai (2022) also found that large majority (79.0%) of the farm families had farming as their primary occupation in Punjab.

With regard to secondary occupation, 43.60 per cent farm families had business (dairy, shops etc.) followed by 16.80 per cent had farming as secondary occupation. Data further showed that for 8.40 per cent and 6.00 per cent farm families, govt./private service and self employment (driver, mechanic, carpenter etc.) were secondary occupation respectively. **Annual family income:** Family income was worked out by considering income from all sources. Table 2 indicates that maximum percentage of the families i.e. 91.6 per cent had annual income between Rs. 2 lakhs -13.33 lakhs while 6.40 per cent of the had income ranging between Rs. 13.34-24.66 lakhs. Very small proportion (2.00%) of families had high income between Rs. 24.67-36 lakhs.

Land holding: It referred to the area of cultivated land in acres owned by the respondent's family. It was categorized into five groups i.e. marginal (<2.5 acres), small (2.5-5 acres), semi medium (5-10 acres), medium (10-25 acres) and large (>25 acres).

Data revealed that 43.80 percent farm families had small (2.5-5 acres) land holding followed by 21.40 per cent who had marginal (<2.5 acres) land holding. This was followed by 20.40 per cent farm families who had semi medium (5-10 acres) land holding. About 9.80 per cent farm families were having medium (10-25 acres) land holding. Only 4.60 per cent farm families possessed more than 25 acres of land. Similar findings were reported by Saikia (2020) in Punjab, who found that half of the farm families had small (2.5-5) land holding.

Herd size: The findings revealed that 27 per cent farm families had more than 4 animals, closely followed by 26.20 per cent who had no animals. Further it was found that 24 per cent farm families had 3-4 animals and 22.80 per cent had up to 2 animals. Overall, data from table 3.2 highlight that majority of the farm families had farming as primary occupation and less than half of families had business as secondary occupation. They had income ranging from Rs. 2 lakhs to 13.33 lakhs. More than half of the farm families were from nuclear family and had 5-8 members. Majority of farm families had medium education level, small land holdings and had more than 4 animals.

There are number of activities a person performs during a day. As far as the farm women is concerned, their daily routine comprises of kitchen work, other household work, looking after children/elderly, teaching children, community related work and agricultural and livestock work. Average time utilization by all respondents was calculated for each activity. Regarding teaching children only those women who reported that they teach her children were considered for calculating average. Findings with respect to time utilization on different activities by respondents is shown in Table 3.

It is evident from the data that kitchen work is the activity that a woman has to perform on priority. She spends a major period of the day in kitchen work which includes pre and post cooking work, meal preparation etc. The respondents spent maximum amount of time i.e. 4.15 hours/day on kitchen work followed by other household work (2.40 hours/day) which include kitchen cleaning, bedroom cleaning, bathroom cleaning, washing and ironing of clothes. The result is nearer to the finding of Bala and Singal (2003). It was further found that they spent 1.45 hours/day on teaching children 1.18 hours/day on care of children/elderly and 1.05 hours/day on community relate work.

It was also observed from the above table that respondent spent higher time i.e. 36.05 per cent on kitchen work followed by other household work (20.85%), agricultural and livestock work (12.59%) and teaching children (11.13%). Findings further revealed that respondents spent lesser time on community related work (9.12%) and care of children (10.26%) respectively. It can be concluded from the table that farm women spent maximum amount of time on kitchen work and other household work.

To compare the farm women for her time utilization, an attempt was made to categorize them into different level of time utilization. The level of time utilization on different household activities has been presented in Table 4 and it was found that majority (69%) of the respondents spent medium time on kitchen work. It means they spent between 104.18 to 163.34 hours monthly and 3.47 to 5.44 hours daily on kitchen work. This was followed by 15.6 per cent of respondent who spent 163.35 to 222.51 hours on kitchen work in a month and 5.44 to 7.41 hours in a day. Around fifteen per cent of the respondents spent less time i.e. 45 to 104.17 hours monthly and 1.5 to 3.47 hours daily on kitchen work compared to others.

Further regarding other household work, data from the table also shows that majority of the respondents i.e. 83.2 per cent spent less time on other household work. It shows that they spent between 13-104.83 hours monthly and 0.4 to 3.49 hours on other household daily. Around fifteen per cent of the respondents spent medium time i.e. they spent 104.84 to 196.66 hours monthly and 3.49 to 6.55 hours daily. Only 2.6 per cent of the respondents spent high time on other household work i.e. they spent 196.67 to 288.5 hours monthly and 6.55 to 9.61daily. Regarding care of children/elderly, nearly half (48.23%) of the respondents spent medium time i.e. 41.62 to 82.97 hours in a month. Less than one third (31.40%) spent less time i.e. 0.25 to 41.61 hours in a month. One fifth (20.4%) of the respondents spent high time i.e. 82.98 to 124.33 hours in a month on care of children.

Only 240 farm women used to teach their children, out of them higher percent (49.17%) of respondents spent medium time on teaching children i.e. 24 to 44 hours monthly. This was followed by less than one third (31.67%) of the respondents who spent less time i.e. 2 to 23 hours in a month. Nearly one fifth (19.16%) of the respondents spent high time on teaching children i.e. they used to teach their children for 45 to 65 hours in a month. With respect to community related work it was also found that majority of the respondents i.e. 86.6 per cent spent less time on community related work i.e. they spent 9.5 to 58 hours in a month on community related work. This was followed by 11.2

Items of time utilization	Hours/day	Hours/month	Percent time	Rank
Kitchen work	4.15	124.5	36.05	1
Other household work	2.40	72.0	20.85	2
Care of children/elderly	1.18	35.4	10.26	5
Teaching children	1.28	38.4	11.13	4
Community related work	1.05	31.5	9.12	6
Agricultural and livestock work	1.45	43.5	12.59	3

Table 3: Average time utilization on different household activities by farm women (n=500)

Level of time utilization	Freq-	Percen-	Mean	Rank
(hours/month)	uency	tage		
Kitchen work				
Low (45-104.17)	77	15.4	2.00	1
Medium (104.18-163.34)	345	69.0		
High (163.35-222.51)	78	15.6		
Other household work				
Low (13-104.83)	416	83.2	1.19	5.5
Medium (104.84-196.66)	71	14.2		
High (196.67-288.5)	13	2.6		
Care of children				
Low (0.25-41.61)	157	31.40	1.89	3
Medium (41.62-82.97)	241	48.20		
High (82.98-124.33)	102	20.4		
Teaching children (n=240	リ			
Low (2-23)	76	31.67	1.87	4
Medium (24-44)	118	49.17		
High (45-65)	46	19.16		
Community related work				
Low (9.5-58)	433	86.6	1.15	7
Medium (59-106.5)	56	11.2		
High (106.6-155)	11	2.2		
Agriculture and livestock	work			
Low (5-107)	43 0	86.0	1.19	5.5
Medium (108-209)	44	8.8		
High (210-311)	26	5.2		
Occupational work (n=76))			
Low (60-120)	22	28.94	1.92	2
Medium (121-180)	38	50.01		
High (181-240)	16	21.05		
Overall time utilization				
Low (123.2-466.7)	165	33.00	1.60	
Medium (466.8-690.2)	203	40.60		
High (690.3-973.8)	132	26.40		

Table 4: Distribution of farm women according to level of time utilization on different household activities (n=500)

per cent of respondents who spent medium time i.e. 59 to 106.5 hours in a month. Only 2.2 per cent of respondents who spent high time i.e. 106.6 to 155 hours/month on community related work.

Further table indicates that majority (86.0%) of the respondents spent less time on agricultural and livestock work i.e. 5 to 107 hours/month. This was followed by 8.8 per cent of the respondents who spent medium time, while 5.2 per cent of the respondents spent high time on agricultural and livestock work. If we compare the farm women for overall time utilization, large percentage i.e. 40.60 per cent of the respondents spent medium level on different household activities i.e. they spent 466.8 to 690.2 hours monthly on different activities. It means daily they spent between 15.56 to 23 hours on different household work. One third (33.00%) of the respondents spent less time on different activities i.e. 123.2 to 466.7 hours/month. More than one fourth of the respondents (26.40%) spent high time on different household activities.

The mean time utilization on different activities was calculated to compare different household activities and it was found that time utilization was highest on kitchen work (X=2.00), followed by occupational work (X=1.92) and care of children/elderly (X=1.89). It was also observed from the data that time utilization on community related work was lowest (X=1.15) followed by other household work and agricultural & livestock work (X=1.19).

It can be concluded from the table that farm women spent medium time i.e. 466.8-690.2 hours/ month on different household activities. Most of the farm women spent comparatively medium time on kitchen work, care of children/elderly, teaching children and occupational work followed by less time on other household work, community related work and agricultural and livestock work.

CONCLUSION

Time utilization on different activities by respondents showed that farm women spent maximum amount of time on kitchen work (4.15 hours/day) and other household work (2.40 hours/day) and minimum amount of time on care of children/elderly and community related work. Majority of farm women spent medium time on kitchen work, teaching children, care of children/elderly and occupational work followed by spent less time on other household work, community related work and agricultural and livestock work.

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Research Article

Modernization of Agriculture for Crop Residue Management and Knowledge of Farmers alongwith Reasons for Adoption and Nonadoption of Super Seeder in Haryana

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ABSTRACT

The goals of agricultural modernization include increasing output while posing no risks to the environment or the welfare of animals, reducing rural poverty and ensuring food security, as well as increasing farm profitability and optimising the use of natural resources. New technologies have long been a source of interest for farmers seeking to reduce costs of cultivation. Super seeder is one of the agricultural technology which is used for sowing of wheat crop. A super seeder is a tractor-mounted machine that chops and lifts rice straw, sows wheat in the soil, and then spreads the straw as mulch over the sowed area. In the field, it also cultivates the paddy straw. As a result, the super seeder is the most effective method for sowing wheat in paddy residue without allowing the straw to burn. So keeping in mind the importance of farm mechanization and sustaible development a study was carried out in Fatehabad district of Haryana state among 120 adopter and non adopter farmers of super seeder farm technology with the objectives to know the knowledge level and reasons behind the adoption and non adoption of super seeder. Data were collected with survey method with the help of well structured interview schedule. Statistical techniques like frequency, chi square, weighted mean scores and rank order were applied as per the objectives of the study. The results revealed that highest percentage of the farmers were having medium level of knowledge i.e. 41.67 per cent followed by 30.00 per cent and 28.33 per cent who were having high and low level of knowledge respectively. Socio-economic variables which exhibit influence on the knowledge level of the farmers who adopted Super Seeder showed that age, level of education, subsidiary occupation, size of land holding, size of family, annual income, social participation, mass media exposure, socio economic status were significantly associated with knowledge level of the farmers regarding super seeder. Reasons for the adoption of Super Seeder revealed that more than 3/4th of the farmers were agreed about using Super Seeder machine incorporate paddy stubble in soil, so there is no need of burning the residue in the field, therefore it is environment friendly technology (rank I). Evidently show the requirement of high hp tractor as one of the reason for non-adoption of Super Seeder followed by high cost of machine.

Keywords: Agriculture, Modernization, Sustainability, Super seeder, Knowledge, Reasons for adoption and non adoption

INTRODUCTION

The process of modern agriculture involves switching from traditional labor-based agriculture to technologybased agriculture. Modernisation of agriculture aiming only at increasing the efficiency of production, if implemented in accordance with the principles of sustainable development, enabled reduction in the negative external effects. The agricultural sector needs to employ a wide range of developing agricultural technologies and farming practises across many different farming systems and structures to meet the diverse and shifting demands of consumers and the

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general public for food, fibre, and other goods and services provided by agriculture, often with uncertain results in terms of their effects on sustainability. The above challenges will be addressed by the need to implement efficient and at the same time, environmentally-friendly production technologies and relevant legal instruments or technologies which oblige agricultural producers to protect the natural environment. Therefore, the relationship between agriculture and the environment will subject to change in the near future as a result of pressure to increase production efficiency as well as concerns about the environment. Technology adoption for sustainable agricultural systems is a difficult and dynamic subject for farmers, extension services, agribusiness, and policy-makers. Consumers are also becoming more and more insistent that the methods used to produce their food limit environmental pressures, conserve natural resources, and give greater consideration to rural viability and animal welfare.

One of the most widely cultivated cereal crops worldwide is wheat (*Triticum aestivum* L.). Wheat is the most important food grain and the main food of Indians, especially in the north of the country, and its area is being planted more and more each year. About 29.8 million hectares of land are planted with crops nationwide. About 8.7 per cent of the wheat produced worldwide is produced in India. Wheat production in the nation has dramatically increased, rising from 75.81 million MT in 2006–07 to an all-time high of 105 million MT in 2019–20 (Kirandeep *et al.*, 2020).

In North-West India and Central and Eastern India, enormous amounts of rice and wheat residue are produced. The management of crop residues is a growing issue for environmentally friendly agricultural development, particularly in Haryana, Punjab, Uttar Pradesh, and Delhi. On the farm, surplus residues those remaining after subtracting residues used for other purposes are usually burned (Pathak et al., 2010). It is estimated that 93 Mt of crop wastes are burned on farms in the country. The 20-30 day window between rice harvest and wheat planting is the primary factor contributing to paddy residue burning (Meena et al., 2020). One key element in sowing technique is compensating for low tillering in wheat, ensuring the optimal plant dispersion in the field, and reducing labor-intensive weed control within ridges or rows

(Kabesh et al., 2009). To meet the nation's constantly rising food needs, raising wheat grain production is a crucial national aim. Several agricultural technologies have been launched by the government to increase production and to protect the environment by giving support to farmers in the form of subsidies. The effect of variety and method of sowing on the yield of wheat was studied by Manan and Sharma 2017 and the analysis revealed that farmers preferred new technologies and new varieties for sowing of wheat crop. There were many sowing methods found, like sowing with Happy Seeder and super seeder. One of the innovative solutions for seeding wheat without burning rice residue is the happy seeder. This technique improves soil health, uses less water, and is safe for the environment (Land force, 2018; Mooventham et al., 2018). Happy seeder offers the means of drilling wheat into rice stubble without burning, eliminating air pollution and loss of nutrients and organic carbon due to burning, at the same time as maintaining or increasing yield (Sidhu et al., 2007) and one of the new modern sowing technology used for agricultural sustainability was found adoption of Super seeder farm machinery. The primary function of the Super Seeder machine is to simultaneously sow wheat seed and plough standing paddy stubble into the ground after harvesting the paddy using a combine harvester equipped with the Super-SMS attachment. Keeping in view importance of Super seeder machine the study was carried out with following Objectives:

- To assess the nature and extent of knowledge regarding super seeder farm technology.
- To delineate the socio economic factors associated with the knowledge of the farmers.
- To find out the reasons for adoption and non adoption of super seeder.

MATERIALS AND METHODS

The study was conducted in Fatehabad district of Haryana state among 120 adopter and non- adopter farmers of Super seeder farm technology. The study was carried out in the 4 blocks of the district namely Bhuna, Bhattu Kalan, Ratia, and Fatehabad. The villages undertaken for the study were Dhaulu, Nadhori and Gorakhpur from Bhuna block; from Bhattu Kalan block village Salamkhera; from Ratia block village Hasinga and from Fatahabad block Dhanger, Bighar, Badopal, Bhirdana, Bhuthan Kalan and Dhani Majra villages were undertaken where maximum number of farmers had adopted Super seeder farm technology. On the whole, a total of 60 Super Seeder adopter farmers and 60 non-adopter farmers were selected. Interview schedule was prepared to collect the desired information as per objectives of the study. Data were collected with survey method with the help of well structured interview schedule. Statistical techniques like frequency, chi square, weighted mean scores and rank order were applied as per the objectives of the study.

RESULTS AND DISCUSSION

In Table 1 it is revealed that highest percentage of the farmers were having medium level of knowledge i.e. 41.67 per cent followed by 30.00 per cent and 28.33 per cent who were having high and low level of knowledge respectively.

Data analysis regarding knowledge aspect of Super Seeder among farmers clearly revealed in Table 2 that 60.00 per cent of the farmers were having knowledge regarding the fact that if the residues are incorporated effectively into the soil across the field so that the

Table 1: Knowledge level of farmers regarding Super Seeder (n=60)

Knowledge level	Frequency	Percentage
Low (0-5)	17	28.33
Medium (6-11)	25	41.67
High (12-16)	18	30.00

residues load becomes uniform across the field. Out of total 58.33 per cent of the farmers had knowledge regarding optimal soil moisture content should be ensured at the time of sowing so as to have uniform crop establishment whereas 18.34 per cent were having no knowledge regarding this fact. With respect to the fact that tractor with double clutch of 60-75 hp should be used to operate the machine only 45.00 per cent of the farmers were fully known to this and farmers were also had knowledge regarding the uses of recommended seed and fertilizers rate through calibrating the planter (43.33%), after the operation cleaning and washing of all parts (41.67%) and Super Seeder can be used as a multiple-crop planter (35.00%).

Socio-economic variables which exhibit influence on the knowledge level of the farmers who adopted Super Seeder are shown in Table 3. It is clearly shown that 36.67 per cent of the farmers among who were 35⁺ to 50 years of age possess the high level of knowledge and 55.56 per cent of the farmers among who were up to 35 years of age were having low level of knowledge. Among the general caste 47.92 per cent of the farmers were having medium level of knowledge. Knowledge level with respect to level of education was found high among who got their education till senior secondary and above senior secondary level whereas highest percentage i.e. 45.00 per cent of low level of knowledge was found among the farmers who got their education up to middle level. Data clearly revealed that 57.14 per cent of the farmers among who were involved into small scale enterprise

Knowledge statements		Yes		No	
	Freq-	Percen-	Freq-	Percen-	
	uency	tage	uency	tage	
Residues incorporated effectively into the soil across the field so that the residues load becomes uniform across the field	36	60	24	40.00	
Optimal soil moisture content should be ensured at the time of sowing so as to have uniform crop establishment.		58.33	25	41.67	
Set rotor speed at 200-220 rpm & operate tractor in $1^{st} gear$ at a speed of 1-1.5 km/h	30	50.00	30	50.00	
Ensure optimal depth of planting through adjustment of depth control wheels.		46.67	32	53.33	
Tractor with double clutch of 60-75 hp should be used to operate the machine		45.00	33	55.00	
Use recommended seed and fertilizer rate through calibrating the planter.		43.33	34	56.67	
After the operation all parts of machine should be cleaned and washed properly.	25	41.67	35	58.33	
Super Seeder can be used as a multi-crop planter	21	35.00	39	65.00	

Socio-economic variables		Knowled	ge level	,
	Low	Medium	High	Total
Age				
up to 35 yrs.	10(55.56)	4(22.22)	4(22.22)	18(30.00)
35 ⁺ to 50 yrs.	6(20.00)	13(43.33)	11(36.67)	30(50.00)
above 50 yrs.	1(8.33)	8(66.67)	3(25.00)	12(20.00)
Total	17(28.33)	25(41.67)	18(30.00)	60(100)
$\chi^2 Cal = 11.49^*$				
Caste				
General caste	11(22.91)	23(47.92)	14(29.17)	48(80.00)
Backward class	6(50.00)	2(16.67)	4(33.33)	12(20.00)
$\chi^2 Cal=4.79$				
Level of Education				
No formal Schooling	1(10.00)	7(70.00)	2(20.00)	10(16.67)
Up to Middle	9(45.00)	8(40.00)	3(15.00)	20(33.33)
Senior Secondary and above senior secondary level	7(23.33)	10(33.33)	13(43.34)	30(50.00)
$\chi^2 Cal=9.46^*$				
Subsidiary occupation of the family				
Nil	11(42.31)	11(42.31)	4(15.38)	26(43.34)
Business and services	5(25.00)	9(45.00)	6(30.00)	20(33.33)
Custom hiring	1(7.14)	5(35.72)	8(57.14)	14(23.33)
$\chi^2 Cal=9.55^*$				
Size of land holdings				
Marginal (up to 1 ha)	7(63.64)	2(18.18)	2(18.18)	11(18.33)
Small (1-2 ha)	4(20.00)	12(60.00)	4(20.00)	20(33.33)
Semi-medium (2-4 ha)	5(22.73)	9(40.91)	8(36.36)	22(36.67)
Medium (4-10 ha)	1(14.29)	2(28.57)	4(57.14)	7(11.67)
$\chi^2 Cal = 12.61^*$				
Type of family				
Nuclear	13(40.63)	12(37.50)	7(21.87)	32(53.33)
Joint	4(14.28)	13(46.43)	11(39.29)	28(46.67)
$\chi^2 Cal = 5.45$				
Size of family				
Up to 4 members	11(44.00)	8(32.00)	6(24.00)	25(41.67)
5-8 members	5(19.23)	15(57.69)	6(23.08)	26(43.33)
Above 8 members	1(11.11)	2(22.22)	6(33.34)	9(15.00)
χ ² <i>Cal</i> =11.59*				
Annual Income				
Rs. 2,00000 - 3,00,000	6(60.00)	3(30.00)	1(10.00)	10(16.67)
Rs. 300000 - 4,00,000	6(23.08)	15(57.69)	5(19.23)	26(43.33)
Above Rs. 4,00000	5(20.83)	7(29.17)	12(50.00)	24(40.00)
$\chi^2 Cal = 12.63^*$			· · ·	

Table 3: Association between socio-economic variables and Knowledge level of Super Seeder (n=60)

Table 3 contd....

Socio-economic variables		Knowled	lge level	
	Low	Medium	High	Total
Social participation				
No organization participation	9(50.00)	6(33.33)	3(16.67)	18(30.00)
One organization participation	5(19.23)	15(57.69)	6(23.08)	26(43.33)
More than one organization participation	3(18.75)	4(25.00)	9(56.25)	16(26.67)
$\chi^2 Cal = 12.38^*$				
Mass media exposure				
Low (4-6)	7(58.34)	4(33.33)	1(8.33)	12(20.00)
Medium (07-09)	5(20.00)	14(56.00)	6(24.00)	25(41.67)
High (10-12)	5(21.74)	7(30.43)	11(47.83)	23(38.33)
$\chi^2 Cal = 10.55^*$				
Socio-economic Status				
Low (5-8)	1(7.69)	7(53.84)	5(38.47)	13(21.67)
Medium (09-12)	12(50.00)	10(41.67)	2(8.33)	24(40.00)
High (13-16)	4(17.39)	8(34.78)	11(47.83)	23(38.33)
$\chi^2 Cal = 14.12^{**}$				

**Significant at 1% level of significance; *Significant at 5% level of significance; Figures in parentheses indicate percentage

were having high level of knowledge where as only 7.14 per cent were having low level of knowledge. Socio-economic status was found to be highly significant with the knowledge level of farmers but caste and type of family were having no significance with knowledge level. Whereas rest of the variables age, level of education, subsidiary occupation of the family, size of land holding, size of family, annual income, social participation and mass media exposure were found to be simply significant with knowledge level of the farmers. Knowledge level with respect to the socio-economic status of the farmers was found high among the farmers who belonged to high socioeconomic status i.e. 47.83 per cent.

Reasons revealed for the adoption of Super Seeder in Table 4 shows that more than $3/4^{th}$ of the farmers agreed that using Super Seeder machine incorporate paddy stubble in soil, so there is no need of burning the residue in the field, therefore it is environment friendly technology (rank I).Regarding additional benefits, farmers reported that it lowers fuel and labour

Table 4: Reasons for	r adoption o	of Super Seeder	(n=60)
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Aspects	Reasons for adoption			TMS	WMS	Rank
	Agreed	Neutral	Disagree			
Super Seeder machine incorporate paddy stubble in soil, so there is no need of burning the residue in the field, therefore it is environment friendly technology.	49	8	3	166	2.76	Ι
Reduce fuel and labour cost with adoption of Super Seeder	45	6	9	156	2.60	II
Higher net return by adoption of Super Seeder	44	7	9	155	2.58	III
It helps in maintaining soil moisture thus reducing the need for at least one irrigation so it is a water saving technology.	42	6	12	150	2.50	IV
It is a labour saving technology as less weedicides are reported	39	9	12	147	2.45	V
Possibility of sowing wheat crop just after rice harvesting i.e. option for long duration wheat and rice varieties.	37	7	16	141	2.35	VI

Aspects	Reas	ons for ad	option	TMS	WMS	Rank
	Agreed	Neutral	Disagree			
Required high hp Tractor	47	9	4	163	2.71	Ι
High cost of machine	46	08	06	160	2.66	II
Not Proper mixing of stubble in soil	36	10	14	142	2.36	III
Chocking of machine in high soil moisture condition	33	9	18	135	2.25	IV
Difficulty in maintaining proper depth of sowing	30	9	21	129	2.15	V
Technical knowledge of the farmers is poor	26	14	20	126	2.10	VI

Table 5: Reasons for non-adoption of Super Seeder (n=60)

costs, higher net returns through the use of Super Seeders by farmers, maintenance of soil moisture, labour saving technology as fewer weedicides are reported and can sow wheat crops right after harvesting rice and can be used to plant multiple crops, got rank II, III, IV, V, VI and VII respectively. Consequently, Super Seeder was seen as a useful technique reported by farmers. Kathpalia et al. (2022) found in a study conducted in the of Haryana state that the rationale for the use of Super Seeders, with more than 3/4th of the farmers agreeing that adoption of super seeder saves time and money because it allows for the seeding of wheat crops immediately following the harvest of rice crops (80%). Regarding further benefits, over 3/4 of the farmers agreed that the implementation of Super would reduce fuel and labour costs (76.66%), increase net returns (75%).

Table 5 Evidently show the requirement of high hp tractor (rank I) as one of the reason for nonadoption of Super Seeder followed by high cost of machine which got rank II. They also agreed that sometimes more weight needs to be loaded for the machine to function properly. The farmers reported about the chocking of machines in conditions of excessive soil moisture (rank IV), difficulty in maintaining proper depth of sowing and the farmers' lack in technical expertise (rank V and VI respectively). Regarding constraints in adoption of Super Seeder Kathpalia et al. (2022) observed that near about half of the farmers were somewhat agreed about the higher cost of Super Seeder/More custom charges being a constraint for non adoption of super seeder. Kathpalia et al. (2022) also found reasons for non adoption of super seeder in Kaithal district of Haryana state and reported that 3/4th of the farmers were agreed that Super Seeder requires high Horse power tractor and sometime extra weight is to be loaded for the proper working of the machine and 73.34 per cent of the farmers were agreed that Super Seeder is expensive.

CONCLUSION

The super seeder is a modernized agricultural tractormounted machine that chops and lifts rice straw, plants wheat into the ground, then spreads the straw as mulch over the sowed area. In the field, it also cultivates the paddy straw. This method saves water while also being environmentally friendly and beneficial to the health of the soil. Farmers sometimes burn paddy residue during the wheat-sowing season, which reduces soil fertility and emits pollutants that are detrimental to people, animals, and the environment. Consequently, to preserve the importance of soil nourishment the most effective tool for seeding wheat in paddy residue without burning straw is the Super Seeder.

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Research Article

Impact of Pandemic on Agricultural Activities in Haryana: A Comprehensive/Critical Analysis

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ABSTRACT

The COVID-19 pandemic has brought unprecedented challenges to the agricultural sector of Haryana, a state in northern India known for its high agricultural productivity. This paper provides a comprehensive analysis of the impact of the pandemic on agricultural activities in Haryana. The study uses both primary and secondary sources of data to examine the effects of the pandemic on agricultural production, supply chain, and marketing, as well as the responses of farmers and policymakers to the crisis. The findings suggest that the pandemic has disrupted agricultural activities in Haryana in multiple ways. The lockdown measures imposed to control the spread of the virus have affected the availability of labour, inputs, and machinery, leading to a decline in crop yields and quality. The closure of markets and transportation restrictions has disrupted the supply chain, causing price volatility and food wastage. Moreover, the pandemic has exposed the vulnerabilities of the existing agricultural system and highlighted the need for resilience and innovation in the face of future crises. Overall, the paper provides a nuanced understanding of the impact of the pandemic on agricultural activities in Haryana and emphasizes the importance of building a sustainable and resilient agricultural system that can withstand future crises.

Keywords: Agricultural activities, Availability of labour, Market and transport restrictions, Resilient Indian agricultural system

INTRODUCTION

Pandemics are not a novel occurrence for humanity, as there have been numerous incidents of such phenomena worldwide. In India, the lockdown was announced by the honorable Prime Minister on March 23, 2020. During the 21-day lockdown, the Indian economy was projected to lose more than 32,000 crores every day (The Hindu Business Line, 2020). Consequently, the economic activities were halted in the country and affected the livelihood of 1.3 billion population. During the lockdown, overall economic growth declined by 7.2 per cent, but in contrast, agriculture and allied sectors recorded a positive growth of 3.4 per cent during 2020-21.

Amid the COVID-19 crisis, agricultural activities related to production and marketing have been deemed "essential services" and were not restricted in any state. Even though agricultural activities were exempted, in the initial phases of the lockdown, the agriculture value chain also faced large-scale disruptions. The lockdown shut down the operations of retail sellers and restricted their movement, severely constrained the movement of goods, closed processing units that consume agricultural commodities, anddespite their essential service tag-shut down some mandis and markets.

The COVID-19 pandemic has had a noticeable impact on agriculture and its related sectors. The production of agricultural goods has declined by 2.7 per cent nationally, with states like Haryana and Himachal Pradesh experiencing significant drops. However, states with strong agricultural economies like Punjab and Rajasthan have shown an increase in production due to the bumper crop production during the rabi season and early completion of crop harvesting.

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The horticulture sector has suffered a decline of 5.7 per cent in production, except for states like Gujarat, Rajasthan, and Karnataka, which have seen a small increase. Poultry production has decreased by 19.6 per cent nationally, with the states of Haryana and Uttar Pradesh experiencing the most significant drops. This can be attributed to lower demand due to fears that the virus could spread through poultry. The dairy industry has been relatively stable, with a decline of 6.6 per cent in production. Animal husbandry has been affected, with states like Haryana, Punjab, and Uttar Pradesh showing significant declines. In contrast, consumption of pork/sheep/goat has increased in some regions as a safer alternative to poultry. The fisheries sector has been indirectly affected by the pandemic, with transportation and market access issues causing a decline of 13.6 per cent in production. States like Punjab, Haryana, and Uttar Pradesh have seen a significant decrease in production. (National Bank for Agriculture and Rural Development Mumbai, August 2020). The pandemic has also resulted in labor shortages in states like Punjab and Haryana. Sales of tractors have experienced a significant decline during the last quarter of FY 2019-20 as well as the first quarter of FY 2020-21 (Srinivasan et al., 2021).

MATERIALS AND METHODS

The study was conducted in the districts of Hisar and Gurugram in Haryana. One block was selected randomly from each district for the study. A purposive sampling technique was employed to select 120 farmers from a cluster of villages. In total, 240 farmers were selected for the study. To gain a comprehensive theoretical understanding of the selected research problems, it was imperative to extensively review numerous sources, including books, journals, periodicals, and government publications. After carefully analyzing these sources, an interview schedule was devised using existing literature to address the research objectives. Subsequently, this interview schedule was employed to conduct primary data collection from the respondents.

RESULT AND DISCUSSION

The table depicted in Table 1 showcases the impact of the COVID-19 pandemic on crop production. Over half of the respondents (51.4%) agreed that the harvesting of crops was delayed, while 46.8 per cent reported a loss of yield. Additionally, 40.9 per cent of the respondents confirmed the low availability of essential agricultural products such as seeds, machinery, fertilizers, and other similar items. Moreover, 40.5 per cent of the respondents faced difficulties in performing farm operations due to the pandemic. It was also reported by one-fifth of the respondents that they experienced delays in sowing crops. Khan *et al.* (2020) also mentioned delay in sowing and harvesting of crops.

Table 2 illustrates the impact of the pandemic on the marketing of crop produce. A significant percentage of the respondents, 45.0 per cent, agreed that the mandis were shut down to minimize the spread of the virus. Additionally, 43.7 per cent of the respondents reported selling their crop produce at lower rates. Furthermore, 41.8 per cent of the respondents reported experiencing exploitation at the hands of middlemen in terms of price fixation of farm produce. Almost as many, 41.4 per cent of the respondents reported difficulties in obtaining transport permits, while 40.6 per cent reported limited nearby sales points. Unfortunately, 34.1 per cent of the respondents also reported wastage of crop produce.

Table 1: Impact of COVID-19 pandemic on crop production (n=220)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Difficulty in harvesting of crops	113(51.4)	71(32.3)	36(16.3)	517	2.35	Ι
Decrease in yield	103(46.8)	76(34.5)	41(18.7)	502	2.28	II
Low availability of farm machinery for harvesting of crops	90(40.9)	75(34.1)	55(25.0)	475	2.15	III
Difficulty in performing farm operations due to covid guidelines	89(40.5)	73(33.1)	58(26.3)	471	2.14	IV
Delay in sowing of kharif crops	44(20.0)	79(35.9)	97(44.1)	387	1.75	V
Figure in the parenthesis denote percentage						

Figure in the parenthesis denote percentage

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Closure of mandis	99(45.0)	85(38.6)	36(16.4)	503	2.28	Ι
Selling crops at cheaper price	96(43.7)	83(37.7)	41(18.6)	495	2.25	II
Exploitation by middle men in price fixation offarm produce	92(41.8)	76(34.5)	52(23.7)	480	2.18	III
Difficulty in receiving the transport permits	91(41.4)	77(35.0)	52(23.7)	479	2.17	IV
Limited sale points	89(40.6)	74(33.6)	57(25.9)	472	2.14	V
Wastage of crops produce	75(34.1)	93(42.2)	52(23.7)	463	2.10	VI

Table 2: Impact of pandemic on marketing of crop produce (n=220)

Figure in the parenthesis denote percentage

Table 3 presents the impact of the COVID-19 pandemic on consumption patterns of rural families. A significant majority of 54.2 per cent of the respondents acknowledged a reduction in the consumption of poultry products. Additionally, 44.6 per cent of the respondents reported an increase in food prices, while 43.7 per cent stated a limited availability of fresh fruits and vegetables at local stores. Furthermore, 39.2 per cent of the respondents opted for cheaper food alternatives, and 37.1 per cent purchased food in bulk to stock up. One-fourth of the respondents also noted a shift from perishable to semi/non-perishable food items.

Table 4 presents the impact of COVID-19 on the floriculture farmers. A significant 60.0 per cent of respondents reported substantial losses due to a sudden fall in demand. A study conducted by Chetan *et al.* (2020) also noted that the lockdown in the country restricted all social gatherings, cultural activities, religious foundations and the closing of the hotel and hospitality industry resulted in low demand for flowers, threatening the livelihood of farmers. 57.1 per cent of the respondents agreed that there was a mismatch between demand and supply. A significant 30.0 per cent of respondents also encountered low prices in the market. More than half, 54.4 per cent of respondents were exploited by mandi brokers due to lower demand, while 32.8 per cent reported exploitation by credit lenders. 54.4 per cent of respondents experienced a shortage of labor. A majority, 50.0 per cent of respondents, confirmed delays in procuring materials from abroad. Furthermore, 48.6 per cent of respondents faced transportation issues while transporting their produce to the market. Lastly, 44.3 per cent of respondents reported that there was a low procurement of floriculture produce by government agencies.

Table 5 presents the effects of the pandemic on agricultural inputs. Among the respondents, 42.7 per cent reported a shortage of agricultural inputs, while 40.5 per cent experienced an increase in input costs. 43.7 per cent of the respondents faced difficulties

Table 3: Impact of pandemic on consumption pattern of rural families (n=240)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Reduction in consuming animal derived/poultry foods such as eggs, chicken, meat etc.	130(54.2)	70(29.2)	40(16.6)	570	2.37	Ι
Increase in food prices	107(44.6)	86(35.8)	47(19.6)	540	2.25	II
Less availability of freshfruits and vegetables	105(43.7)	69(28.8)	66(27.5)	519	2.16	III
Reduction in food quality	94(39.2)	91(37.9)	55(22.9)	519	2.16	IV
Consuming cheaper food alternatives	92(38.3)	93(38.8)	55(22.9)	517	2.15	V
Bought food in largerquantities and stocked	89(37.1)	94(39.2)	57(23.7)	512	2.13	VI
A shift from perishable to semi/non-perishable food products	60(25.0)	85(35.4)	95(39.6)	445	1.85	VII

Figure in the parenthesis denote percentage

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Table 4: Impact of covid-19 on floriculture farmers (n=70)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Substantial loss due to sudden fall in demand	42(60.0)	19(27.2)	9(12.8)	173	2.47	Ι
Mismatch in demand and supply	40(57.1)	22(31.4)	8(11.3)	172	2.45	II
Low prices in the market	40(57.1)	21(30.0)	9(12.8)	171	2.44	III
Exploitation by the mandi brokers/agents due to lower demand	38(54.4)	24(34.3)	8(11.3)	170	2.42	IV
Exploitation by credit lenders	38(54.4)	23(32.8)	9(12.8)	169	2.41	V
Lack of labour	37(52.9)	25(35.8)	8(11.3)	169	2.41	VI
Delay in procurement of material from abroad	35(50.0)	24(34.3)	11(15.7)	164	2.34	VII
Transportation issues for produce to be taken to the market	34(48.6)	21(30.0)	15(21.4)	159	2.27	VIII
Low procurement of the floriculture/horticulture/ other produce by the govt. agencies	31(44.3)	27(38.5)	12(17.2)	159	2.27	IX
Figure in the barrenthesis denote barrentage						

Figure in the parenthesis denote percentage

Table 5: Impact of covid-19 on agricultural inputs (n=220)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Lack of agriculture inputs (fertilizers, seeds, water, pesticides)	94(42.7)	79(35.9)	47(21.4)	487	2.21	Ι
Increase in cost of inputs	89(40.5)	81(36.8)	50(22.7)	479	2.17	II
Lack of credit facilities due to closure of banks & co-operatives	96(43.7)	54(24.5)	70(31.8)	466	2.11	III
Low-quality inputs due tomismatch in demand-supply	62(28.2)	88(40.0)	70(31.8)	432	1.96	IV
Low quality agricultural input provided by the govt.	43(19.6)	87(39.5)	90(40.9)	393	1.78	V

Figure in the parenthesis denote percentage

obtaining credit due to the closure of banks and cooperatives. Furthermore, 28.2 per cent of the respondents acknowledged that the quality of inputs was poor due to a mismatch in demand and supply. Another 19.6 per cent of the respondents agreed that the government provided low-quality agricultural inputs.

The impact of the pandemic on farm machinery is highlighted in Table 6. It is notable that 57.7 per cent of the respondents experienced difficulties in mobilizing specific farm equipment. Additionally, 46.4 per cent of the respondents reported a lack of technical specialists to install the machinery, while 46.8 per cent faced low availability or scarcity of spare parts. Moreover, 43.7 per cent of the respondents encountered difficulties in servicing their farm products. Interestingly, approximately one third of the respondents indicated an increase in demand for automated farm machinery. During the lockdown, 19.6 per cent of the respondents were unable to buy or custom hire farm machinery. Khan *et al.* (2022) also put forth that due to financial crisis during the pandemic, farmers found it difficult to purchase farm tools and machinery for production.

Table 7 presents the impact of the COVID-19 pandemic on farm labor. More than half (51.4%) of the respondents acknowledged that the reversemigration of labor to their native places resulted in a shortage of labor. Additionally, almost half of the respondents faced high wage demands from agrilaborers. 40.5 per cent of the respondents had to rely on household labor to mitigate the labor shortage. Furthermore, one-third of the respondents experienced a scarcity of personal protective equipment such as hand sanitizers and face masks, which caused further delays and problems in farming operations.

The data presented in Table 8 highlights the impact of COVID-19 on fishery farmers. 56.2 per cent of the respondents reported a reduction in fishing activities due to lockdown measures. Exactly 50 per cent of the

Table 6: Impact of covid-19 on farm machinery (n=220)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Difficulty in mobilizingspecific farm equipment	127(57.7)	68(30.9)	25(11.4)	542	2.46	Ι
Lack of technical specialists to install themachinery	102(46.4)	77(35.0)	41(18.6)	501	2.27	II
Scarcity/low availability of spare parts	103(46.8)	68(39.9)	49(22.3)	494	2.24	III
Difficulty in farmproducts servicing	96(43.7)	54(24.5)	70(31.8)	466	2.11	IV
Increased demand for labor-saving farm machinery (automated harvesting equipment)	80(36.3)	85(38.7)	55(25.0)	465	2.11	V
Due to covid-19 measures, farmers didn't get the opportunity to buy/custom hiring theagriculture machinery	43(19.6)	87(39.5)	90(40.9)	393	1.78	VI

Figure in the parenthesis denote percentage

Table 7: Impact of covid-19 on farm labour (n=220)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Lack of labour due to reverse-migration of labour to their native places	113(51.4)	83(37.7)	24(10.9)	529	2.40	Ι
High wage demand of the agri-labourer	112(50.9)	77(35.0)	31(14.1)	521	2.36	II
Increased relianceon household labour during covid-19	89(40.5)	65(29.5)	66(30.0)	463	2.10	III
Shortage in personal protection equipment from COVID-19 infection, such as hand sanitizers and face masks etc.	74(33.6)	66(30.0)	80(36.4)	434	1.97	IV

Figure in the parenthesis denote percentage

Table 8: Impact of covid-19 on pisciculture farmers (n=16)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Reduction in fishing due to covid-19 measures	9(56.2)	3(18.8)	3(18.8)	36	2.25	Ι
Disruption of fish valuechain	8(50.0)	4(25.0)	4(25.0)	36	2.25	II
Decrease in fish consumption	7(43.8)	5(31.2)	4(25.0)	35	2.18	III
Transport issues	7(43.8)	4(25.0)	5(31.2)	34	2.12	IV
Increase in price of fish in market due to hugedemand supply gap	6(37.6)	5(31.2)	5(31.2)	33	2.06	V
Low access to cold storage	5(31.2)	4(25.0)	7(43.8)	30	1.87	VI

Figure in the parenthesis denote percentage

respondents expressed their concerns regarding the disruption of the fish value chain. Additionally, 43.8 per cent of the respondents witnessed a decrease in fish consumption. A significant proportion of the respondents, around 25 per cent, somewhat agreed that they faced difficulties related to transportation issues while supplying fishes to the market. Moreover, 37.6 per cent of the respondents witnessed an increase in the price of fishes. A concern that was also shared by 31.2 per cent of the respondents was the lack of cold

storage facilities. Bamel *et al.* (2020) also addressed numerous challenges faced by the fishery farmers during lockdown including limited input supply, export restrictions on fish and fishery products, low fish prices, limited access to cold storage facilities, non-desired seed stock.

Table 9 illustrates the impact of the pandemic on the poultry farming. An overwhelming majority of respondents, 62.5 per cent, reported substantial losses due to low demand. Over half of the respondents,

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Table 9: Impact of covid-19 on poultry farming (n=24)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Substantial loss due toreduced demand	15(62.5)	6(25.0)	3(12.5)	60	2.50	Ι
Lack of storage facilities	13(54.2)	8(33.3)	3(12.5)	58	2.41	II
Problem in availability of required labour	12(50.0)	9(37.5)	3(12.5)	57	2.37	III
Lack of transportation facilities	11(45.8)	9(37.5)	4(16.7)	55	2.29	IV
Chicks destroyed during covid-19	10(41.7)	10(41.7)	4(16.6)	54	2.25	V
Difficulty in handling the unsold stock	10(41.7)	9(37.5)	5(20.8)	53	2.20	VI
Failing of assessment of demand	9(37.5)	11(45.8)	4(16.6)	53	2.20	VII
Less/non availability of poultry material	8(33.3)	10(41.7)	6(25.0)	50	2.08	VIII
Disease problems and unavailability of propert reatment	6(25.0)	8(33.3)	10(41.7)	44	1.83	IX

Figure in the parenthesis denote percentage

Table 10: Impact of covid-19 on vegetable growers (n=60)

Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Significant loss due to shutdown of mandis	38(63.3)	13(21.7)	9(15.0)	149	2.48	Ι
Deterioration in export of fresh vegetables	36(60.0)	17(28.3)	7(11.7)	149	2.48	II
Lack of cold storage facilities	30(50.0)	21(35.0)	9(15.0)	141	2.35	III
Disruption in transportation	29(48.3)	18(30.0)	13(21.7)	136	2.26	IV
Lack of availability of labour/high wage demand	28(46.7)	17(28.3)	15(25.0)	133	2.21	V
Increase in demand for frozen and conned vegetables	15(25.0)	25(41.7)	20(33.3)	115	1.91	VI

Figure in the parenthesis denote percentage

54.2 per cent, reported insufficient storage facilities. Half of the respondents faced difficulties due to labor shortages, and 45.8 per cent dealt with a lack of transportation facilities. The pandemic also resulted in the destruction of chicks for 41.7 per cent of the respondents, which was consistent with finding of Biswal et al. (2020) who stated that thousands of live birds were buried to avoid the spread of the virus. While an equal percentage struggled with handling unsold stock. About one-third of the respondents complained about their inability to accurately assess demand, while 33.3 per cent reported difficulties in acquiring adequate poultry material. In addition, 29.2 per cent of the respondents were dissatisfied with the lack of grading and packaging options. Finally, onefourth of the respondents expressed concerns about disease problems and the unavailability of proper treatment.

Table 10 illustrates the impact of the pandemic on vegetable growers. The majority of the respondents

reported significant losses due to the shutdown of nearby markets. 60 per cent of the respondents confirmed deterioration in the export of fresh vegetables. Half of the respondents stated the lack of cold storage facilities as a challenge. Additionally, 48.3 per cent of the respondents reported disruptions in transportation. Siddiquei *et al.* (2020) also highlighted the inaccessibility and distance between farms and wholesale markets. Farmers were not capable of delivering vegetables to consumer markets as transport was halted. While 46.7 per cent of them complained about labour unavailability. One-fourth of the respondents observed a surge in the demand for frozen and canned vegetables.

Table 11 depicts the impact of the pandemic on the dairy farming. A significant proportion of respondents, specifically 47.1 per cent, reported a decline in demand for dairy products during lockdown. In addition, 42.8 per cent of respondents confirmed an increase in the cost of inputs such as animal feed,
Statements	Agree	Some what	Disagree	WMS	MS	Rank
		agree				
Decreased demand of dairy products during lockdown	33(47.1)	26(37.1)	11(15.8)	162	2.31	Ι
Increase in the cost of inputs such as animal feed, fertilizers, and vaccines	30(42.8)	23(32.8)	17(24.2)	153	2.18	II
Fall in prices of dairy products	27(38.6)	23(32.8)	20(28.6)	147	2.1	III
Difficulty in transporting products to market, due to lock- down measures	28(40.0)	20(28.6)	22(31.4)	146	2.08	IV
Essential animal husbandry services were not available	25(35.7)	22(31.4)	23(32.9)	142	2.02	V
(feeding, breeding, protection against diseases etc.)						
Artificial in semination in dairy cattle was not done in a timely manner	22(31.4)	26(37.1)	22(31.4)	140	2.0	VI

Table 11: Impact of covid-19 on dairy farming (n=70)

Figure in the parenthesis denote percentage

fertilizers, and vaccines. Furthermore, 38.6 per cent of respondents experienced a fall in prices of dairy products. As a result of lockdown measures, 40.0 per cent of respondents encountered difficulties in transporting their products to the market. Moreover, 35.7 per cent of respondents stated that essential animal husbandry services were unavailable. Finally, 31.4 per cent of respondents reported a lack of timely artificial insemination.

CONCLUSION

The COVID-19 pandemic has had significant impacts on agriculture. The pandemic has disrupted supply chains, created labour shortages, and reduced demand for certain products, leading to financial hardships for farmers and producers. Additionally, food insecurity has increased in many parts of the world due to the pandemic's economic fallout. To address these challenges, it is critical to build a more resilient agricultural system that can withstand future shocks, such as pandemics or climate change. This may involve investing in new technologies, improving supply chain infrastructure, and supporting small-scale farmers and producers. Governments, private sector organizations should work together to build a more sustainable and equitable food system that can provide healthy and affordable food to all, while also protecting the environment and supporting rural livelihoods.

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Short Communication

A Study on Depression in Retired People: An Alarming Sign

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ABSTRACT

The health of elderly people, especially their mental health, has drawn more attention as the aging problem intensifies. It is impossible to ignore the increasing frequency of depression conditions, a common emotional ailment among elderly people. The purpose of the current study was to determine to study depression among retired people. For the study descriptive design was chosen, and a sample of 120 respondents from Udaipur City, Rajasthan was obtained using the random stratified sampling method. The findings show that the participants experienced low levels of depression.

Keywords: Depression, Retired people

"Aging is just another word for living" - Cindy Joseph. Beginning with conception and continuing until death, aging is a lifelong process of maturity and decline. There are several ways to consider it, including biological, psychological, social, chronological, and functional aging (Chalise, 2014). Depression is a common psychiatric disorder that affects nearly one-third of the older population. It is associated with greater rates of morbidity and mortality, as well as higher healthcare costs. Although organized psychotherapy and antidepressants can help older adults with their depression symptoms, they can be especially challenging for the frail elderly. Depression and anxiety hinder everyday functioning and quality of life significantly, and the impacts of sadness and anxiety are especially imposing on the frail elderly (Sethi et al., 2013). People who are dejected are those who have not sufficiently changed their worldviews or perceptions of their situations to arrive at a respectable level of life satisfaction. They frequently convey desperation, remorse, or failure, perhaps using humor, sarcasm, or comments that indicate emptiness or casualness. Despite experiencing some limited levels of life satisfaction, depressed people can be extremely thoughtful and still

feel that the outcome is unsatisfactory. There is no sense of community and there isn't enough time to look for contentment over again (Hearn *et al.*, 2012).

For conducting the research study descriptive method was used, a total of 120 retired people were selected including 60 males and 60 females from Udaipur City, Rajasthan. Stratified random sampling method was used to collect samples. Tool which was developed by Professor. O.P. Mishra, Vidhya Bhooshan and Santosh Kumar (2010) to measure the general depression. Test consists of 32 items, with major dimensions Motivational, Cognitive, Somatic, Behavioural and Emotional. Five-point scoring was used for scoring which were 1 for never, 2 for sometimes, 3 for generally, 4 for often and 5 for always. Frequency and percentage was interpret the level of depression among retired people.

The results of the investigation portrays a pleasant scenario by envisaging high level of depression only in 1.66 per cent subjects followed by low level of depression in the majority of respondents regarding every aspects of depression. Where 2.6 per cent were in moderate level (Table 1).

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categories (n=120)			
Interpretation	Frequency	Percentage	
Minimal depression	1	0.83	
Below average depression	116	96.66	
Moderate depression	3	2.6	
Above average depression	0	0	

0

0

Severe depression

Table 1: Classification of depression on the basis of categories (n=120)

The population ages in a way that results in the greatest total change after retirement. Retirement is characterized by a person's departure from the labor force and a drop in their commitment to and engagement in work-related activities. Retirement can therefore be viewed as a psychological process and a state of life, and experimentally operationalized as such. Additionally, retirement is a stage of life that is linked to decreased levels of physical activity and performance, as well as decreased levels of stress and decreased sensitivity to other people in daily life.

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AUTHOR GUIDELINES

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