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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 1765 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.
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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 5.02 and Journal ID J171. The Journal of Community Mobilization and Sustainable Development, is also available on our website www.mobilization.co.in and it has been registered with www.indianjournal.com for national and global abstracting and indexing. MOBILIZATION envisages reorienting the young professionals and researches for imbibing the values of community participation in research, training and extension efforts.

The aim and scope of the journal are:

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

Editorial

Science communication is crucial in India to bridge the gap between scientific advancements and public understanding, ensuring that citizens can make informed decisions on issues impacting health, environment, and technology. Within the domain of agricultural research, science communication assumes a pivotal role in India by bridging the disconnect between scientific innovations and the farming community, thereby enabling farmers to make well-informed decisions regarding crop management, sustainable practices, and the adoption of new technologies. Considering the nation's diverse agricultural milieu, socio-economic heterogeneity, and disparities in literacy levels, the articulation of scientific knowledge in an accessible manner is indispensable for demystifying complex research outcomes, fostering a culture of innovation, and facilitating the dissemination of knowledge. Furthermore, science communication contributes to the formulation of evidence-based policies, enhances the practical impact of agricultural research on productivity and sustainability, and motivates the engagement of youth in agricultural careers. Addressing misinformation and cultivating public trust in research institutions play a critical role in advancing agricultural development, ensuring food security, and promoting rural prosperity in India.

I am delighted to announce to our esteemed readers that the latest edition of the MOBILISATION Journal has just been released. This new issue brings a fresh collection of insightful articles and research findings, continuing our commitment to providing high-quality, thought-provoking content. We invite you to explore the diverse topics covered in this edition, which address significant issues and advancements in our field. This issue highlights a diverse set of research studies addressing critical issues in agriculture, rural development, health, education, and socio-economic empowerment, reflecting contemporary challenges and opportunities. Topics include motivational factors for farmers joining dairy cooperatives, shifting occupational choices in Punjab's farming families, and the gap between climate change perceptions and the adoption of climate-smart technologies. The health risks faced by tribal women in agricultural tasks, perceived constraints among farmer producer organization (FPO) members, and productivity factors in semi-arid farming systems are also explored. Further, the research delves into women's empowerment through self-help groups, nutritional innovations to combat malnutrition, and entrepreneurial behaviour among small-scale producers. Additional studies examine the impact of digital literacy, interventions to improve agricultural practices, value chain analyses, and socio-cultural dynamics affecting rural livelihoods. Collectively, these studies offer insights into policy formulation, sustainable practices, and strategies to enhance the agricultural sector's resilience and rural communities' well-being in India.

I sincerely thank our journal's dedicated editorial team, loyal readers, and esteemed contributors, whose combined efforts have been essential to our ongoing success. I am particularly grateful to the editorial team for their steadfast commitment to maintaining the highest quality standards and ensuring the publication's smooth operation. I extend my heartfelt appreciation to our distinguished readers, for your continuous support and engagement, which motivate and sustain our mission to foster scholarly dialogue and disseminate knowledge. I also express deep gratitude to our valued contributors, whose insightful research, original ideas, and scholarly contributions have greatly enriched our journal and pushed the boundaries of our fields. Your dedication and pursuit of excellence are truly admirable, and we eagerly anticipate your continued contributions in the years ahead.

J.P. Sharma
Chief Editor

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Research Article

Motivational Factors Influencing Farmers' Decision Towards Dairy Cooperative Membership: An Evidence from JMF

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ABSTRACT

Dairy Cooperatives play a vital role in procurement, processing and marketing of milk products, thereby helping dairy farmers earn remunerative prices for their milk, and enhancing their socio, economic and nutritional standard of living. The increased level of participation and membership by the dairy farmers is commensurate with their level of motivation and factors influencing their decision to join dairy cooperative. The present study illustrates the key motivational factors i.e. both extrinsic and intrinsic factors from a total of 180 member producers of Jharkhand State Cooperative Milk Producers Federation randomly selected from the three districts of Jharkhand State viz. Ranchi, Latehar and Ramgarh. A Rank Based Quotient (RBQ) method was used for prioritizing the motivational factors in the order of preference. The major findings revealed that an assured market for milk, better price realization, modern infrastructural facilities and skilled managers and staff were the major extrinsic motivational factors; whereas voluntary participation and democratic control, the expectation for equal treatment among members were the major intrinsic motivational factors which influenced farmers' decision to join dairy cooperative.

Keywords: Dairy cooperative, Farmers, Motivational

INTRODUCTION

Dairy cooperatives ensure a sustainable supply of raw milk to the dairy sector by coordinating milk from its members and supplying dairy farm inputs (Yilma *et al.*, 2011). Despite efforts to organise smallholder farmers into cooperatives and market dairy products, a major part of rural India's milk is marketed through an informal channel. Most dairy producers have overlooked the possibilities of formal markets, such as cooperative membership. This is mainly due to socioeconomic and dairy farm factors (Chagwiza *et al.*, 2016; Tefera *et al.*, 2017). Low farmer cooperative membership is another issue affecting cooperative performance (Oboh *et al.*, 2008). Rural dairy farmers can boost their revenue through greater milk yield by joining cooperatives. Membership in cooperatives has helped members gain access to benefits that would have been impossible to obtain otherwise. Successful cooperatives serve member-producers' economic and technical needs, according to Nasiri (2010). According to Gasana (2011), farmers join cooperatives for external support, cooperative performance, market access and collective bargaining, access to input services and credits, wealth generation, and risk sharing. The above-listed conditions are crucial to enticing farmers to join cooperatives. Several studies have shown that integration with co-operatives have benefited the farmers and indeed have served as a catalyst for linking

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Indian dairy smallholders to the markets"domestic as well as global markets (Birthal *et al.*, 2007, 2009; Candler and Kumar, 1998; Cunningham, 2009; Kumar, 2010). Dairy farming involves high market dependency and socio-economic values (Bor, 2014), wherein DCs help dairy farmers to vertically integrate to countervail power against oligopolistic powers in distribution and retailing (Van Der Krogt *et al.*, 2007) by organizing dairy supply chains with better strategic logistics between production, processing and distribution (Berre *et al.*, 2014) in emerging markets (D'Antoni and Mishra, 2012) and reducing financial risk and economic uncertainty faced by members in a mature market (Maynard, 2009) due to increasing volatility in milk and feed prices (Wolf and Widmar, 2014) and paying dairy farmers the milk price at levels that far exceeds market prices (Charlebois and Labrecque, 2009), when markets are volatile or even depressed (Yoo *et al.*, 2013) through democratic governance structure controlled by dairy farmers and managed by employees with appropriate skill sets, which help maximize returns and minimize costs of processing inputs, thereby reduce transaction costs (Labrecque *et al.*, 2015). Besides extrinsic variables, intrinsic factors also influenced farmers' decision to join cooperatives, according to various studies. The study of dairy cooperative members from Iowa, Illinois, Minnesota, and Wisconsin in the U.S. revealed factors that influenced their membership in a cooperative. This included beliefs concerning: cooperative principles, collective action, individual member identities as associated with cooperative membership, life satisfaction with farming, member satisfaction with the cooperative operations and representation, member influence on cooperative decision making, and equitable treatment among members (Gray and Kraenzle, 1998). Similarly, a study conducted in Turkey revealed that members' perception of democratic administration, relations with the other state organs, awareness of cooperative principles, and frequency of visits to cooperatives; were some of the intrinsic factors which influenced cooperative membership (Özdemir, 2005).

MATERIALS AND METHODS

The study was conducted in Jharkhand State during the year (2020-22). With a view to give impetus to dairy development in Jharkhand, the State Government formed the Jharkhand State Cooperative Milk Producers' Federation (JMF) in Aug 2014. Out of, the total 14 districts, covered by JMF, the districts were first stratified into High (More than 1000), Medium (500 to 999) and Low (1 to 499) categories based on the size of member-producers available in the districts. A total of 180 respondents (member-producers of JMF) were randomly selected from three districts viz. Ranchi (60), Latehar (60) and Ramgarh (60), purposively selected from high, medium and low categories, respectively. Registered members were conceptualized as those dairy farmers who were having at least one milch animal and supplying milk to JMF for at least last one year. For delineation of motivational factors preferential ranking method i.e. Rank Based Quotient (RBQ) was followed in order to rank factors in the order of their perceived preferences by the respondents. Various factors like Intrinsic and Extrinsic factors were taken into consideration for mapping their motivational factors. The extrinsic factors were further categorized into different sub-groups viz. social, economic, technical and administrative; and ranks were assigned to each statements under each sub-groups based on the perceived importance or priority of each respondents. The farmers were personally interviewed with the help of semi-structured interview schedule to enlist the factors influencing farmers' decision to join JMF.

Rank-based quotient (RBQ) was calculated (Sabarathnam, 1998) on the basis of rank assigned by each respondent to 'prioritize the motivational factors influencing farmers' decision to join dairy cooperative', in the study area, by using the following formula:

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

where, fi = frequency of farmers for the ith rank of the attribute, N = total number of respondents, n = total number of ranks, i = rank of attributes.

RESULTS AND DISCUSSION

The results of the present study delineates several motivational factors that influenced farmers' decision to join JMF as shown in Table 1. Motivational factors were divided into two category *viz.* extrinsic and intrinsic motivational factors. The extrinsic motivational factors were further categorized into different sub-groups *viz.* social, economic, technical and

administrative; and ranks were assigned to each statements under each sub-groups based on the perceived importance or priority of each respondents. As mentioned in Methodology, for this objective Rank Based Quotient (RBQ) technique was used to rank the factors.

These are the driving force which motivated farmers externally. This include various social, administrative, technical and economic factors which affected the decision of the farmers' to become member of dairy cooperative (JMF). The factors along with mean score and rank are presented in Table 1.

It was observed from Table 1 that, the first and foremost important motivational factor was 'Assured market for the milk and milk products', this was due to the rising popularity of customers for *Medha* dairy products in the markets. The second factor ranked in order of preference was 'Growing demand for milk and milk products' since there was rise in consumption of milk products from both rural and urban areas across the State. 'Presence of large size of milking animal herd' was also the key reason for joining JMF as there was surplus milk available for selling to JMF apart from the household consumption. After, this

Table 1: Extrinsic motivational factors influencing farmers' decisions to join JMF (N=180)

S.No.	Extrinsic motivational factors	RBQ	Rank
	Social		
1	Better employment opportunity and job security	38.98	VI
2	Assured market for the milk and milk products	76.67	I
3	Presence of large size of milking animal herd	61.30	III
4	Brand name and image of JMF at State level	46.67	V
5	Growing demand for milk and milk products	69.35	II
6	Wide coverage of milk shed area with more membership in JMF	53.80	IV
	Economic		
1	Increment in income since joining the cooperative	54.17	IV
2	Better price realization and competitive advantage in marketplace	75.00	I
3	Provision of incentives, insurance etc.	41.20	VI
4	Timely payment of the dividends	67.87	II
5	Value addition of the milk to widen the market	60.93	III
6	Provision of credit facilities/bank linkage from the cooperative	47.59	V
	Technical		
1	Better access to improved dairy technology	38.11	V
2	Timely provision of A.I. service, animal healthcare services and dairy inputs (feed, veterinary medicines etc.)	48.56	IV
3	Modern infrastructural facilities for procurement, processing and chilling of milk	78.11	I
4	Structured forward and backward linkage	60.78	III
5	Computerized Data Management System throughout supply chain	72.22	II
	Administrative		
1	Skilled managers and staff with professionalism (in terms of planning, monitoring and control of financial & human resources)	75.11	I
2	Provision of frequent training & extension advisory services from the cooperative	67.11	II
3	Coordination with other govt. and non-govt. agencies	50.00	IV
4	Swift mechanism for redressal of grievance	42.67	V
5	Structured channels for timely dissemination of information regarding the latest schemes, subsidies, technology, meetings etc. among the member producers	62.89	III

'Wide coverage of milk shed area with more membership in JMF' was ranked fourth in the order of preference due to increase in the cooperative membership from both rural and urban areas where there was a huge hidden potential for milk production; also a result of membership; initially by few members; other neighbouring dairy farmers of the village were also interested to join JMF. Another attracting factor for joining JMF was 'Brand name and image of JMF at State level'. As, JMF is the only State Govt. owned dairy cooperative with the brand name "*Medha* Dairy", so it largely appealed people and dairy farmers due its state symbolism and quality. The last ranked motivational factor in the order of priority was 'Better employment opportunity and job security'; since few people from members' families were employed in JMF particularly in MPPs, BMCs and dairy processing plants in various technical and non-technical jobs.

Economic motivation was an important indicator for joining JMF for most of the dairy farmers. Six motivational factors under sub-heading economic factors were identified and ranks were given as per their preference. It was noteworthy to mention from Table 1 that 'Better price realization and competitive advantage in market' was ranked first, this was attributed to the fact that dairy farmers earned remunerative price for their milk produce by pooling it to JMF, which further sold the packaged milk at competitive price as compared with other milk brands in the market. The second important factor was 'Timely payment of the dividends'. Since, JMF paid their members timely; the money was directly credited to their account *i.e.* after 10 days intervals. Besides this, when cooperative made extra profits, the bonus was shared within the members either biannually or annually. 'Value addition of the milk to widen the market' was ranked third for the reason that JMF apart from liquid milk, it also marketed other value added products like, lassi, paneer, ghee, curd etc. The fourth motivational factor was 'Increment in income since joining the cooperative', as many member-producers were economically poor, the regular income from JMF significantly enhanced their livelihood security after joining JMF. Further, 'Provision of credit facilities/ bank linkage from the cooperative' was also perceived an important factor for the reason that JMF indirectly facilitated members in getting loans from the banks by acting as a guarantor. 'Provision of incentives, insurance etc.' was ranked last since it was not timely disbursed among members like bonuses; furthermore JMF also helped their members in getting livestock insurance for their cattle and buffaloes.

Among technical aspects of JMF, it was observed that 'Modern infrastructural facilities for procurement, processing and chilling of milk' was identified as the most important motivational factors; it was due to the reason that JMF was equipped with modern facilities and updated technology throughout the supply chain system. The second important factor was 'Computerized Data Management System throughout supply chain'. Due to this facility, JMF could keep track of their progress in real time and avoid any kind of human error and mismanagement. Next, perceived motivational factor was 'Structured forward and backward linkage' due to the reason that JMF had well organised network of supply chain system with forward and backward linkage across the State. Another factor in the order of preference was 'Timely provision of A.I. service, animal healthcare services and dairy inputs (feed, veterinary medicines etc.)' this is attributed to the presence of good backward linkage system of JMF. The fifth motivational factor was 'Better access to improved dairy technology'; and therefore JMF members were exposed to modern dairy equipment at MMPs, BMCs and dairy plants.

In total there were five administrative factors were identified by respondents which apparently motivate them to join JMF. The presence of 'Skilled managers and staff with professionalism (in terms of planning, monitoring and control of financial & human resources)' was the foremost reason since presence of skilled staffs heightened the efficiency and productivity of the JMF. 'Provision of frequent training & extension advisory services from the cooperative' was the second motivational factor; this was due to the fact that JMF regularly conducted extension activities either at their training centres or directly at farmers' field level and gave them need-based training on dairying and animal husbandry. The third-ranked factor was 'Structured channels for timely dissemination of information regarding the latest schemes, subsidies, technology, meetings etc. among the member producers' this was attributed to the fact that JMF officials regularly interacted with their members directly through various

platforms like field visits, seminars, workshops etc.; besides this, they also used mass media channels for information dissemination like bulletins, magazines, folders etc. published by JMF at regular intervals. Further, it was noted that 'Coordination with other govt. and non-govt. agencies' was also another reason for joining JMF since this gave better economic, social and political stability to the cooperative organization (JMF) in the long run. The last factor in the order of ranking was 'Swift mechanism for redressal of grievance'; this was attributed to the fact that JMF encouraged transparency and took strict compliance of the complaints and grievances while working on the same for future improvement. The above findings were supported by Anigbogu *et al.* (2014); Bayan (2018); Bunde *et al.* (2013); Eshetu and Assefa (2015); Gasana (2011) and Nasiri (2010) who in their studies, accentuated about different factors influencing farmers' decision to join cooperative.

Intrinsic motivation is described as the inner reasons or desires to achieve goals. It generally includes self-interest, curiosity, independent mastery and judgement, internal criteria for success etc. as major important indicators for ascertaining farmers' decision to join JMF. For the present study, a total of eleven intrinsic motivational factors were identified and ranked in the order of preference. The responses of the farmers are presented in the Table 2. Based on the overall ranking, the most important intrinsic motivational factor was 'Voluntary participation and democratic control' for the reason that JMF was self-governed by their member-producers which gave them freedom to join or quit as per their will. Next factor was 'Expectation for equal treatment among members (without social, gender, cultural and other discrimination)' this was because JMF believed in quality and unity in diversity. 'Accountability and transparency in usage of member's fund' was ranked third since JMF kept good record of their financial transactions and timely announced their annual budget. 'Regularity in conduct of meetings' was also an important decisive factor for joining JMF since this gave them opportunity to clarify their queries and kept them updated about latest initiatives and technologies. Besides these 'Trust in the board members and dedicated staffs with diversified experience and knowledge in the dairy sector' also motivated dairy farmers intrinsically. Also since many members successfully 'Acquired knowledge, attitude & skills in advanced dairy production techniques'; other dairy farmers were also motivated to join JMF which this intent. Another major factor was 'Better access to social support services during time of crises; especially during the time of pandemic, drought and natural disaster it announced special package and relief fund for their members and supplied them need based inputs. Other important intrinsic motivational factors in the order of their ranking was '*Esprit de corps* among members of the cooperatives',

Table 2: Intrinsic motivational factors influencing farmers' decisions to join JMF (N=180)

S.No.	Intrinsic motivational factors	RBQ	Rank
1	Expectation for equal treatment among members (without social, gender, cultural and other discrimination)	73.64	II
2	Better access to social support services during time of crisis	49.60	VII
3	Create forum for experiential and information sharing among members	40.61	IX
4	Voluntary participation and democratic control	78.79	I
5	Acquired knowledge, attitude & skills in advanced dairy production techniques	54.04	VI
6	Less interferences of State with the cooperative administration and helping in matters such as finance, legislation, investment projects, subsidies etc.	32.02	XI
7	*Esprit de corps* among members of the cooperatives	45.05	VIII
8	Trust in the board members and dedicated staff with diversified experience and knowledge in the dairy sector	58.79	V
9	Regularity in conduct of meetings	63.64	IV
10	Good commitment from the State govt. and NDDB to ensure better growth of JMF	36.26	X
11	Accountability and transparency in usage of member's fund	68.59	III

'Create forum for experiential and information sharing among members', 'Good commitment from the State govt. and NDDB to ensure better growth of JMF' and 'Less interferences of State with the cooperative administration and helping in matters such as finance, legislation, investment projects, subsidies etc.' The findings were in agreement with the findings of Gray and Kraenzle (1998) and Ozdemir (2005) who highlighted the salient intrinsic factors influencing dairy cooperative membership.

CONCLUSION

The study revealed that milk producers prefer to work with dairy cooperatives due to reducing transaction costs (through institutions), improving milk quality and safety through training and extension programmes for dairy farmers and improving milk marketing infrastructure are critical for capacity building of smallholder milk producers to compete in the market place and with large-scale producers. Market infrastructure such as road, provision of veterinary services, distance from milk collection centre, markets, price risks, etc. are found to have significant effects on farmers' marketing choices. Young and more educated farmers have better chances of inclusion in the organised dairy sector. Apart from the practical implications, this study has a socio-psychological perspective that indicates that the members to a large extent assess their cooperatives in social terms rather than in economic ones. These observations would immensely help dairy cooperatives in understanding the decision pattern for cooperative membership among the dairy farmers.

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Research Article

Farming is no More an Occupational Choice for the Farm Families in Punjab

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ABSTRACT

The present study was conducted to ascertain the occupational choices of parents for their child and children for themselves. The results are based on the data collected from 200 farm families representing five agro climatic zones of Punjab namely zone I (sub - mountain undulating zone), zone II (undulating plain zone), Zone III (central plain zone), Zone IV (western plain zone) and zone V (western zone) through structured interview schedule. The findings revealed that all farm family members comprising of father, mother and child were aware about farming, teaching, medical (serving as doctors and pharmacist), police services and defence services as an occupational choice. Farming and farm related enterprises were not the first choice of occupation. Government job was considered an occupation and was first choice of majority of parents and children. Going abroad was the first preference of those not interested in choosing any career options in India. Higher, fixed income, luxurious life, security, social status were basis for making the choice. Positive perception led to better ranking of farming. Father and child who perceive farming to be economically profitable are more inclined towards it as an occupation. Perception of physical factors were related negatively, but not significant with choice of farming as an occupation in case of mother and child. Children should be persuaded to learn skills depending upon their aptitude particularly those which can help them to substitute income from farming and can be undertaken along with farming. Special emphasis should be laid on sharing success stories of farmers and farmers pursuing allied activities. Extension personnel should organize and conduct different programmes to help children make appropriate occupational choices. Economic, social, physical, personal and psychological factors associated with farming should be highlighted.

Keywords: Occupation, Choice, Farm families, Farming and Factors

INTRODUCTION

Wee (2010) given occupational choice is the process to evaluate one's abilities, interest, skills and personal and societal values in the light of the occupations choices available and how these align with the work values among the various available alternatives of profession. Occupational choice for a student and for their parents is one of the most important decisions for the children life. Whether that decision is to select a subject specialization, organisation for study or occupation or about to choose a particular profession, it should be carefully after consideration of the internal (including personal factors like interest, skills, capabilities, abilities, physical, emotional and intellectual demands of the child) and external environment (which might include child's suitability to profession). This choice is very crucial in determine future of the individual's daily schedule for the rest of their life. Furthermore, it will directly impact the other aspects of life such as individual's life style, self-satisfaction, self esteem, work-life balance and overall quality of life will also be affected.

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The process career choice decision making is very complicated because of the wider range of occupational choices available to an individual and not having an adequate understanding of an occupation without prior engagement. Another difficulty lies in not having clear perception, exact occupational preference, guidance & counselling in schools and outside schools and experiences among family members, friend and relatives in activities related to the chosen occupation for the career. Choosing a particular occupation or career depends upon an individual's choice to which field he wants to go for. A few years ago, parents used to decide the subjects, programme to be opted for admission and then the profession. As per the current scenario, children are career oriented and they have set goals in their mind. They opt to be successful and choose a right job, so that they can, earn a livelihood for themselves and their family, name, fame and reputation in society, manage and maintain a comfortable life, reach heights in career. The perception of occupations and their preferences for professions plays a key role in many vocational behaviours.

As we know constraints in farming are on increase, so a very common question arises in mind of the farm families that can farming be an occupational choice for their child? Firstly, the problem of uncertain income, declining farm income and the increasing incidences of farmer suicides, there are no natural incentives to engage in farming that depends heavily on nature and involves higher uncertainty and risk as compared to other sectors. Secondly, the issue of long-term growth. Increased use of fertilizers and pesticides is both a cause and consequence of the challenge of new pests and diseases. In addition, increased depletion of groundwater resources affects irrigation. Thirdly, small farmers with less than a hectare of land (85% of farmers) cannot access credit from formal institutions (Banerjee and Thapa, 2019). Borrowing finances from private lenders at usurious interest rates means they have to pay off debts using their own produce. Lack of institutional support is accompanied with the decline of social capital (family relations and community support) that used to be important as a safety net. Keeping these in view the present study was conducted to know the awareness of various occupational choices among the farm families, their occupational choice and factors affecting their choice.

MATERIALS AND METHODS

The study was conducted in Punjab state represented by all the five agro climatic zones of Punjab. Punjab has 23 districts. Out of these, two districts were selected randomly from each zone, thus total ten districts were selected for the study. From each selected districts, one block in which main city or some other main city is situated and second block away from the district headquarters was selected. Hence, twenty blocks were selected for the study. Ten farm families actively engaged in farming as their major family occupation were selected from each block through proportionate random sampling on the basis of operational landholding in Punjab. Data was collected from 200 farm families represented by father, mother and one male child studying in class 10/11/12. Data was analyzed using frequency, percentages and correlation analysis was worked to identify the relationship between different factors contributing to perception regarding farming and ranking of farming as an occupation.

Selected Zones	Selected Districts
Sub-mountain undulating zone	Gurdaspur, Hoshiarpur
Undulating plain zone	Rupnagar, SBS Nagar
Central plain zone	Tarn Taran, Ludhiana
Western plain zone	Faridkot, Ferozpur
Western zone	Bhatinda, Sri Muktsar Sahib

RESULTS AND DISCUSSION

A list of occupations was provided to select the occupations about which the respondents were aware**.** Response was sought from parents for their child and children for themselves regarding awareness of occupational choices as shown by data presented in table 1 which revealed that all farm family members comprising of father, mother and child were aware about farming, teaching, medical (serving as doctors and pharmacist), police services and defence services as an occupational choice. Revenue services comprising of Patwari and Naib were known to half of the sample fathers followed by one third (35.0%) mothers and one fifth (21.0%) children.

The response regarding self-employment / entrepreneurship was not specific, hence were clubed under two heads, farm/allied and non-farm based self-

Table 1: Distribution of respondents according to awareness regarding different occupational choices (n=200)

Occupational choices	Father		Mother		Child	
	f	%	f	%	f	%
Farming	200	100.0	200	100.0	200	100.0
Teaching	200	100.0	200	100.0	200	100.0
Medical (Doctor/Pharmacist)	200	100.0	200	100.0	200	100.0
Police services	200	100.0	200	100.0	200	100.0
Defence services	200	100.0	200	100.0	200	100.0
Revenue services (Patwari/Naib/Tehsildar)	102	51.0	70	35.0	42	21.0
Self employment/ Entrepreneurship (farm and allied activities related)	60	30.0	42	21.0	37	18.5
Self-employment/ Entrepreneurship (Non farm)	73	36.5	67	33.5	70	35.0
Singing/Acting	150	75.0	120	60.0	150	75.0
Civil services (IAS, PCS)	150	75.0	150	75.0	100	50.0
Engineering	165	82.5	165	82.5	185	92.5
Law	25	12.5	20	10.0	11	5.5
Management	10	5.0	5	2.5	25	12.5

employment/ entrepreneurship and business. In all the cases, less than half of the sample respondents were aware with most frequent response being dairy, poultry, mushroom and beekeeping for farm and allied activities. Opening a shop (pesticides, fertilizers etc.), a petrol pump, repair of implements were the responses regarding non-farm self-employment occupations. Singing and acting as a profession was known to large majority (75.0%) of fathers and children followed by 60.0 per cent mothers. Civil services as an occupational choice was familiar to majority (75.0%) of parents and half of the children. Large majority (82-92%) of the farm family members knew that engineering can be a profession whereas responses for career in law and management was least known among farm families. Occupational choice in management which included chartered accountant was better known to children (12.5%) in comparison to their parents (5.0% father and 2.5% mothers). Data clearly points toward a need to equip students and parents with knowledge about different opportunities for children which are suitable according to their aptitude.

Chakraborty (2019) in her survey on career option awareness among students (14-21 years) in India, also found that very large majority (93.0%) of students were aware of only seven career options though there are more than 250 career options available in India. Medical, engineering, law, management, computer applications, accounts and finance and designing were the main career options known to the students. Looking at the data from it can be concluded that children and their parents knew about very few occupational choices.

The response of the parents for their first preference as an occupation for their child and children for themselves was sought. First preference was sought rather than ranking of occupations due to lack of response and specificity of occupation at the pretesting stage. The data given in the table clearly showed lack of specificity with regard to the choice.

Data given in Table 2 showed that farming was not preferred as first occupational choice among fathers, mothers except 2.5 per cent of children. The reasons for majority not preferring farming as first occupational choice may be fluctuating income, risky output depending entirely on nature, hard physical labour and seeing their parents or others getting trapped in vicious cycle of debt. Talfere and Woldehanna (2012) also found farming as last preference of occupation among youth. Singh and Gupta (2014) found that adolescents in Uttar Pradesh had negative attitude towards their family occupation of farming and they preferred to choose career in non-agricultural sector due to many constraints in farming. Again, similar trend for preference for farm enterprise was observed with

Table 2: Comparison of family members according to their first occupational choice (n=200)

Occupational choices	Father		Mother		Child	
	f	%	f	%	f	%
Farming	0	0	0	0	1	0.5
Farm related /allied entrepreneurship or Business	0	0	0	0	2	1.0
Continue family business	1	0.5	2	1.0	7	3.5
Start new business (India)	0	0	0	0	4	2.0
Start new business (Abroad)	3	1.5	3	1.5	5	2.5
Government service						
Civil services	3	1.5	1	0.5	2	1.0
Police force	32	16.0	35	17.5	21	10.5
Defence force	65	32.5	63	31.5	43	21.5
Other Govt. Jobs (not specified)	70	35.0	76	38.0	54	27.0
Private service	4	2.0	6	3.0	42	21.0
No choice (Interested in going abroad)	22	11.0	23	11.5	19	9.5

only 1.0 per cent children planning to go for some farm related /allied entrepreneurship or business. The reasons may that the farm families lacked awareness about vast number of choices for self-employment/ entrepreneurship related to farm and allied activities or perceived them in the same light as farming. Very few (only 0.5% fathers and 1.0% mothers) wanted their child to continue in family business. Only 3.5 per cent children were interested to continue with family business.

Very few percentage of parents preferred their children to start a new business but few children reported it as their first occupational choice. None of the parents wanted their children to start a new business in India. However, 2.0 per cent children preferred to start business in India and 2.5 per cent abroad. Very few parents (1.5% fathers and 0.5 mothers) preferred it as an occupation for their child and same was the case with children (1.0%). The reasons may be that they considered it to be difficult to qualify for. Police job was an occupational choice of 16.0 per cent of fathers and 17.5 per cent of mothers for their wards. Interestingly, lesser percentage (10.5%) of children as compared to parents were keen on joining police force. Long hours of duty can be one of the reason. Wards joining defence forces was desired by nearly one third of fathers (32.5%) and mothers (31.5%). However, the percentage of children choosing defence forces (21.5%) was less than the parents. The reasons for parents choosing the occupation might be fixed income with good social status being given to the service personnel's. Another reason can be the settlement of children at younger age (after 10^{th} or 12^{th} class and which can also help in avoiding cost of higher education. However, they were not specific about the cadre (Other Ranks or Officers) or the service (Navy, Airforce or Army). This data also included other security forces such as BSF and CRPF etc.

More than one third (35.0%) of fathers wanted their child to be employed in government jobs other than those referred above under civil services, defence services and police force. With regard to a direct question regarding the occupation, the response was not specific. They just want any government job for their child like teaching etc. with no specific occupation. More than one fourth (27.0%) children opted for government jobs as their first occupational choice. Chachere *et al.* (2018) while discussing on attitude of rural youth in Amravati district of Vidarbha region, Maharashtra State towards farming as a major occupation found that 48.75 per cent of respondents were interested in Services (Government /Non-Government), only those with large land holding favored farming.

The frequency of first preference given to private service was recorded very less. It was found that only 2.0 percent fathers and 3.0 per cent mothers gave their first preference to the service in private sector. However, the frequency of first preference given to

private service by children was recorded high in comparison to father and mother (21.0%). The reasons for wide gap between choice of parents and child regarding private service may be lack of awareness of parents about various multinational companies giving good packages of salary along with other perks/ benefits to their employees. Parents prefer more stable and secure jobs for their wards and may considered it as unstable services with low salary.

Data given in Table 1 revealed that 11.0 per cent parents and nearly 10.0 per cent children had no preference for any occupation had planned to go abroad or send children abroad. Very interestingly, the answer of more than 85.0 per cent of the parents and even more children (90.0) was to go abroad either for studies or some job. Going abroad was the first preference of those not interested in choosing any career option in India. However, this was the goal of a very large percentage when probed about the second choice both from parents and children.

A perception analysis study conducted among the final year students of B.Sc. (Agriculture) in Acharya N.G Ranga Agricultural University, Guntur, Andhra Pradesh analysed job preference with respect to certain predetermined criteria. The results indicated that job in Government sectors got maximum weightage of 33.0 per cent, followed by higher education with the weightage of 31.0 per cent and job in banks received 19.0 per cent and the least amount of weightage with (10.0% and 8.0%) was in entrepreneurship and private job respectively. Similarly the students considered government job as the best choice of livelihood (Times of India, 2018).

A study on analysis of perception of University students' on agricultural entrepreneurship option towards tackling unemployment among educated youths by Ometesho *et al.* (2017) found that about half (50.8%) of the respondents preferred a career path in government sector and 25.8 percent hoped to be self employed. Nearly one fourth (23.4%) aspired to work in the private sector. They perceived that becoming an entrepreneur in the agricultural sector was highly risky and that agribusiness was seasonal in nature meaning there could be periods of waiting without income. Poultry (84.7%) and fish farming (79.6%) were the most preferred agricultural ventures among the respondents. Rai (2016) in her study on factors affecting academic performance and aspirations of undergraduate students of Punjab Agricultural University revealed that 32.0 per cent of students of Agriculture College were interested in taking up government job after completing their degree programme. The data was collected regarding the factors which contributed to making a particular choice of an occupation. Further this data was compiled under different broad factors. Data pertaining to factors affecting occupational choices given in Table 3 showed that these were mainly four types of direct factors that affect their choice of parents for their child and child for self.

Among parents and children, the highest percentage of children (30.0%), mothers' (25.0%) and 15.0 percent fathers' based their choice on comfort in the job in terms of physical work. Difference in both parents can be attributed to mothers being more protective towards children. Only 16.0 per cent children were interested and passionate about the choice they had made and nearly one fourth had made the choice to fulfil parents dream. Only 5.0 per cent father and 11.5 per cent mothers made the choice on the basis of child's interest/ passion while one fourth of fathers and 15.0 per cent of mothers had made the choice based upon what they dream for their child. Short travelling distance from home was reason for very few (1.5%) parents and children showing that parents were not hesitating in sending their children away from home for better occupational avenues. Lukas (2015) in her study on parental involvement in occupational education of their children indicated that majority (61.7%) of parents wanted the interests and abilities of their child to determine his future occupation and 20.2 percent of parents were pragmatic and believed that easy employability is the second occupation choice factor.

A very large percentage considered economic reasons. More than 70.0 per cent of fathers based their choice on income (75.0%) or fixed income (80.0%) as was also the case with mothers' (80.0% and 80.0% respectively). Similarly children (60.0% and above) choosing government job based their decision on higher fixed income along with consideration of it being more comfortable than private job. The youth were not interested to continue as farmers due to the falling

Table 3: Factors affecting first occupational choice of parents for the child and child for themselves (n=200)

Factors	Father		Mother		Children	
	f	%	f	%	f	%
Personal						
Interest/ passion	10	5.0	23	11.5	32	16.0
Short travelling distance from home	3	1.5	2	1.5	2	1.5
Not very strenuous/Comfortable job	30	15.0	50	25.0	60	30.0
Dream for child of parents	50	25.0	30	15.0	50	25.0
Economic						
High income	150	75.0	160	80.0	120	60.0
Fixed income on monthly basis	160	80.0	160	80.0	120	60.0
Profitable	4	2.0	3	1.5	4	2.0
Financially incapable for continuing education	20	10.0	15	7.5	15	7.5
Social						
Family and relative pressure	10	5.0	10	5.0	50	25.0
Social identity	50	25.0	30	15.0	20	10.0
Social status	150	75.0	150	75.0	150	75.0
Want to serve own country	30	15.0	20	10.0	40	20.0
Good facilities for luxurious life	50	25.0	40	20.0	60	30.0
Promotional avenues	60	30.0	60	30.0	60	30.0
Psychological						
Job security	150	75.0	160	80.0	60	30.0
Prestige	150	75.0	160	80.0	150	75.0
Recognition and reward	30	15.0	40	20.0	35	17.5

profitability and income in agriculture (Bera, 2018). Akubari (2016) found that the young people were usually not interested in this field of work, in largely due to their perception of farming, being unprofitable. Study conducted among youth in Uttar Pradesh concluded that poor income from farming and poor living standards were the casual factors luring next generation away from farming (Narain *et al.,* 2015).

Social status was the major basis for making an occupational choice for their children (by the parents) and the children too for themselves (75.0%). Promotional avenues was considered by equal percentage (30.0%) of parents and children. Occupational being instrumental in providing social identity was the concern of more fathers (25.0%) than mother (15.0%) and children (10.0%). It can be because of difference in their social interactions. Nearly one third (30.0%) of respondents based their preference on ability of the job to help in leading a luxurious life. More children (20.0%) than fathers (15.0%) and mothers (10.0%) wanted to serve the country through their choice. The difference clearly reflects the concern of mothers and parents at large for the children while deciding to join security forces. However, the other reasons like job security, income etc. could had be instrumental in the making the choice.

One fourth (25.0%) of the children were under family pressure for making a particular choice. A survey was conducted on youth to determine reasons for not seeking agriculture & farming as favourite profession by the educated unlike the white collar jobs in other fields. It was found that they think that income from farming cannot help them to enjoy the pleasures of owning a beautiful home, fast cars, the latest gadgets and mobile phones like what their colleagues in other jobs have access to (Neelam, 2017). Youth held negative perceptions towards farming, which were reinforced through peer and parental influence (Mohammed and

Noorani, 2015). A study based on perceptions of students in Nigeria on career prospects in agriculture pointed towards considered poor societal value of farmers and only 2.5% of the respondents were interested in agricultural education as a career (Adejoh *et al.,* 2016).

Majority of both parents (more than 70.0%) based their choice on some important psychological factors such as job security for secure future in comparison to lesser children (30.0%). More than 60.0 per cent of both parents and children found prestige an important criteria. Prestige of particular occupation was important to majority of parents and children. Recognitions and rewards as provided in some occupation was concern of few parents (15.0% fathers and 20.0% mothers) and 17.5 per cent children.

Correlation analysis was worked to identify the relationship between different factors contributing to perception regarding farming and ranking of farming as an occupation. Data as given in Table 4 revealed that perception of factors associated with farming were not significantly related to ranking of choice of farming as an occupation. However, better perception of all factors led to better ranking of farming as an occupational choice. Positive perception of economic factors significantly improved the ranking of farming as an occupational choice among fathers and children. Perception of physical factors were related negatively but not significant with choice of farming as an occupation in case of mother and child.

Ranking by fathers was significantly and positively related to physical factors showing that fathers considering farming to be physically strenuous and were not keen on their ward choosing it as an occupation. Better perception of personal factors improved the ranking of occupational choice of farming in case of mothers. Incase of all the three members, perception was negatively related to the choice showing those perceiving farming to be psychologically satisfying assigned better rank to farming as an occupation.

CONCLUSION

Government jobs was the first occupational choice among farm families. Fixed income on monthly basis was the major factor for choosing a particular occupation. Father and child who perceive farming to be economically profitable are more inclined towards choosing it as an occupation. Fathers considering farming to be physically strenuous are not keen on their ward choosing it as an occupation.

RECOMMENDATIONS

- Children should be persuaded to learn skills depending upon their aptitude particularly those which can help them to substitute income from farming and can be undertaken along with farming. Special emphasis should be laid on sharing success stories of farmers and farmers pursuing allied activities and those supplementing their income through other sources.
- Extension personnel should organize and conduct different programmes to improve perception towards farming and to help children make appropriate occupational choices.
- Economic, social, physical, personal and psychological factors associated with farming should be highlighted.

Table 4: Perception as a factor affecting ranking of choice of farming as an occupation

Factors	Correlation			
	Father	Mother	Child	Farm family
Economic factors	-0.15**	-0.05	-0.15**	-0.05
Socio -cultural factors	-0.01	-0.07	0.05	-0.04
Physical factors	0.14**	-0.07	-0.03	-0.05
Personal factors	0.02	-0.02	0.05	-0.06
Psychological factors	-0.04	-0.04	-0.01	-0.04
Overall perception towards farming	0.00	-0.04	0.08	-0.06

*Significant at 5% level of significance

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Research Article

The Discrepancy Between Climate Change Perception and Adoption Levels: Limit the use of Climate-Smart Technology in Agriculture

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ABSTRACT

Agriculture is a sector extremely influenced by fluctuating climatic circumstances. The present study was carried out for 180 respondents in three districts selected randomly of Eastern Uttar Pradesh.100 percent of the respondents of the study have experienced extreme climatic events in the last 5-10 years, making the region climate-prone. The climate Change Perception Scale by Maiti *et al.* (2016) was used with modification to analyse the perception of farmers towards the impact of climate change on crop farming. During the pilot survey, a list of nine adaptation strategies followed by farmers in response to the impact of climate change was prepared. The Climate Change Adaptation Index was prepared to delineate the adoption level of farmers related to adaptation strategies. The results showed that 97 per cent have considered crop diversification as the major adaptation strategy to climate change. For multiple comparisons between perception and adoption levels between all three districts, Duncan Multiple Range Test was used and Z statistics were calculated based on the Mann-Whitney U test. Knowledge-Attitude-Practice (KAP) gap was found as the adoption level was low as compared to the perception level of farmers towards the impact of climate change which in turn could restrict the adoption of climate-smart practices by the farmers.

Keywords: Climate change, Perception, Adaptation, Farmer, Crop-farming, Adoption

INTRODUCTION

Climate Change is not a new phenomenon, keeping in mind the changes occurring in weather pattern in long term. The changes caused by changing climatic scenario are becoming more evident with passing years. IPCC's latest report warns that that the world will have to face warming of around 3 degree Celsius by 2100. The global average temperature has already increased to 1.1 degree Celsius from pre-industrial (1850-1900) levels. Even a single degree rise in global temperature have showed consequences such as longer heat waves days, forest fire, sea level rise, melting of glaciers, droughts and cyclones. Almost every sector is being effected by the impact of climate change; one such most vulnerable to climate change is the highly weather-dependent sector i.e. Agriculture. Climate change has both indirect and direct effects on agricultural productivity including changing rainfall patterns, droughts, flooding and geographical redistribution of pests and diseases. Moreover, the developing countries will be hit hardest by the adverse impact of climate change due to their geographical and climatic conditions, their high dependence on natural resources, and their limited capacity to adapt to a changing climate (International Panel of Climate Change, 2001). India

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is also not left untouched by the vagaries of climate change. Agriculture sector in India is vulnerable to climate change. Higher temperatures tend to reduce crop yields and favor weed and pest proliferation. Climate change can have negative effects on irrigated crop yields across agro-ecological regions both due to temperature rise and changes in water availability. Rain fed agriculture will be primarily impacted due to rainfall variability and reduction in number of rainy days. Analysis of impact of climate change under National Innovations in Climate Resilient Agriculture (NICRA) project has found that climate change is expected to affect yields, particularly in crops like rice, wheat and maize (Press Information Bureau, Ministry of Agriculture & Farmers Welfare, Government of India, 2019). Economic Survey of India report of 2017-18 showed that extreme temperature shocks, when a district is significantly hotter than usual results in a 4 percent decline in agricultural yields during the Kharif season and a 4.7 percent decline in Rabi yields. Similarly, extreme rainfall shocks - when it rains significantly less than usual resulted in 12.8 percent decline in Kharif yields, and a smaller, but not insignificant decline of 6.7 percent in Rabi yields. It will ultimately going to effect the income and livelihood of farming community in India where more than 60 percent of the population depends on agriculture for their livelihood. A report suggests that climate change could reduce annual agricultural incomes in the range of 15 per cent to 18 percent on average, and up to 20 per cent to 25 percent for unirrigated areas (Economic Survey of India, 2017-2018). These evident changes caused by changing climatic scenario necessitate the need for adaptation strategies that are climate-smart and are helpful in increasing the adaptive capacity of the farmers in their local conditions. Adaptation to climate change refers to adjustments or changes in the system to minimize the negative impact and optimize the positive impacts of climate change. Adaptation at local level (farmers; level) is the most critical issue as local actors are the ones that realize the severity of climate change (UNFCCC, 2007). But instead of directly moving to adaptation measures, it is essential to have a look into farmer's perspective towards the negative impact of change. The questions arise; have the farmers perceived these changes in their farming system? What changes they have experienced more due to impact of climate change on farming? Without getting answers to these questions, it would difficult to get the true picture of adoption level of climate smart agriculture among farmers? Adaptation is a two-step process. First, one has to perceive climate change and associated risks; then steps taken to minimize the adverse effects of climate change. Perception should be more or less correct; otherwise steps taken based on wrong perception could have an adverse effect (Tripathi and Mishra, 2017). As a result, the current study was an attempt to assess farmers' perceptions of climate change, to identify farmers' adaptation strategies (at the local level), and to assess farmers' adoption of climate change adaptation strategies.

MATERIALS AND METHODS

The study was conducted in three districts of eastern Uttar Pradesh. Uttar Pradesh is unofficially divided into four regions: Purvanchal (21 districts), Bundelkhand (7 districts), Awadh (21 districts) and Paschim Pradesh (26 districts). Out of all four regions, Eastern Uttar Pradesh (Purvanchal) is most vulnerable to climate change (Tripathi and Mishra, 2017). Majority of the districts of the Eastern Uttar Pradesh were moderately to highly vulnerable to climate change and is expected to show very high and high vulnerability in the mid-century 2021-2050 respectively (Rao *et al.*, 2013). Along with, low educational status, and high population density, the dominance of the small and marginal resource-poor farmers in the eastern region compared to other regions of Uttar Pradesh. Rice and wheat are the most important crops in farmers' production systems, and studies reveal that they are suffering greatly from climate change. It has been observed that maximum temperature may cause the reduction in yield of rice in Eastern Uttar Pradesh by 1.0 to 1.1% per ha by 2020. Similarly, minimum temperature may decrease the yield of rice by 1.5 to 1.9% per ha in Eastern Uttar Pradesh and the wheat yield may decrease by 1.5-2.0% in Eastern Uttar Pradesh due to increase in maximum temperature by the end of 2080 (Kumar *et al.*, 2011).

There are 21 districts in the Eastern Uttar Pradesh; three districts namely Azamgarh, Ghazipur and Varanasi were randomly selected for this study. Two blocks were randomly selected from each selected districts. After the selection of the blocks, two villagers were selected randomly from each block. Thus, 12 villages were selected, randomly, from six blocks of

three districts of eastern Uttar Pradesh for the present study. Fifteen farmers were randomly selected from each village and thus, 180 respondents were randomly selected from 12 villages and considered as the sample of this study. Out of 180 respondents selected for the study, 147 respondents were aware about impact of climate change. Out of these, 143 respondents have adapted at least one adaptation strategy to cope up with the impact of climate change on crop-farming.

Perception towards climate change and its impacts was operationalized as the conscious feeling of the farming community regarding the changing climatic scenario and its impact on agriculture. In order to measure the differential levels of perception regarding climate change and its impact on agriculture, the schedule prepared by Maiti *et al.* (2016) was employed in the present study. The interview schedule used in the present study was divided into three components i.e. perception towards the impact of climate change; perception towards the impact of climate change on crop-farming; and, perception towards the impact of climate change on livestock-rearing. The level of perception of the respondents was calculated for all three components separately. First of all, respondents were asked directly whether they have perceived climate change or not with Yes and No as the response, respectively. The respondents who perceived the climate change were further interviewed to get their level of perception towards features climate change, the impact of climate change on crop-farming and as well as livestock-rearing. The respondents were requested to give their response on a four-point continuum from 'fully perceive' to 'not at all perceive' with a score of 3, 2, 1 and 0, respectively.

Ranking of statements was done based on their index value; statements with higher index value indicated that the respondents were having higher perception about that statement than the statements with the lower index value. The index value was calculated by using the following formula:

$$\text{Climate change perception index} = \frac{\text{Obtained score}}{\text{Maximum obtainable score}}$$

The farming community was categorized into three different levels of perception groups based on the obtained score by the respective respondents by using the cumulative square root frequency method.

Adaptation refers to adjustment in ecological, social or economic systems in response to actual or expected climate stimuli and effects or impacts. Adaptation strategies were operationalized as the measures taken/ adopted by the farming community to cope up with the adverse impact of climate change on crop farming and livestock rearing for sustainable agricultural production. The respondents who gave response 'YES' in perception towards climate change, were again asked whether they have adopted any adaptation strategies in crop farming and livestock–rearing in order to cope up with the adverse impact of climate change on the binary response of 'YES' or 'NO'. Two sets of probable adaptation strategies, for crop and livestock, respectively, were prepared by using the snowball technique. Those said yes, then, further asked to put their responses on a continuum viz.continued the adoption, discontinued the adoption & never followed/ adopted with the score of 2, 1, & 0, respectively. Finally, '*Climate Change Adaptation Index (CCAI)'* was developed at two-level *i.e.* adaptation strategies wise and respondent wise using the following formula:

$$\text{Climate change adaptation index} = \frac{\text{Obtained score}}{\text{Maximum obtainable score}}$$

Ranking of these adaptation strategies was done according to their higher index value. Adaptation strategies with higher index value indicated that these adaptation strategies had comparatively more coping capacity than the adaptation strategies with the lower index value. Cumulative square root frequency method was used to categories households into three categories i.e. low, medium and high level of adoption of adaptation strategies.

In order to get insight into the relationship of perception towards the impact of climate change and adoption of adaptation strategies to cope with the negative impact of climate change for all the three sampled districts i.e. Azamgarh, Varanasi and Ghazipur. Non-parametric test; Mann-Whitney U statistics was applied on the perception and adaptation score of all the three sampled districts and z statistics was obtained in order to analyses the differences in both the scores at 5 percent level of significance. Multiple comparisons were done with the help of post-hoc test, Duncan Multiple Range Test (DMRT) in order to judge the significance of differences between perception and adaption score at the district level.

RESULTS AND DISCUSSION

Table 1 shows that farmers were perceiving delay onset of monsoon and the occurrence of heavy fog during winter as the major features of climate change. It was reported that, except the year 2013, the monsoon arrived late in Eastern Pradesh in the past decade (India Metrological Department, 2020). The farmers have agreed that due to delayed onset of monsoon, sowing of seeds for *Kharif* got delayed and creating problem during transplanting of paddy saplings and ultimately reducing their crop yields. The results are similar to study conducted by Dhaka *et al.* (2010) in Rajasthan where farmers notice late onset and early withdrawal of the monsoon as the major impact of climate change. Not only delay onsets of monsoon, unpredictable rainfall with decline in precipitation in some part of the sampled region (both with the index score of 0.93) were some of the impact of climate change readily perceived by the farmers of sampled region. A study by Banerjee (2014) has showed that farmers have observed that there had been significant variations in the quantity and distribution of rainfall over the years. The cases of frost damage to the crops during winter have increased a lot and affected the vegetable crops, as pointed out by the farmers during data collection. The results were in-line with the study conducted by Dahal *et al.* (2019) where most of the respondents perceived increase in frost severity which is affecting production of vegetable crops in Nepal.

Table 2 clearly shows that farmers were having perception towards negative impact of climate change on crop farming. They perceived that crop farming is extremely vulnerable to climate change (index value 0.89), with the increase in extreme events such as floods, droughts, and heat waves which adversely affect the agricultural productivity (index value 0.89). They also perceived that more pathogen attack and vector development along with a decrease in the production of cereal crops due to increase in temperature and water unavailability. The results are line with the study where, it has been observed that maximum temperature may cause the reduction in yield of rice in Eastern Uttar Pradesh by 1.0 to 1.1% per ha by 2020 and minimum temperature may decrease the yield of rice by 1.5 to 1.9% per ha in Eastern Uttar Pradesh (Kumar *et al.*, 2011) A review done by Karki *et al.* (2020) revealed that farmers worldwide have been experiencing changes n climate particularly regarding rising temperature, unpredictable and reduced rainfall and majority of them have witnessed reduced agricultural production. However, farmers have not relatively well perceived the effect of climate change on farm's soil fertility with the index value of only 0.62 and 0.63. Researchers have shown that rice yields in India experience larger declines during extreme weather conditions (Davis *et al.*, 2019). Similarly, Bhatt *et al.* (2019) indicated that in Uttar Pradesh a declining trend in rice production is seen all agro-ecological region due to heat stress on rice crop.

The results presented in Table 3 showed that 70 per cent, 88.33 per cent and 86.67 per cent of the farmers of Azamgarh district, Varanasi district, and Ghazipur district perceived the impact of climate

Table 1: Index score of perception towards features climate change by the farmers of Eastern Uttar Pradesh

Particulars	Azamgarh (n=42)	Varanasi (n=53)	Ghazipur (n=52)	Overall (n=147)
Increasing temperature during summers	0.96	0.93	0.88	0.92 (III)
Prolonged summer	0.96	0.95	0.89	0.93 (II)
Delay onset of monsoon	0.96	0.95	0.90	0.94 (I)
Occurrence of heavy fog during the winter season	0.97	0.95	0.91	0.94 (I)
Unpredictable rainfalls	0.96	0.93	0.90	0.93 (II)
Precipitation has declined	0.95	0.92	0.91	0.93 (II)
Long dry spells and increased rate of drought	0.95	0.91	0.90	0.92 (III)
Change in the season cycle during last 10-15 years	0.87	0.92	0.90	0.90 (IX)
Increased rate of heat and cold waves	0.90	0.92	0.89	0.91(VIII)

Values in parenthesis indicate column-wise rank

Table 2: Index score of perception towards the impact of climate change on crop farming by the farmers of eastern Uttar Pradesh

Particulars	Azamgarh (n=42)	Varanasi (n=53)	Ghazipur (n=52)	Overall (n=147)
Crop farming is extremely vulnerable to climate change.	0.91	0.89	0.89	0.89 (I)
Increase in extreme weather events such as floods, droughts, and heat waves will adversely affect agricultural productivity.	0.91	0.91	0.91	0.89 (I)
Reduction in crop yields in the rain-fed areas due to changes in rainfall pattern during monsoon season.	0.87	0.90	0.90	0.88 (II)
More enhanced pathogen and vector development, rapid pathogen transmission and increased host susceptibility.	0.92	0.89	0.89	0.89 (I)
The productivity of cereal crops decreases due to increase in temperature and the decrease in water availability.	0.93	0.87	0.87	0.89 (I)
Events of unpredictable rainfall and flood are causing huge crop damage.	0.90	0.88	0.88	0.89 (I)
Change in the cropping pattern due to climate change.	0.74	0.87	0.87	0.84(VII)
Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines.	0.85	0.87	0.87	0.86(VII)
Reduce soil moisture and evapo-transpiration may increase land degradation and reduce soil fertility.	0.61	0.64	0.64	0.63(XII)
Increased soil salinity over the past years has reduced soil fertility.	0.55	0.66	0.66	0.62(XI)
Increased episodes of cold waves/hailstorms during harvesting stage are destroying the standing crops.	0.81	0.86	0.86	0.82 (X)
Change in rainfall pattern is likely to cause severe water shortages and/ or flooding	0.80	0.87	0.87	0.83 (IX)

Values in parenthesis indicate column-wise rank

Table 3: Climate change adaptation among the farmers of eastern Uttar Pradesh who perceived impact of climate change impact on crop-farming (%)

Study Area	Had perception towards climate change perception	Adaptation among those who perceived climate change	
		Adopted	Not Adopted
Azamgarh (n=60)	70.00	90.48	9.52
Varanasi (n=60)	88.33	100	-
Ghazipur (n=60)	86.67	100	-
Overall (n=180)	81.67	97.28	2.72

Values indicate the percentage

change on crop-farming and livestock-rearing. Those who perceived climate change were consequently asked if they had adopted any adaptation to reduce the negative impacts of climate change and 90.48 per cent, 100 per cent, 100 per cent of them, respectively, stated that they have adopted at least one adaptation strategies to cope up with the negative impact of climate change. Therefore, in overall, 97.28 per cent farmers of the eastern Uttar Pradesh adopted any adaptation strategies to cope up with the changing climatic scenario.

Table 4 clearly depicts the index score of each adaptation strategies in crop farming at district level as well as overall sampled region (eastern Uttar Pradesh). 'Crop diversification' was the most preferred adaptation strategy among the farmers of all three districts as well as overall sampled region. Farmers of all the three districts were very much concerned about the total-crop failure and reduction in crops yields due to increase in temperature, uneven rainfall distribution and erratic rainfall condition. Therefore, they were

Table 4: Index score and ranking of adaptation strategies in crop farming followed by the farmers of Eastern Uttar Pradesh

Adaptation strategies	Azamgarh (n=38)	Varanasi (n=53)	Ghazipur (n=52)	Overall (n=143)
Crop diversification	0.87 (I)	1.00 (I)	1.00 (I)	0.97 (I)
Use of tolerant varieties of seeds	0.22 (VI)	0.64 (IV)	0.21 (IX)	0.37 (IX)
Use of high yielding varieties and/or hybrid varieties of seeds	0.55 (III)	0.64 (IV)	0.69 (III)	0.64 II)
Preparation of bunds to control water-flow	0.66 (II)	0.66 (III)	0.62 (V)	0.64 (II)
Search of alternate source of income	0.39 (IV)	0.40 (IX)	0.44 (VIII)	0.41 (VI)
Use of neem in the field/stored grains	0.37 (V)	0.47 (VII)	0.77 (II)	0.55 (IV)
Vegetable farming	NA	0.42 (VIII)	0.63 (IV)	0.38 (VII)
Value addition /Use of by-products of crops	NA	0.55 (VI)	0.50 (VII)	0.38(VII)
In-situ mulching in rice field by *Dhaincha*	NA	0.81 (II)	0.58 (VI)	0.51 (V)

Values in parenthesis indicate column wise rank; NA: Not Adopted

incorporating more crops in their field in order to provide stability in production and nutritional security to their family. Preparation of bunds to control water flow was perceived as the second most important practice by Azamgarh district and the overall region. But, in Varanasi farmers perceived this practice as third important adaptation strategy. Farmers were more concerned about the crop damage due to flood in their field and uneven rainfall distribution. Therefore, preparation of bunds to control water flow and store water for future irrigation purpose was preferred by the overall region. 'Use of high yielding varieties' also secured second rank by the farmers of the overall sampled region, whereas, it was preferred third most important adaptation strategy by the farmers of Azamgarh and Ghazipur district and farmers of Varanasi district perceived this practice as fourth preferred adaptation strategies.

In overall region, fourth most preferred strategy among the farmers was 'use of neem in crop field and stored grains'. But, in Ghazipur, this particular practice was attributed second most preferred strategy because farmers of the Ghazipur district were aware about the negative health impact of pesticides on their crops and hence, they were going for more environmental friendly, cost-effective practices to control increased pest attack on their fields and stored grains. 'In-situ mulching of the rice field by Dhaincha' was considered as the fifth important adaptation strategy by the farmers of overall region and this particular practice was considered second most preferred adaptation strategy by the farmers of Varanasi as farmers were concerned about the reducing soil fertility due land degradation caused due to run-off losses. adaptation strategies like, 'search for alternate source of income', 'use of tolerant varieties of seeds', 'Value addition and use of byproducts of the crops' and 'vegetable farming' got the least preferences by the farmers of the overall region. Adaptation strategies vary location-wise with specific adaptation strategies to particular location. Therefore some strategies got higher rank in their respective district but were less preferred in overall.

Table 5 clearly depicts that there was a significant difference (p=0.00) between perception of an adaptation to climate change in both crop and livestock enterprise in all the sampled districts. It is very much evident from the Table 5 that perception among the famers towards the impact of climate change on crop-

Table 5: Perception of, and adaptation to climate change in crop and enterprise in eastern Uttar Pradesh

District	Crop enterprise		
	Perception	Adaptation	Z statistics
Azamgarh	0.84^{a}	0.34^{b}	-7.56 (p=0.00)
Varanasi	0.86^{a}	0.62^{a}	-5.28 (p=0.00)
Ghazipur	0.86^{a}	0.60^{a}	-6.11 (p=0.00)

a, b means different superscripts in a column differ significantly at 5 percent level of significance. Multiple comparisons were based on DMRT. Z statistics were calculated based on the Mann-Whitney U statistics. Values in parenthesis indicate p values.

farming and livestock-rearing was significantly higher as compared to adaptation to impact of climate change on crop farming and livestock-rearing. One of the major reasons behind the low adaptation to climate change could be that most of the adaptation strategies adopted by the farmers were initiated by the farmers at their own level with the help of their experience and knowledge. They were modifying their production system by taking help of fellow farmers, progressive and sometime by approaching to extension services. Even the extension contact regarding climate change–related adaptation strategies was observed comparatively low as compared to normal agricultural practices. Though the farmers had higher perception towards the impact of climate change but their actions are not consistent with their perception level. This discrepancy between the perception and actual adoption of any practice was commonly referred to as "KAP-gap', KAP refers to "knowledge, attitudes, practice" (Rogers *et al*., 2003). So the formation of a favorable attitude or unfavorable attitude toward an innovation or any practice does not always lead directly or indirectly to an adoption and rejection decisions. In present context also, farmers perceived the climate change impacts very well but accordingly they did not adopted more adaptation strategies. Farmers are still lacking behind in forming a relatively strong base of knowledge after perceiving the impact of climate change; both features of climate change & impact on crop-farming. A "cue or trigger to action" is required in order to narrow this gap. Some of the regular practices followed by the farmers were culture-bound, which is restricting them to go for some other new innovations in their existing production system.

CONCLUSION

- The results call for action plans that are designed in a frame of 'bottom-up approach' or a 'local to regional to country level' strategic implementation of adaptation options to sustain their farming system
- With keeping on focus on awareness campaign regarding the impact of climate change the major focus should be given in promoting Climate-Smart agriculture.
- As it is observed in the results that the major adaptation strategies mostly followed was the crop diversification. There sensitizing farmers for go for systematic pattern of cropping according to weather conditions and even Integrated Farming system can also be promoted.

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Research Article

Investigating the Quality of the Home Environment Practiced by Contemporary Parents: A Pilot Research

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ABSTRACT

A healthy and safe home environment is essential for promoting and protecting health and development during childhood. Children need stable, supportive social environments and access to resources within the home to enhance cognitive, emotional, and physical development (Bronfenbrenner, 2001). Therefore, the proposed study aimed to assess the quality home environment young children residing in Pantnagar, Uttarakhand. In present study, a total of 50 young adult parents (between the age range of 25-35 years) of children studying in nursery and primary classes (2-6 years) from Pantnagar, (U.S. Nagar, Uttarakhand) were drawn as sample of the study through purposive and convenience sampling method. A Google form was created to obtain the date via online mode. A tool namely Home Environment Scale developed by Dr. Reena Sharma and Dr. Vibha Nigam was utilized to achieve the research objectives. The tool is designed to measure the psycho – social climate of home as given by the parents. Suitable statistical method i.e. Frequency and Percentage were obtained for the data collected to analyze the quality of parental home environment. After analysis and comparing the data, the finding of research reflected that that approximately fifty per cent of young children are living either in poor to moderately poor quality of home environment.

Keywords: Home environment, Young children, Contemporary parents

INTRODUCTION

For more than half a century, the home environment has been a central focus of inquiry in the field of early development; a consensus is emerging that the home environment provides an important contribution to children's development, learning, and school success (Collins *et al.,* 2000; Morrison and Cooney, 2001). Home environment is not an abstract concept. It is the combination of physical and psychological environment. First one includes rooms, basic facilities such as water, shelter, clothes, food and other physical needs of the individuals, while the psychological environment of home includes the mutual interactions of the family members, respect, say in the family matters and such other things. Both the aspect has a direct and significant influence on the overall development of child (Mukama, 2010; Muola, 2010). The Parental Home Environment entails emotional warmth displayed by parents while interacting with their children; provision of stimulating and learning experiences in the home; and physical surroundings, such as safety of play areas and cleanliness (Leventhal and Brooks-Gunn, 2001). The environment in which we live has a considerable impact on our behavior and performance (Study Moose, 2024). This can be well understood by the Albert Bandura's study with Bobo Dolls. The aim of Bandura's experiment was to demonstrate that if children were witnesses to an aggressive display by an adult they would imitate this aggressive behavior when given the opportunity (Bandura *et al.,* 1961), suggesting the importance of a good home environment for a child as home is the first place of learning for a child.

Environmental factors that impact child development usually fit into categories like: Social environment (which is the child's relationship with

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others at school and in the community), Emotional environment (which is how well families meet the child's relational needs at home), Economic environment (which is the family's ability to provide financially for the child). If children don't have adequate social interactions at school and in the community, they don't have the opportunity for practical applications of their learning to promote healthy cognitive development. Children who struggle with an unstable situation at home can develop attachment issues that can impede their emotional development and lead to mental health issues later on (Study. Com, 2024). (Mentally Healthy Schools, 2024), changes within the family set up, like divorce or separation, can also impact on children and young people's mental health. For some children and young people, changes can bring relief if there are things going on at home which have caused distress. For others, these changes can bring feelings of anger, sadness, withdrawal and even shame as they try and make sense of their feelings. Urbanization has contributed to an increase in single parent families, primarily due to increasing divorce rates and non marital childbearing and shift from joint family to nuclear family (Anthrolic, 2024). Poverty can place severe strains on parent–child relationships, due to the highly stressful conditions caused by financial problems and material deprivation, thereby generating negative psychological effects and family dysfunction (Conger *et al.,* 2010 and Wadsworth and Berger, 2006). In a family where both parents are working and not able to spend quality time, their children are often lacking necessary support and supervision. Over time, it will make them demoralized, and have serious effects on their academic performance. Without parent's supervision, children will also be very likely to take on bad habits due to peer pressure such as addiction to games like PUBG, smoking, or even taking drugs. There is an alarming issue that less and less close conversation has been made between children and the other family members, many children feel lonely even at their own home (Wow Parenting, 2024).

A healthy and safe home environment is essential for promoting and protecting health and development during childhood. Children need stable, supportive social environments and access to resources within the home to enhance cognitive, emotional, and physical development (Bronfenbrenner, 2001). Alternatively, unstable, noisy, chaotic home environments have negative effects on children's health (Dush *et al.,* 2013) and development (Evans, 2003; Evans and English, 2002). As mentioned above, with change in time family dynamics has changed from joint family to nuclear family, more cases of divorce and separation, increased mental stress and depression among children, urbanization, dual economy, increased influence of media which has led to several good and bad impact on child's learning and development which necessities the understanding of good home environment and correct parenting style. Therefore, the proposed study aimed to assess the quality home environment of young children residing in Pantnagar, Uttarakhand.

MATERIALS AND METHODS

In present study, a total of 50 young adult parents (between the age range of 25-35 years) of children studying in nursery and primary classes (2-6 years) from Pantnagar, (U.S. Nagar, Uttarakhand) were drawn as sample of the study through purposive and convenience sampling method. A Google form was created to obtain the date via online mode. A tool namely Home Environment Scale developed by Dr. Reena Sharma and Dr. Vibha Nigam was utilized to achieve the research objectives. The tool is designed to measure the psycho – social climate of home as given by the parents. It consists of 84 items belonging to five dimensions of home environment, *Acceptance* (child oriented, developmentally relevant, child respecting need take account of what the child actually needs.), *Autocratic* (indicates autocratic atmosphere in which many restrictions are imposed on children by the parents in order to discipline them.), *Over Protection* (implies prevention of independent behaviour and prolongation of Infantile care.), *Permissiveness (*includes provision opportunities to child to express his/her views freely and act according to his/her desires without interference from parents.) and *Rejection* (implies conditional love recognizing that the child has no rights as a person, no right to express his/her feelings, no right to uniqueness and no right to become an autonomous individual). Suitable statistical method i.e. Frequency and Percentage were obtained for the data collected to analyze the quality of parental home environment.

RESULTS AND DISCUSSION

In this rapidly changing world and with the recent technological advancement, home environment helps pupils for their proper development. The home is regarded as the best environment for the young child. The home should produce and provide affectionate and happy life in which the fundamental needs of the children are given due consideration and in which desirable behavioral patterns of the children are designed and inculcated. The home learning context has been studied extensively, especially in the area of developmental psychology, and has been linked to the child's cognitive and social development. The environment factors have got a big influence on the academic performance of a learner (Bradley and Caldwell, 1994). Home environment refers to all sorts of moral and ethical values, emotional, social and intellectual climate set by the family members for the child to contribute his/her wholesome development (Anene, 2005). It directly as well as indirectly influences child's development in a variety of ways including guiding the development of socially skilled behavioral patterns of the child within the context of family life, developing healthy habits and attitudes, arranging peer experience and fostering friendships, developing his/her personality and character including physical and moral development. Home Environment gives appropriate atmosphere which is helpful in child's proper development and helping the children to achieve their goals of life (Kumar, 2018).

Table 1 discussed about the quality of home environment based on the gender, education and residence of the selected respondents which is an important aspect of a child well-being. A child's growth, learning, and exploration all depend on a healthy safe home environment. An environment that encourages achievement, affection and a nurturing relationship between children and their parents is essential for their socialization and psychological development (Bhowmik *et al.,* 2023). Table no.1 depicts that the majority of parent respondents (46.00%) were found with average quality home environment practices followed by parents (44.00%) who provided poor kind of home environment to their young ones. Furthermore, it was also reflected in the table no.1 that only 10.00 per cent of the parent provided good home environment to their children. It can be interpreted from the Table 1 that approximately 50.00 per cent of young children are living either in poor quality home environment or in an average quality home environment as practiced by their parents which is reflag for their socio-emotional and personality development of young children. National Academies of Sciences, Engineering, and Medicine (2016) also explains that children need care that promotes positive emotional health and well-being and that supports their overall mental health, including a positive sense of self, as well as the ability to cope with stressful situations, temper emotional arousal, overcome fears, and accept disappointments and frustrations. Parents and other caregivers are essential resources for children in managing emotional arousal, coping, and managing behavior. They serve in this role by providing positive affirmations, conveying love and respect and engendering a sense of security. Provision of support by parents helps minimize the

Table 1: Frequency and percentage distribution of respondents on the quality of home environment (N=50)

Variables	Particulars	Quality of home environment					
		Good (280-329 and above)		Average (240-279)		Low Below (200-239)	
		Number	Percentage	Number	Percentage	Number	Percentage
Gender	Male (n=18)	01	05.50	08	44.00	09	50.00
	Female (n=32)	04	12.50	15	46.80	13	40.60
Education	Below graduation (n=20)	02	10.00	10	50.00	08	40.00
	Graduation (n=15)	02	13.00	07	46.00	06	40.00
	PG/PhD (n=15)	01	6.00	06	40.00	08	53.00
Residence	Urban (n=26)	01	3.84	12	46.10	13	50.00
	Rural (n=24)	04	16.60	11	45.00	09	37.60
Overall		05	10.00	23	46.00	22	44.00

risk of internalizing behaviors, such as those associated with anxiety and depression, which can impair children's adjustment and ability to function well at home, at school, and in the community (Osofsky and Fitzgerald, 2000). Such symptoms as extreme fearfulness, helplessness, hopelessness, apathy, depression, and withdrawal are indicators of emotional difficulty that have been observed among very young children who experience inadequate parental care (Osofsky and Fitzgerald, 2000).

Gender includes the social, psychological, cultural and behavioral aspects of being a man, woman, or other gender identity. Depending on the context, this may include sex-based social structures and gender expression (Wikipedia). Table no.1 projects that the majority of male parent respondents (50.00 %) were found with poor quality home environment practices as compared to female parent respondents (40.60%) while 44.00 per cent of the male and 46.80 per cent female parent respondents portrayed average kind of home environment for their young children. Furthermore it was also reflected in the table no.1 that only 05.50 per cent male and 12.50 percent female parent respondents practiced the good quality home environment to their children. It can be derived from the table that quality of home environment provided by male parents is quite poorer as compared to female respondents. It also reflectsthat the majority of the parents of both genders had poor acceptance towards their child needs; imposed many restrictions on children in order to discipline them; provided Overt Protection which implies prevention of independent behaviour and prolongation of Infantile care; lack of Permissiveness which includes provision opportunities to child to express his/her views freely and act according to his/her desires without interference from parents and had highly rejection attitude that implies conditional love recognizing that the child has no rights as a person, no right to express his/her feelings, no right to uniqueness and no right to become an autonomous individual (Bhowmik *et al.,* 2023). This result is in agreement with the findings of Prajapati (2020); Mora *et al.* (2016) and Sharma (2017) which also indicates there is gender differences in the home environment of upper primary students.

Parents' educational attainment has an important influence on the environments they create for their children, and it is a predictor of cognitive and behavioral outcomes (Davis-Kean, 2005). 14 Studies have linked higher levels of maternal education with more parental warmth and responsiveness14 more learning materials in the home (Magnuson *et al.,* 2009), increased school readiness (Magnuson *et al.,* 2009), improved educational and employment outcomes throughout life (Dubow *et al.,* 2009). Education influences parenting knowledge and beliefs, which, in turn, affect parenting practices and the quality of home environments (Magnuson *et al.,* 2009 and Jones *et al.,* 2013). Table no.1 projects that the majority of parent respondents (53.00%) with Post Graduation qualification were found with poor home environment as compared to the parent respondents having graduation and below graduation level education (40.00%). Table 1 further depicts that 50.00 per cent of parents having below graduate qualifications portrayed that they were providing average kind of home environment to their offspring followed by parents with Post Graduation (40.00%) educational and graduation (46.00%) while only 06.00 per cent parents with Post-Graduate educational qualification provided good home environment to their children followed by the parents having graduation (13.00%) and below graduation (10.00%) educational qualification. Table no. 1 demonstrates that majority of parents with higher education portrayed poorer practices in their homes. Hoff (2003) also explained that as parents are the first teacher of their children therefore the education level of parents is one of the important factors when we talk about the development and learning of a child. It was found in his assessment that majority of the parents with higher level of education provided poor to average kind of home environment. Parents with more education both talk to, and use more complex and varied language with, their children, which, in turn, predict better language and reading skills throughout childhood. Parents who set unrealistic expectations for their children's academic and career success can create stress, anxiety, and a sense of inadequacy. When children feel that they can never meet their parents' expectations, it can lead to a lack of motivation and a decrease in self-esteem (Mindler Blog, 2024). Trivedi and Mohanty (2019) explains, Education brought a lot of changing in women's life. Today more and more women are getting educated and creating better lives for them. It is seen that most who have completed their college education have opted

for divorce because they can support them financially and they do not want to continue an incompatible marital life. As a result, Young children between the ages of 2 and 6 years feel fearful, confused, and abandoned during parental separation (Chavda and Nisarga, 2023). In light of this research it can be said that changing scenario of family system- from joint to nuclear, nuclear to single working parent and dual earner family is creating financial, social and individual pressure of work-life balance on parents which is leading toward poor quality of home environment. This phenomenon is a significant concern because family structure has been shown to have a profound impact on child well-being-most significantly on physical and mental health (Murphey, 2012). In families where only one parent is present, there are often fewer economic and emotional resources. Competing demands at work and at home can hinder a parent's ability to provide an environment conducive to learning and development (Carlson and Corcoran, 2001).

An enriching and stimulating home environment fosters healthy growth and brain development by providing a child with love, emotional support, and opportunities for learning and exploration (Carlson and Corcoran, 2001). Table 1 projects that majority of the parents belonging to urban residence (50.00%) were found with poor quality of home environment as compared to parent respondents belonging to rural residence (37.60%). Table 1 further depicts that 46.10 per cent of urban and 45 per cent of rural respondents practiced average kind of home environment. Furthermore, it was also reflected in table no.1 that only 03.84 per cent urban and 16.60 per cent rural parents provided good home environment to their children. During assessment we came to this discussion that majority of the parents belonging to either urban or rural families provided poor home environment. Studies reported that parenting programs (e.g., parenting education, consulting) provided by primary health care practitioners, such as home visiting nurses, child developmental specialists demonstrated positive effects on parenting behaviors (Mendelsohn *et al.,* 2007 and Mendelsohn *et al.,* 2007) parenting stress (Mendelsohn *et al.,* 2005) parent–child interactions (Mendelsohn *et al.,* 2011), child cognitive and language development (Mendelsohn *et al.,* 2007 and Mendelsohn *et al.,* 2007, 2005 and 2011) and child behavioral problems (Kliem, Sandner, 2021). However, despite the many efforts to improve positive parenting, the disparity in parenting and parenting resources between rural and urban areas is common. In contrast to current research study many studies across cultural contexts reported that, compared to their urban counterparts, rural parents tended to adopt an over-controlling (Rani and Singh, 2013) and intrusive (Bornstein *et al.,* 2008) parenting style and to accept physical and emotional abuse as a legitimate strategy to discipline children (Rerkswattavory and Chanprasertpinyo, 2019). The disparities in parenting styles and practices may be worsened by the fact that rural parents usually have fewer resources to support child-rearing. Prior studies suggested that it might be uniquely difficult for rural families to develop and maintain positive parenting practices because of the lack of support systems and amenities (Brody and Flor, 1998, Evans, 2006 and Conger RD, Conger *et al.,* 2010.). The rural–urban disparities of parenting style and resources are also evident in the Chinese context. Existing studies reported that rural parents with children of different ages were more likely to adopt a negative parenting style, whereas urban parents adopted a positive one (Yue *et al.,* 2017 and Yang *et al.,* 2005).

From the Table 1 it is clearly visible that majority of the parents whether male or female, rural or urban, less educated or more education provided poor to average kind of home environment. This is probably a result of the factors we discussed above such as urbanization, globalization, women education, dual economy, increased divorce and separation , single parenting, but the another possible determining factor for the quality of home environment could be the type of parenting style, that parents use to rear their children For example, it was found during the assessment that most of the parents show rejection or neglectfulness towards their children, where parents showed less willingness to participate in the activities and help their child. Such parents consider the articles made by their child as trash and generally do not talk to their children when they commit any mistake. The another such parenting style that majority of parents opted was, Autocratic where parents were found to put restrictions on their children for example, children were not allowed to go outside without the permission of elders, the time for sleeping, dining and playing was

predetermined which is expected to be followed by their children, such parents only impose their own interests on the children in terms of career they choose, activity they perform and only allow children to watch enlightening programs on television. Such parents think they are disciplining their child by imposing restrictions and predetermined schedule but they forget about the choices and interest of children and ultimately reduce their ability to take decisions for themselves. Authoritative parents set limits and standards for their Children's behavior that is correct in terms of transformation (Shahsavari, 2012). Other section of parents were found with overprotection towards their children, restricting their child to play alone and involve in household tasks, avoid scolding the child even if they commit some mistake. A small section of parent respondents were found to exhibit acceptance towards their children where they listen the hypothetical story of child with keen interest and try to answer their never ending questions and also give importance to child's interests.

CONCLUSION

The above research study was aimed to find the quality of home environment provided by parents to their young children of the age group 2-6. Based on the gender, educational qualification and residence of selected parents, the study revealed that approximately fifty per cent of the young children are provided either poor or average kind of home environment. This is possibly a result of changing scenario of family system-from joint to nuclear, nuclear to single working parent and dual earner family, creating financial, social and individual pressure of work-life balance on parents leading them toward poor quality of home environment. As a result it is a necessity in today's changing scenario of family system to understand about correct parenting style and good quality home environment which is not just a place of comfort and joy; it's a crucial foundation that profoundly impacts every aspect of a child's life (Warrenton Pediatrics, 2024).

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Research Article

Exploring Farmers' Awareness of Digital Platforms for Extension and Advisory Services: An Analytical Perspective on Key Determinants

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ABSTRACT

The introduction of digital platforms has transformed agricultural practices by improving farmers' access to essential information and advisory services. The present study was undertaken to explore the level of awareness among farmers concerning various digital platforms for Extension and Advisory Services (EAS) in the Indo-Gangetic region of India, a key agricultural zone. Utilizing a multi-stage random sampling approach, 350 farmers from Uttar Pradesh, Haryana, and West Bengal were selected for the survey. Awareness was measured using a structured questionnaire, and categorized into low, medium, and high categories following CSRF method. The study employed Pearson correlation and multiple linear regression analyses to explore the socio-demographic factors impacting awareness. The findings reveal notable regional disparities, with Haryana farmers demonstrating higher awareness compared to other states. Key determinants *viz.* landholding size, ICT ownership, and social media usage positively affected awareness, while age and farming experience were negatively associated. The study underscores the need for focused digital literacy programs to boost the awareness of digital platforms among farmers, especially in areas with lower awareness.

Keywords: Awareness, Digital platforms, Extension and advisory services (EAS)

INTRODUCTION

In recent years, the adoption of digital platforms in agriculture has gained considerable momentum, driven by the need to boost productivity, enhance decision-making, and close the knowledge gap between farmers and agricultural experts (World Bank, 2016). These digital platforms encompass mobile-based services *viz.* SMS alerts and apps, internet-based platforms *viz.* e-commerce and social media, and web-based portals that offer comprehensive agricultural information. They serve as vital channels for delivering advice on crop management, market trends, weather forecasts, and other agricultural practices (Aker *et al.*, 2016; Singh *et al.*, 2023) in user-friendly form, easy to access and cost-effective ways at the right time (Mishra *et al.*, 2020; Chauhan, 2021). For example, mKisan is a mobile-based service providing SMS alerts, while e-NAM is a web-based platform aimed at facilitating market access for farmers (Saini *et al.*, 2023b). Using these platforms equips farmers with up-to-date practices, thereby enabling them to make more informed decisions (Singh *et al.*, 2023), which in turn enhances the outcomes of their agricultural activities.

Despite these potential benefits, the use of such services among farmers varies widely across different regions and demographic groups. Several studies have

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highlighted key barriers to the adoption of digital platforms, including lack of awareness, limited digital competency, inadequate infrastructure, and the lack of localized content tailored to farmers' needs (Dhaka *et al.*, 2010; Subashini *et al.*, 2017; Fawole *et al.*, 2012). For instance, while platforms *viz.* Kisan Call Centres (KCC) offer direct access to expert advice, farmers in remote areas often struggle with poor network connectivity and lack of up-to-date information on government schemes ad market trends, limiting their ability to effectively use these services (Gandhi *et al.*, 2018). Similarly, internet-based platforms *viz.* e-NAM, which offer substantial market opportunities, are underutilized due to lack of digital literacy, lack of comprehension of e-NAM trading process, thereby hindering effective navigation of these tools (Saini *et al.*, 2023a; Shanmukh, 2024).

Given these challenges, assessing farmers' awareness of digital platforms for extension and advisory services (EAS) is crucial, as awareness is a key precursor to adoption. Understanding the factors that influence farmers' awareness can provide valuable insights into the barriers and drivers of digital platform adoption, making this study particularly relevant in the current era of agricultural digitalization. While previous studies have explored various aspects of information and communication technology (ICT) adoption in agriculture, there remains a gap in the literature regarding the specific factors that affect farmers' awareness of digital platforms providing extension services. Most research to date has concentrated on general adoption rates or the impact of digital tools on productivity, leaving a void in understanding the determinants of awareness itself. This study aims to fill that gap by categorizing farmers based on their awareness level, exploring the relationships between awareness and various socio-demographic factors, and identifying the key predictors of awareness. By addressing these areas, the study seeks to offer a comprehensive understanding of the factors that shape farmers' awareness of digital platforms for EAS, identifying the most effective ways of reaching and serving them. The findings from this research can help policymakers, extension workers, and technology developers in crafting targeted interventions to enhance ICT adoption, thereby contributing to the broader objective of agricultural development.

MATERIALS AND METHODS

The study was undertaken in the Indo-Gangetic region, a key agricultural area in India, to assess the awareness of farmers towards various digital platforms for EAS. A multi-stage random sampling technique was employed to select the study locations and respondents. Initially, three states within the Indo-Gangetic region were randomly selected: Uttar Pradesh (UP), Haryana, and West Bengal. To ensure a diverse representation, a further selection was made within each state. Specifically, two districts each from West Bengal (total districts: 23) and Haryana (total districts: 22), and three districts from Uttar Pradesh (total districts: 75) were randomly chosen (Figure 1), providing a comprehensive geographic coverage across these states. The rationale for choosing more districts from Uttar Pradesh was due to its larger number of districts, providing a wider representation of the state's diverse agricultural practices and socio-economic conditions. From each of the selected districts, a sample of 50 farmers was randomly chosen, resulting in a total sample size of 350 farmers. This sample was designed to capture a wide range of demographic and socio-economic backgrounds, ensuring that the findings would be broadly representative of the farmers in the region.

Awareness was operationalized as "the familiarity of the farmers with the existence of various digital platforms for EAS". To measure farmers' awareness, the study focused on five widely recognized digital

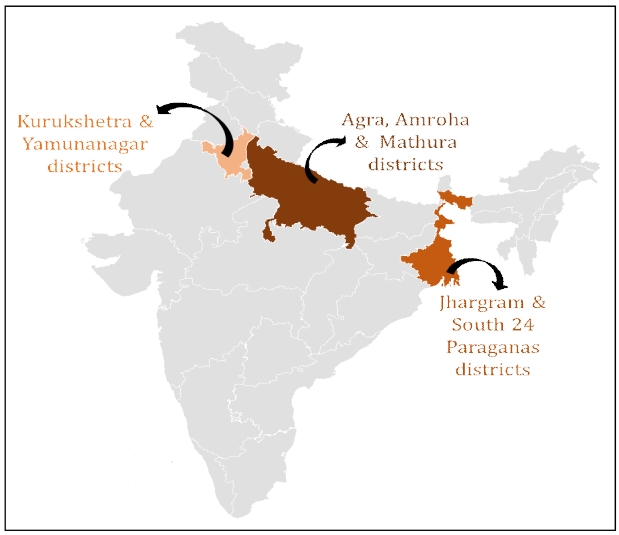

Figure 1: Sampled districts from the Indo-Gangetic region

platforms: mKisan, IKSL (IFFCO Kisan Sanchar Limited), KCC (Kisan Call Centre), e-NAM (National Agriculture Market), and Kisan Sarathi. The awareness of these platforms was assessed through a structured questionnaire, where respondents were asked to rate their level of awareness on a three-point continuum: fully aware (2), partially aware (1), or not aware (0). The responses were then quantified to calculate an individual mean awareness score for each respondent, allowing for a standardized measure of awareness across all respondents, facilitating the subsequent analysis. The mean awareness score was calculated using the formula:

$$\text{Mean awareness score} = \frac{\text{Total score obtained}}{\text{Maximum possible score}}$$

Following the calculation of the awareness scores, the farmers were classified into three levels using the cumulative square root frequency (CSRF) method. Thereafter, the data was analysed statistically through Pearson correlation to examine the relationships between the mean awareness scores and various socio-demographic factors, while multiple linear regression was employed to identify the key predictors of awareness among the farmers. These analyses offered valuable insights into the factors that influence farmers' awareness of digital platforms for EAS, contributing to the study's overall objective of understanding and improving ICT adoption in agriculture.

RESULTS AND DISCUSSION

A comparative overview of farmers' awareness levels regarding digital platforms for EAS across three states, West Bengal, Haryana, and Uttar Pradesh is provided in Table 1. The data reveal significant regional disparities in awareness levels. In West Bengal, a substantial majority of farmers (57%) fall into the low awareness category, with only 8 per cent achieving high awareness, resulting in a mean awareness score of 0.314 ± 0.206. This suggests that farmers in West Bengal are less familiar with or less engaged in digital platforms for EAS. In contrast, Haryana exhibits a much higher awareness level, with 45 per cent of farmers in the high awareness category and a mean score of 0.494 ± 0.290, indicating a stronger penetration and usage of digital tools in this state. Uttar Pradesh shows a more evenly distributed awareness level among its farmers, with a considerable percentage in both medium (40.667%) and high (24.667%) categories, and a mean score of 0.357 ± 0.199. The results of the one-way ANOVA ($F = 17.032$, $p < 0.001$) confirm that the differences in awareness levels across these states are statistically significant, emphasizing the need for targeted interventions to improve digital literacy and platform adoption in regions like West Bengal. Overall, across the three states, 38% of farmers exhibit low awareness, 36.29 per cent have medium awareness, and 25.71 per cent possess high awareness. This indicates that while a significant portion of the farming population remains in the low and medium awareness levels, a considerable number of farmers, especially in Haryana, demonstrate high awareness of digital platforms for EAS. This distribution suggests regional differences in the uptake and awareness of these services, underscoring the need for targeted awareness initiatives to bridge the gap in regions like West Bengal.

The regional differences in farmers' awareness identified in this study are consistent with previous research findings. For example, Kumar *et al.* (2017) observed that regions with better infrastructure and higher digital literacy rates, *viz.* Haryana, tend to have farmers who are more aware of and utilize ICT services more frequently, supporting our current findings. In contrast, Prasad *et al.* (2023) highlighted that challenges *viz.* lack of training and practical

Table 1: Categorization of farmers based on their awareness level of digital platforms for EAS

Districts	Mean awareness score			One way ANOVA	
	Low (<0.29)	Medium (0.29-0.53)	High (>0.53)		
	Frequency (%)			Mean ± S.D.	F
West Bengal (n_1=100)	57(57.0)	35(35.0)	8(8.0)	0.31 ± 0.20	17.03***
Haryana (n_2=100)	24(24.0)	31(31.0)	45(45.0)	0.49 ± 0.29	
Uttar Pradesh (n_3=150)	52(34.6)	61(40.6)	37(24.6)	0.35 ± 0.19	

Note: ***Significant at p-value <0.001; S.D. represents Standard deviation of the given category

exposure towards ICTs, linguistic issues and limited network connectivity in states like West Bengal contribute to lower awareness and uptake of ICT-based advisory services, which corresponds with the low awareness scores we observed. Thus, despite nationwide digital agriculture efforts, regional differences persist, likely due to unaddressed socio-economic factors.

The Pearson correlation coefficients between selected independent variables and the mean awareness score related to digital platforms for EAS, a perusal of which shows that most of the variables are significantly correlated with the awareness score at the 0.01 level as given in Table 2 and Figure 2. Among these, social media use behaviour exhibits the strongest positive correlation, followed by ICT ownership and land holding. Other factors, *viz.* education, annual income, and extension participation, also show substantial positive correlations. Conversely, age and farming experience are negatively correlated with the mean awareness score, indicating that younger and less experienced farmers are more likely to be aware of digital platforms. The significant negative correlation between farming experience and awareness likely indicates that more experienced farmers tend to be older and may be less inclined to adopt new technologies. Older farmers are often more accustomed to traditional methods and may encounter difficulties when it comes to adapting to modern digital tools, resulting in lower awareness and use of digital platforms for EAS. This pattern highlights a generational gap in technology adoption, with younger, less experienced farmers being more receptive to integrating modern agricultural practices.

These findings are consistent with those of Hasan *et al.* (2019), who reported that younger, more educated farmers are more inclined to adopt and benefit from ICT in agriculture. Similarly, Raghuprasad *et al.* (2013) identified a strong positive correlation between exposure to social media and awareness levels, underscoring the role of digital engagement in raising awareness. However, the negative correlation between farming experience and awareness are consistent with the findings of Poudel *et al.* (2023), but contrasts with the findings of Kumar *et al.* (2021), who suggested that more experienced farmers might possess higher awareness due to their longer exposure to extension services. These differences may be attributed to regional variations in the accessibility and promotion of ICT-based services. These findings collectively suggest that while younger, more educated, and technologically connected farmers tend to have higher awareness, the role of experience in shaping awareness may vary depending on other contextual factors.

Table 2: Relationship analysis of awareness with different socio-demographic variables

Variables	Pearson correlation
Age (years)	-0.458**
Educational	0.610**
Land holding (ha)	0.687**
Farming experience (years)	-0.412**
ICT ownership	0.706**
Social media use behaviour	0.760**
Social participation	0.703**
Extension contact	0.772**
Extension participation	0.735**

Note: ** Correlation is significant at the 0.01 level (2-tailed)

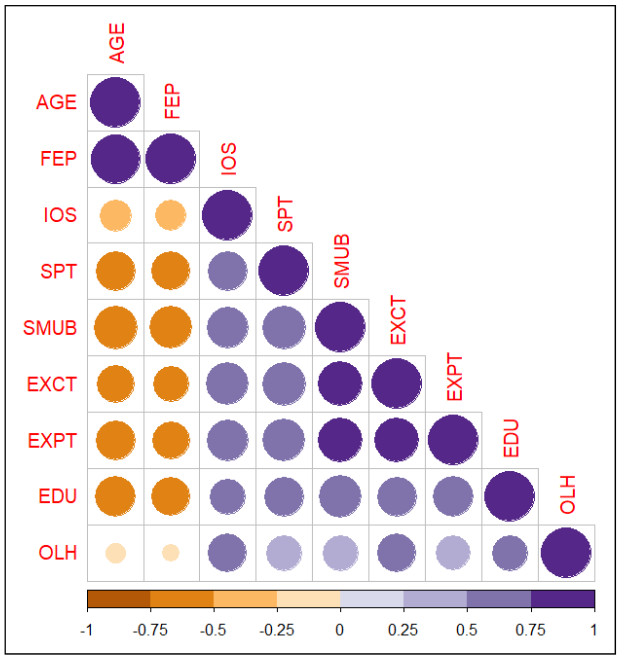

Figure 2: Correlation plot between independent variables of farmer's awareness about digital platform for EAS. (AGE: Farmer's age, FEP: Farming experience, IOS: ICT ownership, SPT: Social participation, SMUB: Social media usage behaviour, EXCT: Extension contact, EXPT: Extension participation, EDU: Education, OLH: Operational landholding)

The results of multiple linear regression analysis, presented in Table 3, indicated that several key factors significantly influence farmers' awareness of digital platforms for EAS. The model fit indices for regression analysis for accessing awareness of farmers about digital platforms for EAS are shown in Figure 3. Specifically, the significant determinants of awareness include land holding, farming experience, ICT ownership, social media use behaviour, social participation, extension contact, and extension participation. These variables were all statistically significant in explaining the variation in farmers' awareness, with ICT ownership ($\beta = 0.161$, $p = 0.032$), social media use behaviour ($\beta = 0.313$, $p < 0.001$), social participation ($\beta = 0.241$, $p = 0.004$), extension contact ($\beta = 0.247$, $p = 0.027$) and extension participation ($\beta = 0.129$, $p = 0.001$), showing particularly strong positive effects. Since, correlation assesses the linear relationship between two variables, without considering others, the negative correlation between farming experience and awareness (Table 2) implies that, in a simple bivariate analysis, as farming experience increases, awareness tends to decline-possibly because older, more seasoned farmers favour traditional methods over digital tools. However, the positive regression coefficient between these two

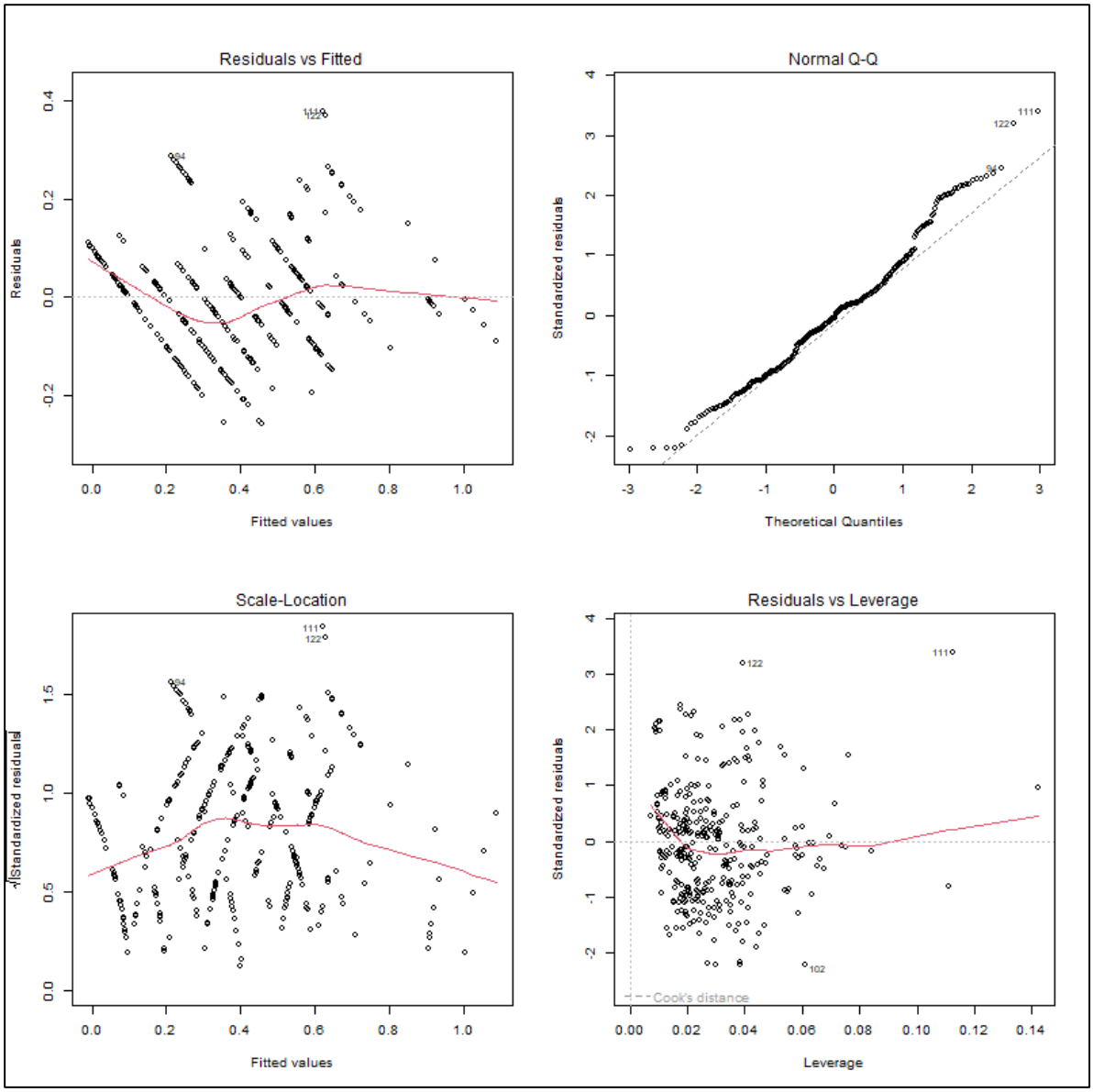

Figure 3: Model fit indices for regression analysis for accessing awareness of farmers about digital platforms for EAS

Table 3: Regression analysis explaining the awareness of farmers about digital platforms for EAS

Explanatory variables	Unstandardized coefficients		Standardized coefficients	t
	B	Std. Error	Beta	
(Constant)	-.238	.095	-	-2.509*
Age	-.002	.002	-.113	-0.919
Education	.001	.008	.006	0.149
Land holding	.052	.008	.249	6.456***
Farming experience	.005	.002	.267	2.276*
ICT ownership	.161	.075	.092	2.152*
Social media use behaviour	.313	.049	.373	6.388***
Social participation	.241	.084	.128	2.882**
Extension contacts	.247	.111	.118	2.215*
Extension participation	.129	.039	.162	3.279**

Note: ***Significant at p-value <0.001; ** p-value <0.01, *p-value <0.05

Table 4: ANOVA summary for predictors of farmers' awareness about digital platform for EAS

Model	SS	df	MS	R	R^2	Adjusted R^2	F
Regression	15.4	9	1.7				
Residual	4.7	340	.01	0.87[a]	0.76	0.75	122.9***
Total	20.2	349					

Note: ***Significant at p-value <0.001; df: degrees of freedom; SS: Sum of Squares; MS: Mean Square;
Predictors (a): (Constant), Extension participation, Land holding, Farming experience, ICT ownership, Education, Social participation, Extension contact, Social media use, Age

variables suggests that when controlling for other factors (*viz.* education, ICT ownership, or social media use), increased farming experience actually associates with higher awareness. This could be due to a suppressor effect, where the benefits of experience, *viz.* accumulated knowledge and access to resources, offset the initial reluctance to adopt new technologies.

Thus, the final regression model, which explains a significant proportion of the variation in awareness, can be expressed as follows:

Farmer's Awareness about Digital EAS = -0.238 - 0.002(Age) + 0.001(Education) + 0.052(Land holding) + 0.005(Farming experience) + 0.161(ICT ownership) + 0.313(Social media use behaviour) + 0.241(Social participation) + 0.247(Extension contact) + 0.129(Extension participation)

This equation suggests that while factors *viz.* land holding, ICT ownership, social media use behaviour, etc. significantly contribute to higher awareness levels, other variables *viz.* age and education did not show a significant impact in this context. Overall, the model provides valuable insights into the predictors of awareness, guiding further efforts to enhance digital platform adoption among farmers.

The outcomes of a multiple regression analysis aimed at identifying the factors affecting farmers' awareness of digital platforms for EAS Table 3. The model summary presented in Table 4 indicates that the model accounts for a substantial portion of the variance in awareness, with an R^2 value of 0.765, meaning that about 76.5 per cent of the variation in awareness is explained by the predictors in the model. The ANOVA table further validates the model's overall significance ($F = 122.905$, $p < 0.001$) as shown in Table 4, indicating that the predictors collectively play a significant role in explaining the variation in awareness.

CONCLUSION

The present study highlights the importance of various socio-economic factors in shaping farmers' awareness of digital platforms for EAS. Key determinants, *viz.* land holding, farming experience, ICT ownership, social

media use behaviour, and extension participation, emerged as significant predictors of awareness. While larger land holdings and greater social media engagement positively influence awareness, limited digital competency and access to ICT tools continue to be barriers, particularly for smaller and older farmers. Policymakers and extension workers should prioritize enhancing digital literacy and providing targeted training on ICT usage, particularly in regions with lower awareness levels. Initiatives *viz.* expanding access to digital platform-based advisory services, improving rural internet infrastructure, and promoting digital inclusion can help bridge the awareness gap. By focusing on these areas, stakeholders can ensure that digital platforms reach a wider farmer population, ultimately driving adoption and improving agricultural outcomes.

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Research Article

Health Hazards of Tribal Women in Agricultural Activities in Kandhamal District of Odisha

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ABSTRACT

The entry of women into the workforce as paid labour has been a gradual process extending over several centuries with a substantive increase following industrialization and World War -II. According to the Indian Fiscal commission, "Agriculture is not merely an occupation; it is a way of life which for centuries has shaped the thought and outlook of many millions of people." According to the International Labour Organization (ILO), the agricultural sector is one of the most hazardous to health worldwide. Agricultural work possesses several characteristics that are risky for health: exposure to the weather, close contact with animals and plants, extensive use of chemical and biological products, difficult working postures and lengthy hours, and use of hazardous agricultural tools and machinery. Most agricultural work is carried out in the open air and consequently agricultural workers are dependent on weather changes to perform their tasks. This factor not only undermines the efficiency of the operations, but also influences working conditions, making them difficult and dangerous (e.g. a rainstorm while harvesting, gusts of wind when pesticides are being applied, etc.). The existing research is highlighting the health hazards experienced by farm women in agricultural activities in Kandhamal District of Odisha. The significant findings reflected that most of the tribal women (55%) were affecting medium level of health hazards which leads to frustration, hearing loss, skin disorders, certain cancers, chemical toxicity, and heat-related illnesses; 24.2 per cent of tribal women were affected by high level of health hazards where, 20.8 per cent were affected by lower level of health hazards. Majority of tribal farm women suggested that medical facilities should be available at village level.

Keywords: Farm women, Health hazards, Agricultural activities

INTRODUCTION

Farm women are the key contributors of Indian agriculture. The farm women have now entered into the global economy, still encountered by occupational hazards and related adverse health outcomes in agriculture. Growing food has been an interminable saga of her life. Like other rural women, tribal farmwomen also play an important role in agriculture. The tribal societies in India are considered as the weakest sections of the population in terms of common socio-economic and demographic factors such as poverty, illiteracy, lack of developmental facilities and adequate primary health facilities (Thakur *et al.*, 1991; Basu, 1994). The tribal women are discriminated, though they make enormous contributions to the agriculture and allied sectors.

As agricultural work is carried out in the countryside, the workers are subjected to the health hazards of a rural environment as well as those inherent in the specific work processes involved. Most agricultural work is carried out in the open air and consequently agricultural workers are dependent on weather changes to perform their tasks. This factor not only undermines the efficiency of the operations, but also influences working conditions, making them difficult and dangerous. In its strict sense, a hazard is

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simply something which could potentially be harmful to a person's life or well-being. However, hazards are sometimes classified by the combination of the likelihood of the hazard turning into a health effect and by the seriousness of that effect. When we refer to hazards in relation to occupational safety and health the most commonly used definition is 'A hazard is a potential source of harm or adverse health effect on a person or persons'. The occupation of farmers including farm women in difficult areas is one of the pivotal points of consideration for navigating progress and prosperity among them at individual as well as in community levels (Misra *et al.*, 2016; Hidalgo *et al.,* 2010).

Perhaps more than any other occupational group, agricultural workers are exposed to a tremendous variety of environmental hazards that are potentially harmful to their health and well-being. Farmers and farm workers suffer from increased rates of respiratory diseases, noise induced hearing loss, skin disorders, certain cancers, chemical toxicity, and heat-related illnesses. It is estimated that 2 to 5 million people every year suffer acute poisonings and that 40,000 die. Millions of injuries are known to occur, with at least 170,000 of these being fatal for agricultural workers each year. Agricultural and plantation works were associated with a variety of occupational health hazards in the form of physical hazards due to extreme weather conditions, sunrays; chemical hazards like pesticides/ fertilizer hazards and different forms of biological and mechanical hazards. Most of agricultural workers were highly susceptible for suffering from numerous work-related health disorders. He observed that clinically well recognized group of occupationally acquired health problems were respiratory, dermatological, traumatic, poisoning and neoplastic nature. Prevalence of zoonotic disease and behavioural health problems were also found among them (Chaudhuri, 2000). The increasing use of machinery and of pesticides and other agrochemicals has aggravated the risks. In several countries, the fatal accident rate in agriculture is double the average for all other industries. Machinery such as tractors and harvesters cause the highest frequency and fatality rates of injury. Exposure to pesticides and other agrochemicals constitute major occupational hazards which may result in poisoning and death and, in certain cases, work-related cancer and reproductive impairments. Engberg (1993) and Van der Hoek & Konradsen (2005). Unsafe equipment and conditions, inadequate training, and limited availability and use of personal protective equipment all contribute. Health and injury burdens depend on the type of farming activity, the type of worker, and the geographic location. Research in India suggests that agricultural workers using powered machinery are most at risk from fatal accidents, but that injuries are actually more common in less mechanized villages, probably owing to lower adherence to safety standards. Basic hazards like sharp tools and snake bites can also cause debilitating wounds and fatalities. Different forms of animal husbandry expose workers to different zoonotic diseases. Besides farm activities farmwomen involve in domestic activities. These arise from the worker's failure to adapt to an alien psychosocial environment. Frustration, lack of work satisfaction, insecurity, poor human relationships and emotional tension are some of the psychosocial factors that may undermine both the physical and mental health of workers.

MATERIALS AND METHODS

The study was conducted purposively in Phiringia and Khajuripada block of Kandhamal district of Odisha. From each selected block, 4 villages namely Telapali, Porapada, Nabaguba and Arapaju were selected randomly. The study is based on both primary and secondary sources of data. The secondary data are collected from various sources highlighted the impact of health hazards on tribal women engaged in different agricultural activities. The primary data are collected by well-structured questionnaires to analyse the socio-economic status of the tribal households. The sample units are the women members of these households, preferably occupying a prominent position in the family which is purposely chosen to know about the different health hazards faced by rural women in agricultural activities. The primary among this was the massive communication barriers not only due to the unfriendly landscape but also the language gap. To overcome this gap the investigator stayed among them to build an informal rapport after which they could be made to reciprocate to the queries by overcoming their nonbeliever attitude towards support members. The information is collected as is delivered by them with all their raw expression of the awful status in many

cases. The analysis was done using a scale which consists of 15 items based on the three-point rating scale by indicating most often (3), sometimes (2) & never (1). The statistical tests and procedures were used for analysing the data, included percentage, mean, Karl Pearson's coefficient of correlation and multiple regressions.

RESULTS AND DISCUSSION

Based on their socio-economic profile, the tribal farm women are distributed as shown in the above table. About 44.2 per cent of respondents, mostly from the middle and older age groups, were illiterate, according to the table. In contrast, 21.7 per cent of respondents had completed primary school, followed by upper primary school (13.3%), higher secondary school (10%), secondary school (9.2%), and higher education or graduation (1.7%). Based on the tables, it can be inferred that approximately 90 per cent of the participants are married and manage their family and agricultural responsibilities concurrently, leading to work-related health hazards. The majority of responders work mostly in agriculture, with dairy and poultry coming in second. The majority of respondents come from medium sized families, which can have up to four or six members. These families also use farm tools and equipment at a medium level and do not own appropriate or women-friendly agricultural tools. A tiny percentage of tribal women did, however, use

Table 1: Socio-economic Profile of tribal women engaged in agricultural activities (N=120)

Category	Frequency	Percentage
Age		
Young (<30 year)	14	11.7
Middle (30-50 year)	82	68.3
Old (>50 year)	24	20.0
Education		
Illiterate	53	44.2
Primary Education	26	21.7
Upper Primary	16	13.3
Secondary Education	11	9.2
Higher Secondary	12	10.0
Graduation & above	2	1.7
Marital Status		
Married	108	90.0
Unmarried	9	7.5
Widow	3	2.5
Occupation		
Agriculture	81	67.5
Dairy	19	15.8
Poultry	12	10.0
Piggery	8	6.7
Sericulture	0	0.0
Family Size		
Small (< 4 Members)	12	10.0
Medium (4 to 6 Members)	97	80.8
Large (> 6 Members)	11	9.2
Farm Power		
Low (10.44)	14	11.7
Medium (10.44 – 18.00)	93	77.5
High (18.00)	13	10.8
Cosmopoliteness		
Low (8.65)	14	11.7
Medium (8.65 – 11.15)	96	80.0
High (11.15)	10	8.3
Extension Contact		
Low (6.74)	0	0.0
Medium (6.74 – 7.90)	88	73.3
High (7.90)	32	26.7
Extension Participation		
Low (6.46)	25	20.8
Medium (6.46 – 8.02)	95	79.2
High (8.02)	0	0.0
Training Received		
Low (0.80)	0	0.0
Medium (0.80 – 1.36)	110	91.7
High (1.36)	10	8.3
Mass Media Exposure		
Low (5.81)	0	00.0
Medium (5.81 – 6.99)	77	64.2
High (6.99)	43	35.8
Organizational Participation		
Low (6.31)	21	17.5
Medium (6.31 – 8.82)	74	61.7
High (8.82)	25	20.8

Table 1 contd....

farm power at a greater degree. The results shown in the table indicate that the majority of tribal women, or 80 per cent of them, fell into the medium category of cosmopoliteness, which is primarily used for bazaars and visiting relatives in another community.

A perusal of the data presented in table revealed that 73.3 per cent respondents showed interest in medium level of extension contact which may cause of occasional visits by extension staff to the villages for the help of rural people. However, their participation in extension activities was found to be zero because of the respondents' lack of interest and poor time management. It is drawn from the above table that majority of the respondents i.e. 91.7 per cent had medium level of trainings where 8.3 per cent of the tribal women received high level of training. The probable reason might be that the members have to acclimatize with the rules and regulations of the group as most of them from SHGs group. As far as the utilization of the mass media by the respondents is concerned it could be seen that only 64.2 per cent were belonged to medium category of mass media exposure group followed by 35.8 per cent respondents were use mass media on regular basis which is from radio and television. The involvement of the respondents in organization was found more in occasionally basis which is 61.7 per cent followed by 20.8 per cent on regular basis and 17.5 per cent in lower number of participation.

A health hazard is a warning against what could potentially adversely affect one's health. The information pertaining to the health hazards of rural women engaged in agricultural activities were analyzed and presented in Table 2.

Table 2: Health hazards of tribal women engaged in agricultural activities (N=120)

Category	Frequency	Percentage
Low (22.19)	25	20.8
Medium (22.19 – 24.83)	66	55.0
High (24.83)	29	24.2

Mean = 23.57; S. D. = 1.32

The table 2 shows the distribution of tribal women according to their health hazards on the basis of mean and standard deviation. It is withdrawal from the above table that most of the tribal women were affecting medium level of health hazards i.e., 55 per cent tribal women. Arya and Pandey (2001) reported that in transplanting and weeding operation, women have to work in standing water which may cause many diseases related to skin and water. 24.2 per cent of tribal women were affecting high level of health hazards where 20.8 per cent of tribal women were affected by lower level of health hazards. Similar findings were also reported by Cordes and Foster (1988) and Aktar *et al.* (2009).

To determine the relationship between Health Hazards of respondents with independent variables were analysed statistically, correlation coefficient was computed and the findings were furnished as under:

From the above table it was found that, of all the independent variables taken into consideration, four variables viz. family size, farm tools and equipment, training received and mass media exposure showed negative and significant relationship at 1% level of probability. Age, education, marital status, occupation, cosmopoliteness, extension contact, extension participation and organizational participation did not establish any significant relationship with the health hazards faced by respondents. Hence, the null hypothesis was accepted concerning the characteristics and concluded that these characteristics were not correlated with health hazards.

To know the important varieties with their prediction ability in explaining the dependent variable

Table 3: Correlation Analysis between Independent Variables and Health Hazards (N=120)

Variables	Correlation (r-value)	Significant value
Age	0.052	0.569
Education	-0.154	0.094
Marital Status	-0.026	0.780
Occupation	-0.028	0.762
Family size	-0.798**	0.000
Farm Tools and Equipment	-0.859**	0.000
Cosmopoliteness	-0.035	0.703
Extension System Link	0.035	0.707
Extension Participation	-0.096	0.297
Trainings Received	-0.574**	0.000
Mass Media Exposure	-0.710**	0.000
Organizational Participation	0.012	0.894

**Correlation is significant at the 0.01 level
*Correlation is significant at the 0.05 level

Table 4: Regression Analysis between Independent Variables and Health Hazards of tribal women (N=120)

Variables	Beta Value	t-value	Significant value
Age	-0.016	-0.303	0.762
Education	0.002	0.040	0.968
Marital Status	-0.051	-1.008	0.316
Occupation	-0.007	-0.128	0.899
Family size	-0.158	-1.478	0.142
Farm Tools and Equipment	-0.613	-4.989	0.000
Cosmopoliteness	0.041	0.803	0.424
Extension System Link	0.033	0.666	0.507
Extension Participation	0.005	0.098	0.922
Trainings Received	-0.043	-0.660	0.510
Mass Media Exposure	-0.118	-1.518	0.132
Organizational Participation	-0.007	-0.139	0.890

$R^2 = 0.760$; F= 28.237

of respondents, multiple regression analysis was carried. The regression coefficient (b) values 't' values and significant values are presented.

The results presented in Table 4 indicated that the traits had 76.00 per cent of the variation in the health hazards of respondents was the result of the influence of all 12 variables put together. This variation was observed to be statistically significant as the computed 'F' value (28.237) was significant. Therefore, the null hypothesis was rejected by accepting the empirical hypothesis and concluded that all the 12 independent variables put together have influenced significant variation in health hazards to the extent of 76.00%.

CONCLUSION

Farming is also associated with exposure to a wide range of hazards, all of which can have undesirable consequences, such as infections by pathogens, injuries from exposure, poisonings, physiological disorders, respiratory tract infections, and musculoskeletal disorders. According to the Centres for Disease Control and Prevention (CDC, 2013), agriculture ranks among the top three most hazardous occupational groups in terms of fatalities, injuries, and work related illnesses. The health status of tribes particularly that more vulnerable among the vulnerable i.e. women, children and elderly population need special care and treatment. The very state of unawareness about the means and methods of the modern health care system makes them further weak and susceptible to change. Therefore it is suggested to improve health literacy among the tribes. It is felt that tribal health needs a policy level intervention at the states and the national level.

An intriguing aspect of the tribal community's way of life is their health, which also serves as a window into their daily routine. Tribes are much more inaccessible since they live in hills or densely forested areas. Furthermore, it is impossible to even obtain health care services. The explanation above makes it evident that the majority of research was done to determine the underlying causes of various diseases as well as their prevalence among tribal people living in various sections of the nation, both communicable and non-communicable. Tribes' health conditions, in especially those of the most vulnerable - women, children, and the elderly-require special attention and care. They become even more vulnerable to change when they are ignorant of the tools and procedures of the contemporary healthcare system. Thus, it is recommended that the tribes' level of health literacy be raised. It is believed that state and federal governmental intervention in the area of indigenous health is necessary. The above discussion enlightens that the respondents are experiencing tremendous difficulties during their work in field, and which are still neglected and ignored. The existing scenario can be improved to some extent by applying appropriate ergonomic approaches for the users for their well-being and sustainability concerning their comfort ability and improving efficiency.

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Research Article

A Study on Perceived Constraints Among FPO Members of Odisha

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ABSTRACT

The concept of FPOs is that the farmers producers of agricultural products can form groups and register themselves under Companies Act, 2013. The aggregation of small and marginal farmers as FPOs has helped increase market linkages to improve farmers' economic strength. This study was conducted in Puri district of Odisha during the period 2020-21. Data were collected from a total of 50 respondents through well-structured interview schedule from the respondents of eight FPOs from 2 blocks i.e., Nimapara and Brahmagiri. The study focused on state-wise progress of FPO promotion as on 31.05.2022 from the current data published by SFAC, bottlenecks perceived by the members of FPO and suggestions to overcome the challenges. The data were analysed through Garrett ranking technique and the challenges were ranked under socio - political, organizational, economic and other constraints. The constraint, lack of co-ordination between members of FPO for different group activities (97.65) was ranked "first" and non – availability of timely credits ranked last with an average mean score of (40.53) by the respondents.

Keywords: Bottleneck, Farmer producer organizations, Garrett ranking technique, Rank

INTRODUCTION

Agriculture is the primary occupation of people of India. 54.6 per cent of total population of India is engaged in agriculture and allied sector activities (Census, 2011) and accounts for 17.8 per cent of the country's Gross Value Added (GVA) for the year 2019-20. Indian agriculture depends predominantly on the small and marginal farmers who possess large number of small holdings. Small and marginal farmers (Below two hectares) constitute 86.2 per cent of the total land holdings and 47.3 per cent of the land under cultivate (Agriculture Census, 2015-16). It adds significantly to the country's economy. Improvement in the status of the farmers of India is possible through commercialization and diversification of their agricultural activities which can be achieved by introducing sustainable agricultural practices, implementation of agricultural policy reforms, bringing institutional change, optimizing input efficiency, developing human resources and through participation of the NGOs in agriculture. Increase in cost of cultivation due to scattered and fragmented land holding restricts the access of marginal/small farmers to the public resources, modern technology, credit facility and also control over the markets. For them agriculture has gradually become unviable. There is a need to improve support services for small and marginal farmers by creating link between producers and buyers of agricultural produce. Currently this type of linkages are either very weak or do not exist (Kathiravan *et al.,* 2017). In this situation we can mobilize producers in groups and create their associations called as Farmer Producer Organization (FPOs) whose purpose is to empower farmers; especially small and marginal ones across various states so as to enhance technology adoption, improve adoption of innovative agricultural practices, improve productivity, develop direct

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marketing capacity , enable enhanced access to inputs and credit, and thereby enhance farmer incomes, simultaneously augmenting their sustainable livelihoods (SFAC, 2019). Farmer organizations allows small and marginal farmers to take part in the market more strongly and unitedly, farmers are in a better position to obtain necessary market information, lessen the transaction costs of accessing inputs and outputs, tap into high value markets, securing access to new technologies and to permit them to compete with large farmers and agribusinesses (Sunil *et al.,* 2021). This concept of FPOs is a new dimension to the farmer centric approach. "These farmer producer organisations are considered as the promising tool to help the small and marginal farmers to empower themselves". The study is therefore proposed to know the current scenario of the FPOs in India, to identify the challenges perceived by the members of FPOs for the betterment of the livelihood of farmers by collecting data and information from the existing FPOs members.

The concept of producer companies came into existence in 2002 in India by the Government of India. Its main aim was to set up the farmer producer organisations in order to bring the transformations in the in agro-food industries of the country. These Farmer Producer Companies are created in such a manner that they are effectively managed and are capable to handle supply chain of agricultural produces (SFAC, 2019). A decade after the concept came into existence the first producer company was officially registered in India (Trebbin, 2014). Farmer producer organisation (FPO) is nothing but a group of primary producers of any commodity and also is a legal entity formed by producers (NABARD, 2019). FPOs are getting financial support both from state and central government and their agencies. However, these are receiving major support from small farmers agribusiness consortium (SFAC), NABARD and national rural livelihood missions (NRLM) and also receiving technical support from promoting NGOs and Resource Institutions (CIKS and FWWB, 2017).

About 70 to 80 per cent FPOs membership hold by small/marginal farmers. At present more than 5000 (both FPOs and FPCs) are working in the country (National Paper - PLP, 2021-22). They are all formed under the various programmes and initiatives of Government of India (including SFAC), State Governments, and NABARD. In India so far 901 FPOs have already been registered and 9 are processing to get registered (SFAC, 2022). When it comes to number of registered farmers it is highest in Madhya Pradesh with 149 numbers of FPO followed by Karnataka with 126 numbers of FPOs and it is found that the number of mobilised farmers in Madhya Pradesh and Karnataka are 139252 and 128827 respectively. In Odisha there are 41 numbers of registered farmers with 38605 numbers of mobilised farmers. But not showing any active results from North-East of India SFAC (Annual report: 2019).

MATERIALS AND METHODS

This study was conducted at Puri district of Odisha in order to point out the importance of FPOs in changing the livelihood of farmers in a positive way. Two blocks of Puri district i.e., Nimapada and Brahmagiri were selected purposively because of highest number of FPOs amongst all the blocks in that district. There were four number of FPOS (Dhanua Producer Company Ltd., Nimapara FPCL, Vegi Coasta Producer Company Ltd., Nabachintan Producer Company Limited) present under Nimapada block and four number of FPOs present under Brahmagiri (Allarnath Farmer Producer Ltd., Bababhimeswar Farmers Producers Company Ltd., Baliharchandi Farmers Producers Company Ltd., Hengula Farmers Producer Company Limited) block. A sample of 50 respondent farmers were selected randomly from among eight FPOs. Interview method was taken as a correct tool for collecting data. An interview schedule taking into account all the variables keeping the objective in the eye was developed and data were collected through personal interview from the selected members. The data collected were tabulated, ranked and analysed by Garrett ranking technique and findings interpreted.

Constraints are the factors or hinderance that restrict an object from achieving its probable outcome with reference to the objectives. So, it is essential to identify and prioritise them that hinder the performance of respondents. In the present study constraints hindering farmer producer organizations were studied and analysed. Primary information was taken from respondents during exploratory study and some major constraints were identified and thereafter with the help of experts and review of literature the list of constraints were given a final shape. Garrett's technique

Table 1: State Wise Progress of FPO Promotion as on 31.05.2022

S.No	State/UTs	Number of Farmers			Number of FPOs		
		Mobilized	Under Mobilization	Total Targeted Farmer	Registered	Under the process of registration	Total
1.	Andhra Pradesh	15499	0	15300	16	0	16
2.	Arunachal Pradesh	4750	0	4750	6	0	6
3.	Assam	12331	0	10500	18	0	18
4.	Bihar	36958	0	35600	38	0	38
5.	Chhattisgarh	29436	0	29000	26	2	28
6.	Delhi	3535	0	3500	4	0	4
7.	Goa	1810	0	1750	2	0	2
8.	Gujarat	25462	0	24000	25	0	25
9.	Haryana	14081	0	12750	23	0	23
10.	Himachal Pradesh	7213	0	7150	8	0	8
11.	Jammu & Kashmir						
	Jammu (Division)	5854	0	5481	1	0	1
	Srinagar (Division)	4090	0	4080	1	0	1
12.	Jharkhand	12009	0	12000	10	0	10
13.	Karnataka	128827	0	128500	126	0	126
14.	Madhya Pradesh	139252	10748	150000	149	0	149
15.	Maharashtra	106012	0	104500	105	0	105
16.	Manipur	6450	500	6950	8	0	8
17.	Meghalaya	2990	760	3750	3	1	4
18.	Mizoram	1700	1000	2700	1	1	2
19.	Nagaland	3450	300	3750	4	0	4
20.	Odisha	38605	295	38900	41	0	41
21.	Punjab	6288	0	6000	7	0	7
22.	Rajasthan	60303	197	60500	50	0	50
23.	Sikkim	18537	0	15750	30	0	30
24.	Tamil Nadu	15168	1832	17000	13	4	17
25.	Telangana	300048	0	29998	26	0	26
26.	Tripura	4705	1045	5750	7	0	7
27.	Uttarakhand	6004	0	6000	7	0	7
28.	Uttar Pradesh	57370	0	56000	57	1	58
29.	West Bengal	93784	0	90500	89	0	89
	Total	892521	16677	892409	901	9	910

was used to choose and rank the constraints. The ranking technique provides way to convert the barriers into numerical scores. The major advantage of this technique over normal frequency distribution is the bottlenecks are prioritised based on their importance on the basis of the mindset of respondents. Similar responses on more than two constraints may have been awarded different ranks. Garrett's formula for converting ranks into per cent is given by the following equation.

$$\text{Percent position} = \frac{R_{ij} - 0.5}{N_j} \times 100$$

where, R_{ij} = Rank given for the i^{th} item by the j^{th} respondent.

N_j = Number of items ranked by the j^{th} respondent.

Per cent positions of every rank was changed into numerical scores indicating to table given by Garrett and Woodworth (1969). For every constraint, scores of each respondent were summated and divided by total number of respondents. After that, average scores of all factors were ranked in descending order, ranks were given and most hindering constraints were identified.

RESULTS AND DISCUSSION

Barriers encountered by respondents were assembled under four important criteria viz., socio- political, organizational, economic and miscellaneous constraints. Respondents were asked to mark the challenges faced by them under a five-point scale continuum ranging from "Not at all important", "slightly important", ''important'', ''fairly important'' to ''very much important" with a score of 1, 2, 3, 4 and 5 respectively.

Constraints perceived by the respondents were analysed by Garrett technique, which varied from "very much important" to "Not at all important" constraint. Based on numerical value, the constraints faced by the FPO members were ranked and presented in table 2.

Table 2 showed the details of per cent positions, table value, average mean score and rank given by the members of FPO. It is clear from the findings that, lack of co-ordination between the members for different group activities ranked "first" with an average mean score of 97.65 followed by ineffective linkage (95.87), Inadequate training to members of FPO (87.98), Inadequate knowledge about emerging techniques (84.76), inefficient monitoring (79.54), Inadequate financial guidance and assistance (76.53), Unavailability of personalized advisory services (65.83),predominance of part time farmers (64.32), labour dispute (59.21), labour demand at peak section

Table 2: Identification of bottlenecks perceived by members of FPO of Puri district of Odisha

S.No.	Constraints	Percent Positions	Table Value	Average Score	Rank
A.	***Socio-political constraints***				
1	Political affiliation of member	96.42	15	52.78	XIV
2	Sub – group formed execution	63.88	43	56.89	XII
B.	***Organizational constraints***				
3	Lack of co-ordination for different group activities	2.77	86	97.65	I
4	Inefficient monitoring	25	63	79.54	V
5	Ineffective linkage	8.33	77	95.87	II
6	Predominance of part time farmers	41.66	54	64.32	VIII
7	Non – availability of literature on FPO activities	91.6	23	44.05	XVII
8	Non – inclusion of local leaders in FPO	86.11	28	46.47	XVI
9	Inadequate training to members of FPO	13.88	71	87.98	III
C.	***Economic constraints***				
10	In adequate profit to individual members	69.44	40	53.54	XIII
11	Low price for produces	80.55	33	47.78	XV
12	Non – availability of timely credits	97.22	13	40.53	XVIII
13	Non availability of collateral security for getting loans	58.33	46	56.98	XI
14	Inadequate financial guidance and assistance	30.55	60	76.53	VI
D.	***Other constraints***				
15	Labour demand at peak section	52.77	49	57.43	X
16	Labour dispute	47.22	51	59.21	IX
17	Unavailability of personalized advisory services	36.11	57	65.83	VII
18	Inadequate knowledge about emerging techniques	19.44	67	84.76	IV

(57.43), Sub–group formed execution (56.89), In adequate profit to individual members (53.54), political affiliation of member (52.78), low price for produces (47.78), non – inclusion of local leaders in FPO (46.47), Non – availability of literature on FPO activities (44.05), non – availability of timely credits (40.53).

The study showed that, the lack of coordination between the members of FPO for different group activities was ranked as "first as an important constraint than the other constraints. The reason might be less communication and interaction and a smaller number of group meetings between the existing sub-groups under each farmer producer organization of Nimapara and Brahmagiri blocks of Puri district. Majority of the respondents were marginal to small land holding farmers and mainly involved in agriculture and allied activities like with ruminants and poultry farming activities. The most important drawbacks perceived by the respondents were lack of co-ordination between members of FPO for different group activities, ineffective linkage between members and group activities, inefficient monitoring by the local leaders of the group which were revealed under organizational constraints. Under economic constraints, inadequate financial guidance and assistance comes at first as because majority of the farmers were uneducated so they were unable to seek and get the necessary and important financial guidance and assistance. But the success of these farmer producer organizations is very much dependent upon the motivation, unity and commitment of the members. The integrity, planned hard work, correct strategy and guidance and quality leadership as well as suitable market environment are the most important factors for the successful growth of such organizations.

a) Capacity building and training of members of FPO promoting organisations is necessary. This can be achieved by mobilising farmers through influencing and motivating potential FPO members, creating a viable common business plan, etc. Such plans need to be market oriented integrating input as well as output business, with proper selection on crops/commodities and revenue-generation.

b) Capacity building and training of leaders of FPOs, as well as their manager is very essential. Institutions may introduce certificate / diploma courses to train leaders and managers. Such courses need to be institutionalised and developed by concerned institution viz. agricultural universities, entrepreneurship development institutions, NIAM, MANAGE, VAMNICOM etc.

c) The number of farmer members may be increased/decreased depending upon the interest of the FPOs, on the basis of commodity categories, geographical location, etc.

d) FPOs need to be provided with seed, pesticide, fertilizer sales license, insecticide, as well as APMC license and dealerships on priority basis.

e) Improvement of infrastructure and technical facilities of FPOs such as pack house, warehouse, sorting and grading, packaging, material handling, transportation and machines, etc.

Majority of the farmers live in rural areas where many of these farmer producer organisations are found. These organisations are suffering from inadequate and inefficient professionals and lack effective management practices to run the business proficiently and strong motivating leaders to run the organisation in proper way. To mitigate this bottleneck, it's the time for policy makers to look beyond the concept of farmer. By involving and taking proper guidance and advice from the well-educated people from the same locality or else qualified children of the members instead of looking for someone outside the locality will definitely enhance the effectiveness and efficiency of the organisation to run smoothly. By providing better training, capacity building, providing accurate and timely data and suggestions and effective monitoring by the external agencies will definitely help the organisation to last for longer time. And also, it will be a pleasure and matter of pride to the members of the organisation to see their own children working in the office. To fulfil credit needs of the FPOs, Govt. of India initiated multiple schemes to provide credit guarantee support to FPCs (Farmer producer companies) for facilitating collateral free lending. So, both state and central Government should come up with plans like providing the start-up capital subjected to repayment of the same amount. Meanwhile by giving some subsidies in case if farmer producer organisation started running successfully. Because Govt.

need to help them until they start helping themselves. Research has to be conducted in order to know the reality of the actual situation. To mitigate the problem of lack of accessible market facility Government has to strengthen the supply chain facility with a good transportation facility. Organisations need to provide the facility and support to the interested members of FPOs to set up their own store for the marketing of fresh farm produces by performing he basic required value addition in order to avoid loss and also to attract the buyers increasing the demand of the farm produce. It also helps the organisation to exploit the growing market as the demand for quality product rises ultimately increasing the level of profit of the farmers. e-Marketing and quality certifying forums should be strengthened with proper rules and regulations with strong laws to assure traders about quality of the produce which will ultimately benefit the consumers. All can't be done by Government alone. It should encourage the public-private partnership (PPP) to invest in infrastructure like cold-storages, processing units in supply chain management etc. Even for the skill development training of the organisation members. For policy makers it's actually time to upgrade and change the system. private people need to train the members of FPO and insider to evaluate the results. Research needs to be conducted to analyse the effectiveness and implementation of the outputs of training conducted in an organisation. With these solutions we can look forward to build a strong, fruitful Farmers producers' organization.

CONCLUSION

In today's scenario, farming seems like a difficult task to do for living and most of the farmers especially youth are not interested in taking agriculture as primary occupation and are shifting towards other sources of income generation. By taking this as a serious issue, Government and policymakers are trying hard to address the problem with the number of schemes, programmes and other innovative initiatives for agriculture development and the socio-economic welfare and all-round development of the farmers. One such initiative which is trying to address farmer's problems by bringing them all together to a new generation collective forum i.e. Farmer Producer Company (FPC). Although farmer producer company model is an effective pathway for overall s development of farmers but still many of the farmers are not aware of the aims, objectives, purpose of FPCs, their benefits, and functional activities. The purpose of the present study is to analyse the details of state-wise data of registered, under the process of registration FPOs, mobilised and non-mobilised farmers, challenges faced by the FPOs of puri district of Odisha and suggesting some measures to overcome the problems. The study found that the FPCs help in maximizing benefits of members by helping in capacity building of its members through training, provide better accessibility to agricultural inputs, market and services, enhance knowledge about effective agricultural practices through group meeting and proper guidance and suggestion from local leaders, help in reducing transport cost of members and enhance the bargaining power of the member farmers for more profit making were the major perceived effect of FPCs. Perception of the farmers largely affects the joining of Farmer Producer Company's by the farmers, performance of FPCs, sustainability, effectiveness and viability of the FPCs. Appropriate strategies should be formulated according to the perception level of farmers that would satisfy the farmers and enhance the interest and need of farmers towards farmer producer companies. The other motivating and influencing factors also need to be identified and addressed to facilitate the high performance of FPCs.

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Research Article

Students' Preferences for Online Education During COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic has become a focus on reforming teaching, learning models and strategies. Most educational institutes have shifted to online learning platforms to keep the academic activities going. However, the questions about the preparedness, designing and effectiveness of e-learning is still not clearly understood, particularly for a developing country like India. The present study was conducted in CCS HAU Hisar, Haryana on a sample of 200 students selected purposively. The study explored the student's preferences for various attributes of online classes. The results indicated that majority of the respondents opted for online classes through WhatsApp as a communication means to class updates. Most of the students preferred to use both smart phone and laptop for attending online classes. It was also noticed that students preferred live recorded classes (44.5%) with quiz (70.0%) at the end of each class to improve the effectiveness of learning. However, in agricultural education system where many courses are practical oriented, shifting completely to online mode may not be possible and need to devise a hybrid mode, the insights from this article can be helpful in designing the curriculum for the new normal.

Keywords: COVID-19, Online education, Pandemic and preferences

INTRODUCTION

COVID-19 is the severe pandemic of the twenty first-century which took the entire world by surprise. On December 31st, the World Health Organization reported a cluster of instances of novel corona virus (COVID-19) in Wuhan city, China (Cruickshank and Shaban, 2020). Due to high contagiousness, the virus spread in the world rapidly and became a global health challenge in no time. On March 11th, 2020 COVID-19 was proclaimed as a pandemic by the WHO (Cucinotta and Vanelli, 2020).

Flipped classroom is one of the blended learning approaches where students can learn through pre-recorded lectures and during the class time students discuss with teacher about actual implementation, project work, workshops interactively that leads to active learning (Thanthawi Ishak *et al.*, 2020). As per ongoing research it is found that there is need to understand the students' preferences and attitude towards e-learning technologies for getting required outcome from the online education system. It is observed that most of the online education system fails due to lack of understanding or analysis of students' technical resources availability, comfortless and flexibility. To bridge this research gap, preference-based e-learning system helps to make positive change in education system and that leads to students as well as teachers' satisfaction in revolutionized teaching learning process (Desai *et al.*, 2021). In this context this study was undertaken to explore the preferences of the students for various attributes of online classes

MATERIALS AND METHODS

The present study was conducted in Chaudhary Charan Singh Haryana Agricultural University in Hisar district of Haryana state. The target population of the study comprised students (UG & PG) studying in different

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colleges that had shifted to online teaching and learning modalities during COVID-19 pandemic.

A total sample of 200 students comprising of 100 undergraduate and 100 post graduate students was drawn. For undergraduate students a proptionate sample of 100 students was drawn from three colleges namely College of Agriculture, I.C College of Home Science and College of Agricultural Engineering & Technology as College of Basic Sciences & Humanities was only for post graduate students. However, for post graduate students, a total sample of 100 students was drawn at random comprising of 25 students from each college. A self-constructed questionnaire-based survey method was used to achieve objectives of the research problem. All the data was entered and analysed through the Statistical Package of Social Science (SPSS version 20). The descriptive statistics analysis of data was performed to determine the mean, standard deviation, frequency, and percentage.

RESULTS AND DISCUSSION

Technical requirement for online classes preferred by the students elucidated that various device preferred by the students for attending online classes were Smartphone (34.0%), laptop (19.0%), both laptop and smartphones (43.5%) and desktop (3.5%) which clearly suggests that if any organization which wants to develop an application for the online learning, it has to ensure that the platform is compatible with smartphone and laptop. Supported by the study of Desai *et al.* (2021). Their survey revealed that among 458 students, (283) 62% students using smart phone, (109) 24% using laptops and (42) 9% students using Desktop PC, (14) 3% using tablet PC. Majority of the students (61.0%) preferred WhatsApp as the best way to communicate class updates followed by posting in university website (6.0%), text messages (3.5%), email (11.5%) and google classroom (18.0%). Supported by Mishra *et al.* (2020).

Mobile data pack was the major source of internet for 72 per cent of the students followed by (5.5%) LAN and (22.5%) wi-fi. According to Muthuprasad *et al.* (2021) mobile data pack was the source of internet for 82 per cent of the respondents.

The structure of online classes refers to online class format, nature of course material and nature of video content. The data in Table 2 revealed that live classes that can be recorded was the most preferred class format by students (44.5%) since it gives them a flexibility in learning. whereas (25.5%) preferred recorded classes that can be uploaded at the university

Table 1: Technical requirement for online classes preferred by the students (n=200)

Particulars	F (%)
Communication means to class updates	
Posting in university website	12 (6.0%)
Text messages	7 (3.5%)
e-mail	23 (11.5%)
WhatsApp	122 (61.0%)
Google classroom	36 (18.0%)
Preferred device for online courses	
Both smartphones and laptop	87 (43.5%)
Smartphones	68 (34.0%)
Laptop	38 (19.0%)
Desktop	7 (3.5%)
Sources of internet	
LAN	11 (5.5%)
Mobile data pack	144 (72.0%)
Wi-Fi	45 (22.5%)

Table 2: Structure of online classes preferred by students (n=200)

Particulars	F (%)
Online class format	
Live online class	52 (26.0%)
Live classes that can be recorded	89 (44.5%)
Recorded classes that are uploaded at university website/you-tube etc.	32 (16.0%)
Sending reading material	27 (13.5%)
Nature of course material	
Reading material is sufficient	41 (20.0%)
Video content supplemented with reading material	148 (74.0%)
Video content is sufficient	11 (5.5%)
Nature of video content	
Power point presentation	71 (35.5%)
Course instructor should teach using whiteboard	43 (21.5%)
Lecture only	31 (15.5%)
As per the convenience and requirement	55 (27.5%)

website/YouTube/any other application, 33.0 per cent opined in favour of live classes and 11.5 per cent preferred only reading materials as shown in Table 2. The findings had been supported by Muthuprasad *et al.* (2021).

Regarding the nature of course materials, majority of the students (74.0%) preferred video content supplemented with reading materials, followed by only reading material is sufficient (20.0%) and Video content is sufficient (5.5%) Regarding the nature of video content majority of the students (71.0 %) preferred Power point presentation, (58.0%) Course instructor should teach using whiteboard and (22.5%) preferred Lecture only.

In Table 3 Around 42.5 per cent of the students wanted online classes as per the schedule to complete the syllabus. Followed by 21.5 per cent wanted daily online classes, 10.0 per cent prefers weekly online classes, 11.0 per cent wanted online classes should be taken twice a week and 15.0 per cent wanted alternate days of online classes should be taken. Surprisingly 51.5 per cent of the students preferring 45 min duration for each class whereas (35.5%) wanted 30 mins and (12.0%) one hour of duration for online classes. Around 66.5 per cent of the respondents desired to spend only 2 to 4 h in a day for online class followed by (26.0%) 4-6 hours and (7.5%) more than 6 hours. Slightly less than half (44.5%) wanted 15 min break followed by (18.5%) 10 min break, (29.5%) 20 min and (7.5%) more than 20 min break between two consecutive classes. Thus, from this it can be concluded that classes should be taken as per the schedule until the syllabus had not completed. The online classes should be of 45 mins and at least 15 mins of break must be given between two consecutive classes. It was supported by Thompson's (2014) formula of work for 52 min and break for 17.

Table 3: Preference of students for frequency and duration of online classes (n=200)

Particulars	F (%)
How often do you expect the course instructor to conduct the classes?	
As per the schedule to complete the syllabus	85 (42.5%)
Daily	43 (21.5%)
Weekly	20 (10.0%)
Twice a week	22 (11.0%)
Alternate days	30 (15.0%)
Suitable duration for online classes	
30 min	71 (35.5%)
45 min	103 (51.5%)
1 h	26 (13.0%)
Time spends in a day for online classes	
2-4 h	133 (66.5%)
4-6 h	52 (26.0%)
More than 6 h	15 (7.5%)
Break between the two classes	
10 min	37 (18.5%)
15 min	89 (44.5%)
20 min	59 (29.5%)
More than 20 mins	15 (7.5%)

Various methods preferred for clarifying the queries were a platform with option for posting queries (24.0%), through live chat (41.5%) which is also most preferred by the students because they can ask their queries on the spot when the online class will be going on and get an immediate response from the instructor, students also preferred email to the course instructor (20.5%) and WhatsApp (14.0%). Interestingly, 43.0 per cent of the respondents expect the instructor to clarify their doubts within a class whereas, 32.5 per cent within a day, 20.5 per cent in next class and 4.0 per cent within a week as shown in Table 4.

Examinations form an integral part of any learning activity and proper assessment of acquired knowledge

Table 4: Preference of students for addressing the queries (n=200)

Particulars	F (%)
Way for clarifying queries by instructor	
Live chat	83 (41.5%)
e-mail to the course instructor	41 (20.5%)
Platform for posting queries	48 (24.0%)
WhatsApp	28 (14.0%)
Expected time for clarifying queries by instructor	
Within class	86 (43.0%)
Within a day	65 (32.5%)
In next class	41 (20.5%)
Within a week	8 (4.0%)

reflects the student's ability to learn and also give feedback to teachers who in turn modify the pattern of evaluation. The nature of assessment is known to influence the learning behaviour and attitude of students (Anand *et al.,* 1998). Table 5 shows that majority of the students (70.0%) preferred quiz at the end of every class because it helps in learning and long-term memory, leading to better performances in examinations and also boost the confidence of the students thus quiz at the end of the class is important for effective learning on the other side 29.5 per cent said assignments should be assigned at the end of the class. The findings is in line with Muthuprasad *et al.* (2021). Around 48.5 per cent of the total students felt that at least one-week time should be given for submitting their assignments followed by (2.5%) 1 day, (38.5%) 2-3 days and (10.5%) before the next class scheduled.

Table 5: Preference of students for Plans and criteria for evaluation (n=200)

Particulars	F (%)
Quiz of 5-10 min after class	
Yes	140 (70.0%)
No	60 (30.0%)
Assignment at the end of the class	
Yes	79 (39.5%)
No	121 (60.5%)
Deadline for submitting assignments	
1 day	5 (2.5%)
2-3 days	77 (38.5%)
1 week	97 (48.5%)
Before the next class scheduled	21 (10.5%)

Table 6 refers preferred pattern of exam and surprisingly, 52.0 per cent of the students wished to attend live exam via zoom/skype/MS team/ google meet etc. and (30.0%) of students wanted written home exam whereas, (13.5%) said that exams should be taken by video recording and (4.5%) felt that podcast can be the best way for giving exams and around 54.5 per cent of the students preferred both objective and subjective mode of examination rather than descriptive examination.

From Table 7 it can be seen that majority students (60.5%) preferred courses/ seminars to be held face-to-face than online and (19.0%) for courses/seminars

Table 6: Preference of students for pattern of examination (n=200)

Particulars	F (%)
Type of exam	
Written home exam	60 (30.0%)
Live exam via zoom/skype/MS team/ google meet etc.	104 (52.0%)
Video recordings	27 (13.5%)
Podcast	9 (4.5%)
Pattern of exam	
Objective	40 (20.0%)
Subjective	30 (15.0%)
Both objectives and subjective	109 (54.5%)
Multiple choice questions only	21 (10.5%)

Table 7: Preference of students for online platform (n=200)

Particulars	F (%)
Choice for holding seminar/courses online or face-to-face	
For courses/seminars to be held online	36 (18.0%)
For courses/seminars to be held face-to-face	121 (60.5%)
A combination of both	43 (21.5%)
Online platform	
Skype	16 (8.0%)
e-learning	1 (0.5%)
Zoom	74 (37.0%)
Avaya	0
Google meet	109 (54.5%)

to be held online and (21.5%) were in the favour of both online and offline. Google meet (54.5%) by students was the most preferred online platform for conducting classes followed by zoom (37.0%) and skype (8.0%). A study from Mizoram University also showed that software's like Zoom and google meets were mostly embraced as teaching modes Mishra *et al.* (2020).

Table 8 elucidates the preferred mode useful in online learning. It was categorized in three categories that were useful, somewhat useful and not useful. Mean value was calculated. Mean value greater than two was most preferred and less than 2 was least preferred. Among email, text, and telephone/voice mail, students

Table 8: Preferred mode to be useful for online learning by the students

Preferred mode	Very useful		Somewhat useful		Not very useful		Total	Mean
	F	%	F	%	F	%		
Online slide presentations with audio	142	71	53	26.5	5	2.5	537	2.68
Online collaboration tools (Wiki, Google Docs etc.)	78	39	106	53	16	8	462	2.31
E-Mail	12	6	66	33	122	61	290	1.45
Online videos (YouTube, TED etc.)	123	61.5	62	31	15	7.5	508	2.54
Telephone/Voicemail	9	4.5	68	34	123	61.5	286	1.43
Internet–based live lecture using two-way video and audio	114	57	64	32	22	11	492	2.46
Internet–based live lecture using two-way audio with presentation slides.	144	72	40	20	16	8	528	2.64
Average mean	**2.21**							

perceived telephone/voice mail to be the least useful. Aligning with a study by Frey *et al.* (2003), online students prefer email and text because of their flexibility. In this study, two different types of Internet-based live lectures were compared. Internet live lectures with two-way audio with slide presentations were rated the highest, followed by two-way video and audio. One might expect that two-way video and audio would be the most preferred format because it is considered to be a richer medium than the other formats. However, live video lectures are often interrupted due to bandwidth issues. In alignment with Hertel *et al.* (2008).

CONCLUSION

The study scrutinized the preference of the students on online learning. The findings of this study indicated that majority of the respondents opt for online classes through WhatsApp as a communication means to class updates. Students preferred well-structured content with recorded videos uploaded in university websites. They also mentioned the need for interactive sessions with quizzes and assignments at the end of every class to optimise the learning experience. The findings also emphasize on the most preferred mode by the students and revealed that internet live lectures with two-way audio with slide presentations were rated the highest, followed by two-way video and audio. Therefore, the study's insights contribute valuable information for curriculum designers and educational institutions in adapting to the new normal, offering a nuanced understanding of student preferences and proposing practical strategies to enhance the effectiveness of online learning in the context of agricultural education.

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Research Article

Productivity and Profitability of Mung bean (*Vigna radiate* L. Wilczek)- Wheat (*Triticum aestivum* L.) Cropping System under Different Tillage in Semi-arid Conditions

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ABSTRACT

The field experiment was conducted at CCS Haryana Agricultural University, Regional Research Station, Bawal (Rewari), India during 2019-20 and 2020-21. The soil of experimental site was loamy sand in texture and low in organic carbon, N and P, while medium in K. The treatment included nine tillage combinations for crop establishment under mung bean (*Vigna radiate* L. Wilczek)-wheat (*Triticum aestivum* L.) cropping system (MWCS) viz., Zero tillage mung bean (ZTM) *fb* zero tillage wheat (ZTW), ZTM *fb* reduced tillage wheat (RTW), ZTM *fb* conventional tillage wheat (CTW), Reduced tillage mung bean (RTM) *fb* ZTW, RTM *fb* RTW, RTM *fb* CTW, Conventional tillage mung bean (CTM) *fb* ZTW, CTM *fb* RTW, CTM *fb* CTW, laid out in randomised block design in three replications. The yield of mung bean was statistical at par under ZT, reduced tillage (RT) and conventional tillage (CT), whereas higher values were found under ZTM- sown in sequence with ZTW as compared to RTW and CTW during both the years. The grain yield of wheat was also statistically similar across different crop establishment methods/tillage practices in MWCS during 2019-20, however, the maximum grain yield was obtained under ZTM-ZTW (5367 kg ha^{-1}). During 2020-21, the grain yield of ZTW (5025 kg ha^{-1}) in sequence with ZTM was significantly higher than RTW (4622 kg ha^{-1}) and CTW (4593 kg ha^{-1}). Whereas in sequence with RTM, ZTW (4959 kg ha^{-1}) was superior to CTW (4641 kg ha^{-1}) but at par with RTW (4698 kg ha^{-1}). Wheat sown under ZT, RT or CT after CTM produced similar grain yields. The highest net returns (Rs. 99,656-107,168 ha^{-1}) were received when both the crops were sown under ZT, whereas, the lowest returns were under CTM-CTW (Rs. 81,969-93,091 ha^{-1}) during both the years, and B-C ratio (2.54-2.82) of also followed the similar trend. This was mainly due to lowest cost of cultivation (Rs. 61,775-62,025 ha^{-1}) under ZTM-ZTW, and highest under CTM-CTW (Rs. 69,773-71,273 ha^{-1}).

Keywords: Productivity, Economics, Mungbean, Wheat, Cropping system

INTRODUCTION

Mung bean (*Vigna radiata* L.)-wheat (*Triticum aestivum* L.) is an important cropping system and these crops are grown widely in arid and semi-arid regions. In India, wheat is grown on an area of 30.45 million ha with production and productivity of 107.7 million tonnes and 3537 kg ha^{-1}, respectively. While in Haryana, it is grown over an area of 2.3 million ha with a production of 10.45 million tonnes and productivity of 4533 kg ha^{-1} during 2021-22 (Anonymous, 2023). Mungbean accounts for about 65 per cent of its world acreage and 54 per cent of its production of total pulses. The area, production and productivity of kharif moong in Haryana was 19.1 thousand ha, 12.49 thousand ton and 654 kg ha^{-1}, respectively during 2018-19 (DES,

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2019). Efficient cropping systems by inclusion of diversified crops in rotation is important to maintain soil bio-physical property and protect from water and air erosion for sustainable agriculture growth in future. Cropping sequence and crop rotations involving legumes and pulses also helps in minimizing the rates of build-up of population of insect-pests, through life cycle disruption, biological nitrogen fixation, control of off-site pollution and enhancing biodiversity (Kassam and Friedrich, 2009).

In general, conservation agriculture (CA) allows a reduction in production costs, time and labour. CA is characterized by three principles namely continuous minimum soil disturbance, permanent soil organic cover and diversification of crop species grown in sequence and/or associations (FAO, 2017). CA is being practiced on over an area of around 125 million hectares world-wide (Pradhan *et al.*, 2018) and has several reports of reduced production costs, improved water use efficiency, and sustained or increased crop productivity across the globe (Kassam *et al.*, 2009). Under conservation agriculture, we need to follow and encourage no-till/zero tillage along with maintaining soil cover and suitable crop rotations preferably involving pulses/legumes.

Zero-tillage (ZT) technology refers to the growing of crop with the least possible soil disturbance, which involves controlling unwanted vegetation by other than mechanical means or by minimum use of tillage equipment (Kumar and Godara, 2017). With introduction of ZT in Haryana, farmers can save 59.0 L/ha diesel, 8 hr/ha of tractor time and approximately 3,000 MJ/ha of tractor operation energy as compared to conventional tillage (Sharma *et al.*, 2002). Zero-tillage in wheat across different cropping systems and landscapes is now a very widely accepted preposition to improve productivity, profitability, soil health, grain quality, input use efficiency and overall system sustainability including effective management of crop residues, natural resources and environmental pollution (Coventry *et al.,* 2011; Malik *et al.*, 2014; Punia *et al.*, 2016; Yadav *et al.*, 2020). Zero-tillage wheat in sequence with non-rice crops (cotton, pearl millet, sorghum, mung bean and cluster bean) has also been realized very promising in south-west Haryana (Yadav *et al.*, 2020).

Keeping these points in view, the present investigation on productivity and profitability of mung bean-wheat cropping system under zero tillage establishment in semi-arid conditions of Haryana was carried out with the objective of to assess the effect of zero tillage on growth, yield, yield attributes and economics of mung bean and wheat in comparison with conventional tillage

MATERIALS AND METHODS

A field experiment was conducted during 2019-20 and 2020-21 on mung bean-wheat cropping system at Regional Research Station, Bawal, Rewari, Haryana, India situated at 28.1°N latitude and 76.5°E longitude at an elevation of 266 meter above mean sea level with sub-tropical climatic conditions. Soil of the experimental field was categorized as loamy sand in texture, with low in OC, N and P, while medium in K. Peculiar characteristics of the experimental site are semi-arid climate with hot sunny days along with dry winds during summer and severe cold days during winter. Mean maximum temperature reaches as high as 48°C and mean minimum temperature reaches as low as 2°C. Sometimes minimum temperature touches the freezing point. South-west monsoon season i.e., from July to September contributes around 80 per cent of the total annual rainfall. Western disturbances also cause significant amount of rainfall during winter months. The total rainfall was 428 mm during *kharif* 2019, while it was 227 mm during *kharif* 2020. The rainfall during *rabi* season was 101 mm 2019-20 and 68 mm in 2020-21. The experiment was laid out in randomized block design with 9 tillage treatment combinations viz., Zero tillage mung bean (ZTM) *fb* zero tillage wheat (ZTW), ZTM *fb* reduced tillage wheat (RTW), ZTM *fb* conventional tillage wheat (CTW), Reduced tillage mung bean (RTM) *fb* ZTW, RTM *fb* RTW, RTM *fb* CTW, Conventional tillage mung bean (CTM) *fb* ZTW, CTM *fb* RTW, CTM *fb* CTW with three replications. The varieties used were 'WH 1105' (Wheat) and 'MH 421' (Mung bean). Both the crops were raised as per recommended package of practices of the State Agriculture University

For conventional tillage treatments, each plot was prepared with two harrowing + two ploughing followed by planking as preparatory tillage. Whereas for reduced tillage, only one harrowing followed by

planking was done. In zero tillage treatment, no tillage operations were carried out for both the crops and sown directly one week after applying pre-seeding herbicide glyphosate @1.0% + 0.1% surfactant to knock-down the pre-merged weeds. Zero-till seed-cum-fertilizer drill was used for sowing across conventional, reduced and zero tillage plots keeping row to row distance of 20 cm. Recommended seed rate of 20 kg ha^{-1} for mung bean and 100 kg ha^{-1} for wheat was used for sowing.

Cost of cultivation (variable) and gross returns (Rs. ha^{-1}) for different treatments were calculated on the basis of prevailing market rates of the inputs and outputs. Net returns (Rs. ha^{-1}) were worked out by subtracting the total cost of cultivation of each treatment from gross income of respective treatment. Benefit: cost ratio was also worked out to ascertain the economic viability of different treatments. Utility of adopting different practices was computed by using the following data.

Gross returns = Total value of the produce (both grain and straw)

Net returns = Gross returns - Total cost of cultivation

Benefit Cost Ratio: Benefit cost ratio was worked out by using following formula:

$$\text{B:C ratio} = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

Note: System profitability/economics were computed during both years.

Data collected during the study were statistically analyzed by using the technique of analysis of variance (ANOVA) described by (Cochran and Cox, 1959). To judge the significant difference between means of two treatments, the critical difference (CD) was worked out using following formula:

$CD = (\sqrt{2EMS/r}) \times t$ value at 5%

Where, CD = critical difference

EMS = error mean sum of square

r = number of replications

t = value of t-distribution at 5% level of error degree of freedom.

The results were tested for treatment means by applying 'F' test of significance on the basis of null hypothesis. The 'OPSTAT' (Sheoran *et al*., 1998) software of CCS Haryana Agricultural University, Hisar, India was used for statistical analysis.

RESULTS AND DISCUSSION

Number of branches per plant, Pods per plant, grains per pod and test weight were found non-significant in mung bean under all the methods of crop establishment during both the years, however numerically higher values were recorded when mung bean was sown after ZTW as compared to RTW and CTW (Table 1). Stori *et al.* (2018) and Sapre *et al.* (2019) also reported similar effect of ZT on these yield attributes.

In wheat the effective tillers per m^2, spike length, grains per spike and 1000-grain weight were observed similar under different methods of establishment in mung bean-wheat cropping system (MWCS). However, numerically maximum values of yield attributes were recorded where both the crops were established with zero-tillage methods of sowing followed by RTM-ZTW and CTW-ZTW; and lowest under CTM-CTW (Table 2). Statistically similar but numerically higher number of productive tillers m^{-2} were also reported by Rani *et al.* (2020) under zero tillage wheat sowing.

The seed yields of mung bean were similar under all crop establishment methods in MWCS. Numerical differences were more pronounced during second year, with highest seed yield under ZTM-ZTW (785 kg ha^{-1}). Zero tillage planting of mung bean produced higher mean seed yield, biological yield and HI than CT in earlier studies (Hussain *et al.,* 2020). Singh *et al.* (2011) also reported higher grain yield in zero tillage sowing of mung bean with happy seeder (an improved form of ZT drill) as compared to CT. Improved grain yields of mungbean under zero tillage method of crop establishment might be linked to beneficial effects of retaining crop residue on soil surface in comparison to conventional tillage.

The grain yield of wheat was not significantly influenced by different methods of tillage in MWCS during 2019-20. During 2020-21, grain yield of ZTW sown after ZTM (5025 kg ha^{-1}) was higher than RTW (4622-4722 kg ha^{-1}) and CTW (4593-4641 kg ha^{-1}),

Table 1: Effect of tillage practice on yield attributes in mung bean under MWCS

Treatment	Branches plant^{-1}		Pods plant^{-1}		Grains pod^{-1}		1000-grains weight (g)	
	2019	2020	2019	2020	2019	2020	2019	2020
ZTM-ZTW	5.6	5.2	19.5	15.6	9.2	10.5	42.3	39.8
ZTM-RTW	5.4	5.1	19.4	15.2	9.2	10.3	42.4	39.6
ZTM-CTW	5.6	4.5	19.3	14.4	9.1	9.9	42.2	38.8
RTM-ZTW	5.5	5.2	19.4	15.6	9.1	10.4	42.4	39.3
RTM-RTW	5.3	5.1	19.3	15.3	9.0	10.1	42.4	39.0
RTM-CTW	5.6	5.0	19.2	13.8	9.0	9.7	42.4	38.2
CTM-ZTW	5.4	5.1	19.6	15.8	9.1	10.2	42.4	39.2
CTM-RTW	5.3	5.0	19.3	15.7	9.0	10.0	42.4	38.8
CTM-CTW	5.3	5.0	19.2	13.7	9.1	9.7	42.6	38.1
SEm ±	0.3	0.3	0.5	1.0	0.4	0.3	0.4	0.8
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

*ZTM, zero-tillage mung bean, ZTW, zero-tillage wheat, RTM, reduced tillage mung bean, RTW, reduced tillage wheat, CTM, conventional tillage mung bean, CTW, conventional tillage wheat

Table 2: Effect of tillage practices on yield attributes in wheat under MWCS

Treatment	Effective tillers m^{-2}		Spike length (cm)		Grains spike^{-1}		1000-grain weight (g)	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
ZTM-ZTW	362	327	11.1	11.2	53.6	51.6	41.6	39.4
ZTM-RTW	352	322	10.9	11.1	52.5	50.7	41.2	37.9
ZTM-CTW	350	320	10.8	10.9	52.7	50.4	40.5	37.8
RTM-ZTW	357	325	10.9	11.1	53.4	51.1	41.4	39.0
RTM-RTW	350	320	10.7	10.1	52.4	50.5	40.5	37.7
RTM-CTW	347	317	10.5	10.2	51.5	50.4	40.3	37.6
CTM-ZTW	357	324	10.8	11.2	53.1	51.9	41.2	38.6
CTM-RTW	348	318	10.6	11.0	52.8	50.3	40.1	37.6
CTM-CTW	347	317	10.5	10.7	51.2	50.1	40.1	37.3
SEm ±	13	11	0.4	0.4	1.7	2.7	0.6	1.1
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

*ZTM, zero-tillage mung bean, ZTW, zero-tillage wheat, RTM, reduced tillage mung bean, RTW, reduced tillage wheat, CTM, conventional tillage mung bean, CTW, conventional tillage wheat

irrespective of tillage practices in mung bean (Table 3). In sequence with RTM, ZTW was superior to CTW but similar to RTW; whereas in sequence with CTM, all methods of wheat establishment were similar. Positive effect of ZT in legume-based rotation might be due to residue retention on surface which may enhance nutrients availability (Reyes, 2002), improve soil microbial activity (Subbulakshmi, 2007), temperature moderation (Yadav *et al.*, 2002), better soil moisture regimes (Karlen *et al.*, 1994) and soil physical conditions (Alam *et al.*, 2014), ultimately resulting in better yield attributes and ultimately the yields.

The straw yield of wheat as well as mung bean was not significantly affected by different methods of tillage in MWCS during both the years (Table 4). Though in 2019-20, the maximum straw yield of wheat was obtained under ZTM-ZTW (7607 kg ha^{-1})

Table 3: Effect of tillage practice on seed yield, stover yield, and harvest index in mung bean under MWCS

Treatment	Seed yield (kg ha^{-1})		Stover yield (kg ha^{-1})		Harvest index (%)	
	2019	2020	2019	2020	2019	2020
ZTM-ZTW	926	785	2091	1866	30.7	29.6
ZTM-RTW	925	783	2078	1829	30.8	29.9
ZTM-CTW	925	780	2069	1826	30.8	29.9
RTM-ZTW	915	778	2072	1879	30.6	29.1
RTM-RTW	919	757	2062	1869	30.9	28.9
RTM-CTW	917	754	2075	1886	30.7	28.6
CTM-ZTW	911	775	2023	1800	31.1	30.1
CTM-RTW	913	756	2058	1836	30.7	29.2
CTM-CTW	915	753	2024	1834	31.1	29.1
SEm ±	32	37	59	37	0.7	1.1
LSD (p=0.05)	NS	NS	NS	NS	NS	NS

*ZTM, zero-tillage mung bean, ZTW, zero-tillage wheat, RTM, reduced tillage mung bean, RTW, reduced tillage wheat, CTM, conventional tillage mung bean, CTW, conventional tillage wheat

Table 4: Effect of tillage practices on seed yield, straw yield and harvest index in wheat under MWCS

Treatment	Grain Yield (kg ha^{-1})		Straw Yield (kg ha^{-1})		Harvest Index (%)	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
ZTM-ZTW	5367	5025	7607	7211	41.7	41.2
ZTM-RTW	5241	4622	7268	6820	41.9	40.7
ZTM-CTW	5191	4593	7264	6829	41.7	40.3
RTM-ZTW	5346	4959	7463	7116	41.9	41.2
RTM-RTW	5232	4698	7268	6669	41.9	41.5
RTM-CTW	5178	4641	7236	6640	41.8	41.5
CTM-ZTW	5329	4822	7440	7213	41.7	40.2
CTM-RTW	5196	4722	7175	6582	41.9	41.9
CTM-CTW	5157	4625	7160	6565	42.0	41.4
SEm ±	155	89	114	539	1.3	1.7
LSD (p=0.05)	NS	270	NS	NS	NS	NS

*ZTM, zero-tillage mung bean, ZTW, zero-tillage wheat, RTM, reduced tillage mung bean, RTW, reduced tillage wheat, CTM, conventional tillage mung bean, CTW, conventional tillage wheat

followed by RTM-ZTM (7463 kg ha^{-1}) and CTM-ZTM (7440 kg ha^{-1}). While during 2020-21, it was recorded highest (7211 kg ha^{-1}) under ZTW when sown in sequence with ZTM closely followed by RTM (7116 kg ha^{-1}) and CTM (7213 kg ha^{-1}). These results again indicated ZT is a potential and an alternate method of establishment of wheat under MWCS and also the superiority of system based ZT.

The harvest index of mung bean and wheat did not differ significantly by different methods of establishment in MWCS during both the years. Harvest index under different tillage methods varied between 30.6-31.2 per cent during 2019 and 28.6-30.1 per cent during 2020 in mung bean and between 41.7-41.9 per cent during 2019-20 and 40.21-41.9 per cent during 2020-21 in wheat. Hussain *et al.* (2020) in Pakistan have also reported higher grain yield (12%), biological yield and HI of wheat when it was planted by zero tillage as compared to traditional farmers' practice in wheat (winter)-mung bean (summer) cropping sequence. Zero tillage cultivation practices are most suitable for their

Table 5: Effect of tillage practice on system economics (Rs/ha) in MWCS

Treatment	Gross return (Rs ha^{-1})		Cost of cultivation (Rs ha^{-1})		Net Profit (Rs ha^{-1})		Benefit-Cost ratio	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
ZTM-ZTW	168943	161681	61775	62025	107168	99656	2.82	2.54
ZTM-RTW	166559	153784	62775	63275	103784	90509	2.73	2.37
ZTM-CTW	165639	153015	66525	66025	99114	86990	2.57	2.26
RTM-ZTW	167841	159921	62773	63273	105069	96648	2.75	2.47
RTM-RTW	166004	153427	63773	64523	102231	88904	2.68	2.32
RTM-CTW	164880	152119	67523	67273	97358	84847	2.52	2.21
CTM-ZTW	167269	157074	66523	65773	100746	91301	2.59	2.33
CTM-RTW	164951	153819	67523	67023	97429	86796	2.52	2.24
CTM-CTW	164364	151741	71273	69773	93091	81969	2.38	2.12

*ZTM, zero-tillage mung bean, ZTW, zero-tillage wheat, RTM, reduced tillage mung bean, RTW, reduced tillage wheat, CTM, conventional tillage mung bean, CTW, conventional tillage wheat

cost effectiveness, labour saving, high energy saving, increase cropping intensity and higher net income with efficient utilization of locally available resources (Kumar *et al*., 2022).

When both the crops were sown under ZT, gross returns were highest during both the years (Rs. 168993/- ha^{-1} in 2019-20 and Rs. 161681/- ha^{-1} in 2020-21), whereas, it was lowest under CT (Rs. 164364/- ha^{-1} in 2019-20 and Rs. 151741/- ha^{-1} in 2020-21). The minimum cost of cultivation (Rs. 61775/- ha^{-1} in 2019-21 and 62025/- ha^{-1} in 2020-21) was incurred when ZT was employed in both the crops, whereas, the maximum was recorded under CT (Rs. 71273/- ha^{-1} in 2019-20 and Rs. 69773/- ha^{-1} in 2020-21) closely followed by RT.

The net returns (Rs. 107168/- ha^{-1} in 2019-21 and 99656/- ha^{-1} in 2020-21) and Benefit-Cost ratio (2.82 in 2019-21 and 2.54 in 2020-21) was also recorded maximum when both the crops were sown after ZT during both the years, whereas, they were the lowest under CT. Kumar *et al.* (2017) reported that the farmers adopted zero tillage in wheat observed reduction in cost with similar yield, increased soil fertility, less lodging and avoiding of terminal heat. Zero tillage planting system reduced the farmer's total input expenditure by 6.7 per cent that amounts Rs. 6236 ha^{-1} and increased net return by 32 per cent (Rs. 25601 ha^{-1}) in comparison with farmer practice, comprised of intensive tillage practices (Hussain *et al*., 2020). The higher net returns and B:C ratio of mung bean-wheat cropping system as obtained under zero tillage was primarily due to lower cost of tillage operation and higher grain as well as stover yields as compared to other crop establishment methods (Tripathi *et al.,* 2013).

CONCLUSION

From the present well-structured two years' field investigation, it is safely concluded that mung bean and wheat sowing under zero tillage proved the best option during both the years as compared to other tillage treatments with respect to growth and yield of mung bean as well as wheat in MWCS. The yield and yield attributes of mung bean were found at par under different tillage practices during both the years. While in wheat, they remained similar during 1st year but during 2nd year, yield increased under ZTM-ZTW by about 9 per cent as compared to CTM-CTW.

The net saving of Rs. 9498 and 7748 ha^{-1} in cost of cultivation was recorded under ZTM-ZTW as compared to CTM-CTW in 2019-20 and 2020-21, respectively. The net returns of MWCS increased by 15 and 22 per cent under ZTM-ZTW as compared to CTM-CTW. The maximum benefit-cost ratio (B:C) was recorded when both the crops were sown under ZT (ZTM-ZTW), whereas, it was the lowest under CT (CTM-CTW).

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Research Article

A Study on Problems Faced by the Farmers in Marketing of Basmati Rice in Jammu District of J&K

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ABSTRACT

The Jammu district of J&K was the focus of the current study. Two blocks based on highest area under Basmati crop were selected purposively. Then, two villages from each selected block were randomly chosen and 25 Basmati rice growers from each village were randomly examined via the personal interview approach, making a total of 100 Basmati rice growers. The study revealed that the major problem faced by the farmer (Bishnah and R.S. Pura) were lack of market information i.e. 65 per cent followed by un-organized marketing and low price paid by the farmers (58%) and not getting remunerative price for the produce (46%). The chi-square test showed a significant difference in the severity of two blocks (Bishnah and R.S. Pura), with high commission costs being reported by 48% of respondents in Bishnah and 42% of respondents in R.S. Pura.

Keywords: Production, Constraints, Basmati, Marketing

INTRODUCTION

In India, the majority of the population relies on agriculture as their primary source of income. Throughout the way they live, Indian farmers are exposed to both production and market risk. The main causes of market-related risks include price fluctuations brought on by changes in domestic and international fundamentals, poor market intelligence, inadequate infrastructure facilities for storage and transportation, a large number of intermediaries, a lack of awareness of quality standards, etc. The farmers produced more than enough of the majority of the commodities, but they were unable to take advantage of the true rewards in the form of increased agricultural revenue. In a nation like India where agriculture predominates, commodity price instability has always been a key issue for farmers, processors, merchants, as well as consumers. The world's most significant grain crop is rice (*Oryza sativa*). In several regions, its cultivation dates back more than 6500 years. The global output of rice amounts 678 million tonnes per year and occupies an area of 161 million hectares. India produces roughly 104.32 million tonnes of rice over an area of 43.86 million hectares. Nearly all of the states in the nation cultivate rice, but the five largest are West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, and Tamil Nadu. Whereas, Jammu and Kashmir contains very small amount of area i.e. 0.51 million hectare, production of 0.52 million tonnes but its productivity (2.2 tonnes/ha) is high as compared to National average productivity (1.9 tonnes/ha). Anantnag and Srinagar are the only districts in Jammu & Kashmir where production is higher as compared to other districts of J&K, whereas Baramula is the greater productivity district of Jammu & Kashmir. Anantnag & Pulwama is called the Rice bowl of J&K. The main varieties of basmati rice as notified under the Seeds Act, 1966 are Basmati 386, Basmati 217, Ranbir Basmati, Basmati 370, Type-3 (Dehradoon Basmati), Pusa Basmati -1, Pusa Basmati-1121, Punjab Basmati-1, Haryana Basmati-1, Kasturi and Mahi Sugandha. About 1 lakh metric tonnes of numerous varieties of basmati rice are produced in the state of J&K. The aroma of the basmati grown in

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the R.S. Pura belt in the Jammu area has gained its worldwide recognition. Wherever the right climatic conditions, soil characteristics, and temperature are present, basmati may be cultivated. The creation of "PUSA 1121 Basmati" which has important benefits over the traditional variety of basmati, is thought to be the reason for the continuing expansion of basmati rice in the upcoming years. Several Basmati cultivars have been announced under the 1966 Seed Act. Typically, the harvesting season for basmati crops ends in October or November, with the planting season beginning in May or June. Rice in Jammu & Kashmir is grown only once in a year because of extreme climatic condition. Farmers in J&K have chosen PB-1509 because of its greater yields, which has boosted its market share. Ranbir Basmati is also the main type farmed in J&K, making up 69 per cent of the state's basmati acreage PB-1509 holds 17 per cent of the market while PB-1121 holds 14 per cent.

India is now the greatest rice exporter in the world. In the 2019–2020 fiscal year, India exported over 6 million tonnes of rice (basmati and non-basmati) from the months of April to September. In terms of value, rice currently makes about 20 per cent of all agricultural exports from India. The several varieties of rice that fall under the category of basmati rice for export are sella rice, steamed rice and pusa rice. Shipments of basmati rice rose by nearly 10 per cent between 2015-2017 compared to the previous three years, whereas shipments of non-basmati rice declined after 2014–2015. India exported 12.682 MT of basmati and non-basmati rice to the global rice market in 2017–18 and 12.067 MT in 2018–19. Basmati rice exports from India are 6.296 MT for the global market. Under the public distribution system, rice is provided to ration card holders at a discounted rate through a network of 0.477 million Fair Price Shops (FPSs). In some state due to inefficient marketing system, the farmer share's in consumer rupee is low. A sufficient share of consumer rupee is deprived by intermediaries. An efficient system of marketing of rice will result in reduction of middleman profit and marketing cost thus, increasing farmer's share in consumer rupee.

MATERIALS AND METHODS

Basmati rice crop was purposively selected because in Jammu district basmati rice is world famous for its aroma. Thus, to identify the dynamics of marketing channels of basmati rice marketing the study has been conducted. In terms of area and basmati rice production in the state, two blocks of basmati rice were purposefully chosen for the study. The Bishnah and R.S Pura block of Jammu district was selected purposively because these blocks are having highest area and production of this crop. Additionally, two villages-Gagian and Badyal Brahmana from the R.S. Pura block and Chak Charkan and Salehar Upper from the Bishnah block- have been chosen at random.

The farmers were divided into three groups, namely marginal, small, and medium, based on the amount of their land holdings: marginal (up to 1 ha), small (1.01-2 ha), and medium (2.01-4.0 ha). It's important to note that there were no large farmers in the research region. As a result, both primary and secondary data were gathered for the study. The data from producer-farmers were collected through personal interview. The data collected from farmers pertain to marketing of basmati rice from selected block of district Jammu. Data include information regarding total cultivated area, size of holding, area cultivated in kharif season of basmati rice, quantity retained for on farm consumption of basmati rice, family size etc. Information on quantity stored for future sale as well as home consumption, means of transportation and transportation cost were also collected.

RESULTS AND DISCUSSION

The Table 1 shows the farmers' monthly basmati rice disposal trend as well as the price they paid throughout the course of the several months. According to the data, sample farmers sold the most of their produce in the months of January (740.18 quintals), December (604.0 quintals), March (224.00 quintals), February (149.94 quintals), and April (30.00 quintals). The total amount sold in each of the months of December, January, February, March, and April represented 34.55, 42.33, 12.81, 81.6, and 1.87 per cent of the marketable surplus respectively. These month's respective quintal prices were Rs. 3789.49, Rs. 4080.32, Rs. 4336.89, Rs. 443.78, and Rs. 4432.17. According to the price paid for basmati rice generally during this month, roughly 42.33 per cent of the total marketed surplus of basmati rice was sold during January. Marginal farmers were

Table 1: Monthly and channel-specific Basmati sales

Farm category	November		December		January		February		March		Other months		Total	
	Qty	Price	Qty	Price	Qty	Price	Qty	Price	Qty	Price	Qty	Price	Qty	Price
Village Trader														
Marginal	180.00	3600.00	150.00	3820.00	-	-	-	-	-	-	-	-	330.00	3700.00
Small	60.00	3685.00	100.00	3864.00	-	-	-	-	-	-	-	-	160.00	3750.00
Medium	4.00	3700.00	11.18	3815.63	-	-	-	-	-	-	-	-	15.18	3950.00
Total	244.00	3622.13	261.18	3836.66	-	-	-	-	-	-	-	-	505.18	3737.96
Wholesaler														
Marginal	100.00	3850.00	130.00	4026.92	-	-	-	-	-	-	-	-	230.00	3950.00
Small	60.00	3960.00	120.00	4260.00	-	-	-	-	-	-	-	-	180.00	4160.00
Medium	70.00	3950.00	66.00	4260.00	50.00	4300.00	154.00	4476.23					340.00	4300.00
Total	230.00	3909.13	316.00	4164.11	50.00	4300.00	154.00	4476.23					750.00	4159.06
Rice Miller														
Marginal	40.00	3775.00	45.00	3916.67	-	-	-	-	-	-	-	-	85.00	3850.00
Small	25.00	3825.00	28.00	3966.96			-	-	-	-	-	-	53.00	3900.00
Medium	40.00	3850.00	40.00	3980.00	50.50	4260.00	70.00	4350.00	30.00	4432.17	-	-	230.50	4190.00
Total	105.00	3815.48	113.00	3951.55	50.50	4260.00	70.00	4350.00	30.00	4432.17	-	-	368.50	4069.86
Consumer Directly														
Marginal	5.00	4100.00	20.00	4211.36	10.05	4290.00	-	-	-	-	-	-	35.05	4218.02
Small	10.00	4190.00	20.00	4350.00	19.13	4467.46	-	-	-	-	-	-	49.13	4363.17
Medium	10.00	4280.00	10.00	4450.00	20.26	4519.58	-	-	-	-	-	-	40.26	4442.79
Total	25.00	4208.00	50.00	4314.54	49.44	4452.74	-	-	-	-	-	-	124.44	4348.05
Overall														
Marginal	325.00	3706.15	345.00	4049.21	10.05	4290.00	-	-	-	-	-	-	680.05	3830.00
Small	155.00	3846.81	268.00	4088.34	19.13	4467.46	-	-	-	-	-	-	442.13	4020.00
Medium	124.00	3936.29	127.18	4147.81	120.76	4320.11	224.00	4436.78	30.00	4432.17	-	-	625.94	4260.00
Total	604.00	3789.49	740.18	4080.32	149.94	4336.89	224.00	4436.78	30.00	4432.17	-	-	1748.12	4032.02

discovered to have sold their whole marketed surplus throughout the harvesting month. Small farmers sold between 40 and 70 per cent of their output in January, while medium farmers sold 50.32 percent of their produce in February. The maximum amount of Rs. 4348.05 per quintal was obtained by the farmer when his produce was sold directly to the consumer, or through channel I (Producer - Consumer), whereas a very low amount of Rs. 3737.96 per quintal was obtained when the farmer sold his produce through channel II (Producer - Villager Trader - Wholesaler - Rice Miller).

In case of marginal farms the maximum percentage of quantity was sold through village traders (48.52) followed by wholesaler (33.82), rice miller (12.50) and consumer (5.15) respectively, whereas the small farms sold their maximum percentage of quantity through wholesaler (40.71), village trader (36.19), rice miller (11.99) and a very small quantity was sold to consumer (11.11). The table.2 further revealed that highest percentage of produce was sold through wholesaler (54.32), rice miller (36.82), consumer (6.43) and very less proportionate quantity was sold through village trader (2.42) in case of medium farms.

It is evident from the Table 3 that the most serious problems were lack of marketing information, not getting remunerative price for the produce and unorganized marketing and low price paid by farmers as reported by 65 percent, 58 per cent and 46 per cent farmers respectively. According to the Chi-Square test, there was a significant difference in the severity of the two blocks (Bishnah and R.S. Pura), with farmers in Bishnah reporting high commission charges at a rate of 48 per cent, while farmers in R.S. Pura reported them at a rate of 42%. High cost of transportation was reported by 52 per cent in Bishnah Block and 36 per cent in R.S. Pura block, whereas problem faced by the farmers due to cheating by middleman was reported by 22 per cent farmers in Bishnah Block and 32 per cent farmers in R.S. Pura Block.

CONCLUSION

The most serious problem were lack of marketing information, not getting remunerative price for the produce and unorganized marketing and low price paid by farmers as reported by 65 percent, 58 percent and 46 percent farmers respectively. Chi-Square test revealed that there was a significant difference between the severity of two blocks (Bishnah and R.S. Pura) namely high commission charges was reported by 48 percent farmers in Bishnah block, 42 per cent in R.S. Pura Block. High cost of transportation was reported by 52 per cent in Bishnah Block and 36 per cent in R.S. Pura block, whereas problem faced by the farmers due to cheating by middleman was reported by 22 per cent farmers in Bishnah Block and 32 percent farmers in R.S. Pura Block.

Table 2: Percentage of basmati rice sold through various distributors

Farm Category	Village traders	Wholesaler	Rice Miller	Consumer directly	Others	Total
Marginal	48.52	33.82	12.50	5.15	0.00	100.00
Small	36.19	40.71	11.99	11.11	0.00	100.00
Medium	2.42	54.32	36.82	6.43	0.00	100.00
Total	28.90	42.90	21.08	7.12	0.00	100.00

Table 3: Farmers' difficulties with basmati rice marketing

Farmers' difficulties	Basmati rice growers (%)		Overall
	Bishnah (n=50)	R.S Pura (n=50)	(n=100)
Lack of market information	72.00	58.00	65.00
High cost of transportation	52.00	36.00	44.00
Cheating by middleman	22.00	32.00	27.00
High commission charges	48.00	42.00	45.00
Not getting remunerative price for the produce	68.00	48.00	58.00
Un- organised marketing and low price paid by farmers	56.00	36.00	46.00

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Research Article

Development and Nutritional Analysis of Standardized Health Mix with Germinated Siddi Rice

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ABSTRACT

Cereals, pulses and oilseeds are among the most primary foods consumed world over and make up a significant portion of human diet. They contribute significant amount of protein, dietary fibre, vitamins, minerals along with phytochemicals in addition to providing energy. Cereals undergo significant biochemical and physico-chemical changes during germination. In the present study, the health mixes were standardised using with and without heat treated test Siddi rice flour, roasted greengram flour and roasted groundnut flour were evaluated for sensory properties using 9-point hedonic scale. As malting improved palatability and acceptability, longer shelf life was observed due to reduced moisture content. The colour analysis revealed greater L*, b*, E*, C* and h* and lesser a* values for test mix than control representing lighter, less red and more yellow colour due to decreased starch content. The physico-chemical properties of test health mix compared with control health mix showed decreased hydration capacity, swelling capacity, wheying off, sediment content, reconstitution time and cooking time but improved for flowability, cohesiveness and dispersibility with ideal properties for preparation of better-quality health mix. The water activity of control mix was 0.47±0.08 and test mix was 0.44±0.06. The moisture content of control mix was 5.53±0.30 per cent and test mix were 3.88±0.09 per cent with ash of 1.52±0.02 and 1.57±0.05 per cent, protein content of 16.25±0.36 and 15.60±0.12 per cent, fat content of 6.15±0.13 and 6.86±0.17 per cent, crude fiber of 1.48±0.02 and 1.26±0.08 per cent, carbohydrates of 67.59±0.42 and 69.09±0.09 per cent, respectively. The energy was 401.7±0.17 and 415.56±0.20 Kcal/100g for control and test health mix. There was decline in total sugars, reducing sugars, non-reducing sugars and amylose with increase in total starch and amylopectin for test mix compared to control.

Keywords: Siddi rice, Malting, Health mix, Physical parameters, Water activity, Nutritional analysis, Reconstitution time

INTRODUCTION

Cereals and legumes play a significant role in diets contributing to nutrient intake of humans. Rice has influenced the culture, diets and economics of millions of people. "Rice is life" for more than half of humanity (Ahuja *et al.,* 2008). Rice can be processed into variety of products that improved the nutritional quality of rice-based foods (Juliano, 1990). Rice's distinctive characteristics like hypoallergenicity and bland flavour make it ideal for a variety of food product development. Farmers will be benefited by developing value-added products through income generation and sustainability of low-grade varieties (Anitha and Rajyalakshmi, 2014).

Legumes are widely grown all over the world for their nutritional and economic significance that were appreciated and recognised on a global scale. In India, where the majority of population are vegetarian, legumes serve as an affordable source of essential proteins in addition to providing variety to diets (Sood

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et al., 2002). Pulses are referred to as poor man's meat due to their high protein content ranging from 20.0 to 40.0 per cent (Mahajan and Chattopadhyay, 2000).

One of the most significant edible legumes farmed and consumed in India is green gram often known as the mung bean (*Vigna radiata* L.). It ranks as India's third-largest pulse crop (Chandrasekhar and Ghosh, 2002). In terms of protein quality, green gram is on par with or better than other legumes like chickpea, black gram, peas, pigeon pea and also is a healthy source of carbohydrates and minerals (Jood *et al.*, 1998). The nutritional value of cereals to pulses are superior to cereals or pulses alone. Lysine is lacking in cereals, while methionine in pulses, but when consumed together, they balance one another. The combination of cereals and pulses is very inexpensive but a great source of calories, protein, carbohydrates, dietary fibre, vitamins and minerals. These are relatively stable during storage because of their low moisture content and processing them is also simple (Borkotoky and Sarma, 2016). According to several researchers, malting significantly improved the digestibility, sensory quality, nutritional value and storage quality. Thus, weaning foods, quick mixes and beverages can be made with malted flours (Griffith and Perez, 1998; Desai *et al.*, 2010).

MATERIALS AND METHODS

The WGL-44 rice is commonly referred to as Siddi was analyzed in the present study procured from Krishi Vigyan Kendra, PJTSAU, Wyra, Khammam. The procured paddy sample was stored in jute bags and

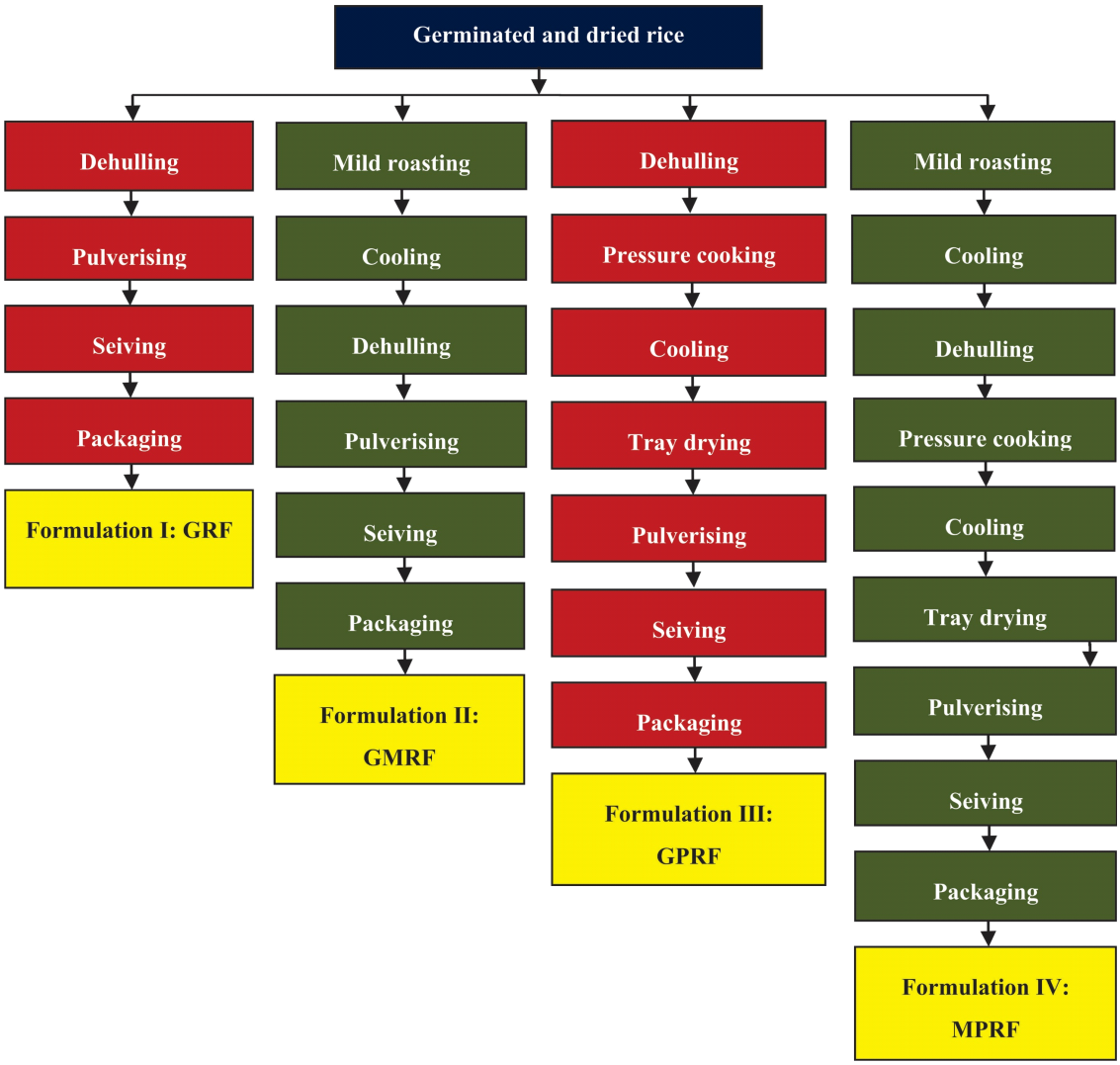


Figure 1: Flow chart for rice flour formulations in health mix

kept at room temperature till analysis. Four formulations of germinated rice flour with or without heat treatments were prepared as given in Figure 1.

The formulated rice flours were added with the roasted groundnut flour in the proportions given in Table 1 along with 20.0 g of roasted green gram flour to all samples for preparing health mixes. The prepared health mixes were evaluated for sensory properties using 9-point hedonic scale by 15 semi trained panelists from PGRC, PJTSAU, Hyderabad (Meilgaard *et al*., 1999). Based on sensory properties the best formulation of health mix was determined for physico-chemical parameters, nutritional characteristics including sugars and starches.

The physical properties were analyzed using standard methods like colour (Hunter Lab, 2013), hydration and swelling capacity (Williams *et al.,* 1983), bulk density (Stojceska *et al*., 2008), tapped density (Narayana and Narasinga 1984), wheying off (Khurana, 2006), sediment content (Rani *et al.,* 2016), flowability and cohesiveness (Sahni and Shere, 2017), reconstitution time (Nwanekezi *et al*., 2001), dispersibility (Kulkarni *et al*., 1991), cooking time (Wani *et al*., 2013) and total insoluble solids (Picouet *et al.,* 2016) were estimated for developed health mix powders and microscopic structure of porridges made by health mixes (FSSAI, 2016).

The functional parameters analysed were water absorption index and water solubility index (Anderson *et al.,* 1969), oil retention capacity (Beugre *et al*., 2014), hydrophilic-lipophilic index (Njintang *et al*., 2001), foaming capacity (Lawhon *et al*., 1972) and emulsion activity (Elkhalifa and Bernhardt, 2010).

Table 1: Compositions of health mix

S.No.	Rice flour (g)	Roasted groundnut flour (g)	Roasted green gram flour (g)
HM-1.	80.00	-	20.00
HM-2.	75.00	5.00	20.00
HM-3.	70.00	10.00	20.00
HM-4.	65.00	15.00	20.00
HM-5	60.00	20.00	20.00

Note: Rice flour can be GRF, GMRF, GPRF and MPRF. GRF: Germinated rice flour; GMRF: Germinated and malted rice flour; GPRF: Germinated and pregelatinised rice flour; MPRF: Germinated, malted and pregelatinised rice flour.

The chemical and nutritional properties of rice will be analyzed by standard procedures *viz.,* water activity by (Abramovic *et al.,* 2008), moisture AOAC (2005a), ash (AOAC, 2005b), protein AOAC (2005c), fat (AOAC, 1997), crude fiber (AOAC, 1990), carbohydrate and energy (AOAC, 1980), total sugars, reducing sugars and non-reducing sugar (Somogyi 1952), total starch (Southgate, 1976), amylose and amylopectin content (Williams *et al.* 1958).

RESULTS AND DISCUSSION

Development of health mix with germinated rice: Health mix was developed in four different formulations using germinated rice flour *viz.* germinated rice flour (GRF), germinated and malted rice flour (GMRF), germinated and pregelatinised rice flour (GPRF), germinated, malted and pregelatinised rice flour (GMPRF) along with roasted groundnut flour in varying amounts and roasted green gram flour at constant amount.

Profiling of sensory parameters of developed health mix: The health mixes prepared using above combinations were subjected to sensory evaluation with 9-point hedonic scale for the selection of best accepted formulation. The scores obtained for appearance, colour, taste, coarseness, flavour and overall acceptability of health mixes were depicted in Figure 2.

The best score for appearance, color, flavour, taste, coarseness and overall acceptability of germinated malted rice health mix (GMRHM) prepared with heat treatment were for those made from HM4 mix with 8.87±0.09, 8.86±0.09, 8.80, 8.66±0.12, 8.62±0.10 and 8.60±0.13 followed HM5 (GMRHM) with scores of 8.27±0.11, 8.20±0.10, 8.33±0.12, 8.06±0.14, 8.33±0.06 and 8.06±0.15 This might be due to addition of more roasted groundnut flour for HM5 composition than other composition of health mixes.

Furthermore, the scores for appearance, color, flavour, taste, coarseness and overall acceptability of germinated rice health mix (GRHM) prepared without any heat treatment were for those made from HM4 mix with 7.86±0.10, 7.72±0.09, 7.78±0.12, 7.78±0.16, 7.78±0.12 and 7.20±0.09 respectively.

The scores for appearance, color, coarseness, taste, flavour and overall acceptability of GPRHM were for HM4 compositions with score of 7.60±0.13,

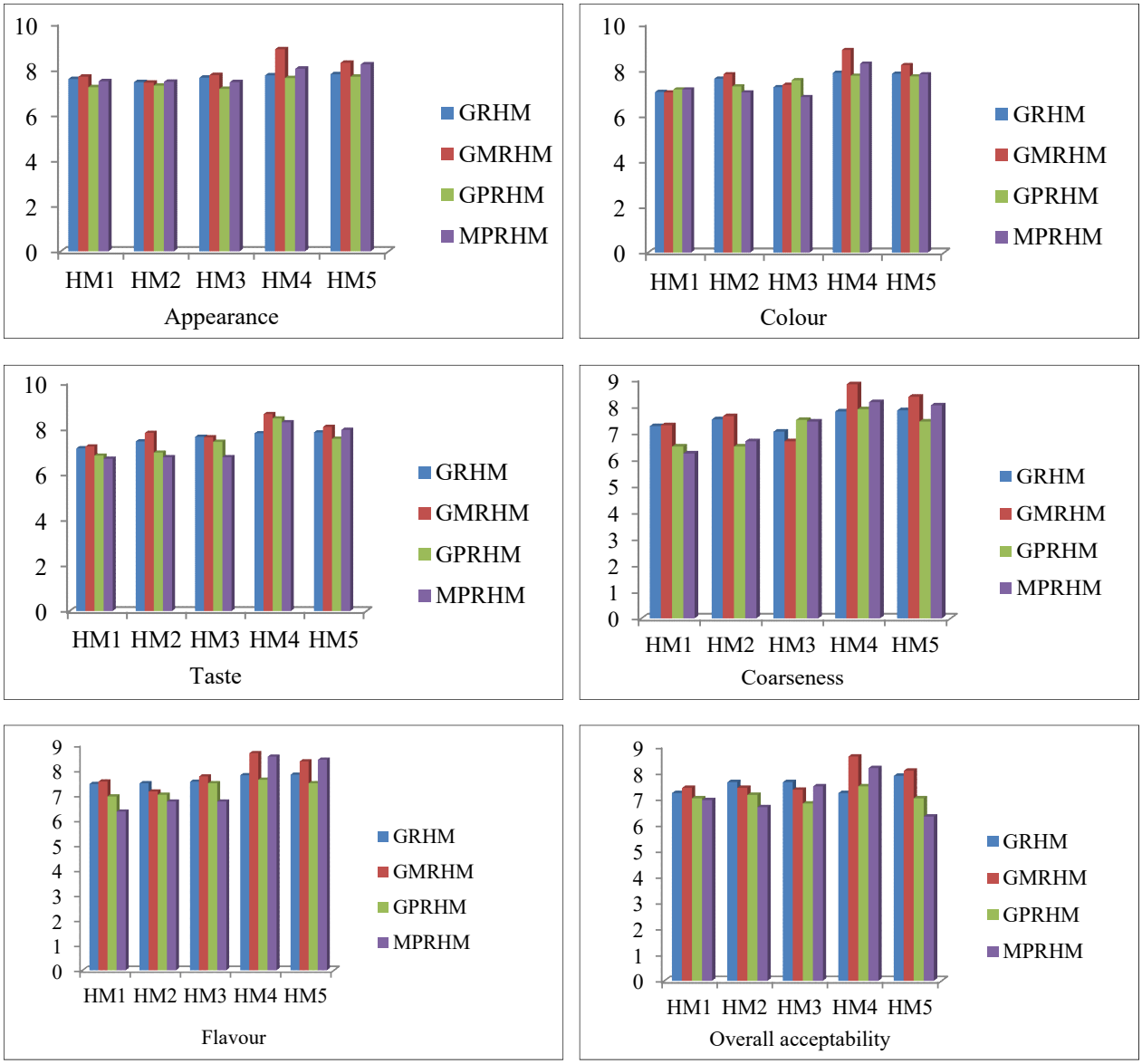


Figure 3: Sensory scores for health mixes with different treatments and compositions

Note: Values are expressed as mean ± standard deviation of fifteen determinations

GRHM: Germinated rice health mix; GMRHM: Germinated malted rice health mix; GPRHM: Germinated pregelatinised rice health mix; MPRHM: Germinated malted pregelatinised rice health mix.

7.73±0.16, 7.86±0.06, 8.43±0.13, 7.60±0.09 and 7.00±0.13 respectively. Followed by germinated, malted and pregelatinised health mixes (MPRHM) with HM4 composition having scores of 8.01±0.19, 8.26±0.12, 8.13 ±0.12, 8.26±0.13, 8.52±0.21 and 8.16±0.12 respectively.

Pregelatinized starches compared to natural starches had higher cold water swelling ability, percentage solubility, water absorption capacity and pH (Alebiowu and Itiola, 2002; Adedokun and Itiola, 2010). This resulted from amylopectin being released during pregelatinisation that disrupted the structure of starches and contributed to swelling of starches (Thomas and Atwell, 1999).

The benefits of roasting included improved palatability and acceptability as well as longer shelf life due to moisture reduction (Aworh, 2008). Statistically significant difference ($p \leq 0.05$) was observed among all samples for appearance, color, coarseness, flavour and taste where as it was noticed that there was no significant difference in overall acceptability of HM4 and HM5 health mixes for all treatments.

Selection of best health mix developed with germinated siddi: The mean scores for all sensory attributes of HM4 GMRHM mix was superior to GRF, GPRHM and MPRHM compositions. The same was selected as best accepted health mix. The control mix (CSHM) was composed of 65.0 per cent germinated rice flour and test mix with 65.0 per cent germinated and malted rice flour along with 15.0 per cent roasted groundnut flour and 20.0 per cent roasted greengram flour were further analysed for physico-chemical characteristics, functional and nutritional characteristics including sugars and starches of health mixes.

Profiling of developed health mix with germinated Siddi rice: The physico-chemical parameters, nutritional characteristics including sugars and starches were analysed for control and test mix and presented in Tables 2 to 6.

Colour analysis: Colour scores of CSHM and TSHM were presented as L*, a*, b*, E*, C* and h* values and were analyzed using Munsell colour charts. The maximum L*, b*, C*, E* and h* values were observed for TSHM with 75.22±0.01, 21.89±0.06, 22.07±0.16, 14.64±0.15 and 82.47±0.15 respectively and least for CSHM with 73.03±0.47, 20.49±0.08 20.86±0.08, 11.17±0.45 and 79.06±0.25 respectively indicating more lightness and yellow character for TSHM.

While the maximum a* values were noticed for CSHM with 3.96±0.04 and least for TSHM with 2.89±0.04 indicating more redness and higher colour intensity for CSHM as perceived by human eye. There was statistically significant difference for all color values of samples ($p \leq 0.05$) as shown in Table 2. The caramelization and browning reactions might be reason for change in color of roasted black chickpea (Wani *et al.*, 2017). Additionally, brown pigment formed during high temperature roasting due to enzymatic and non-enzymatic browning, which reduced the lightness even more.

Hydration and swelling capacity of CSHM was 2.74±0.06 g and 6.65±0.10 ml respectively and for TSHM was 2.73±0.06 g and 6.14±0.07 ml respectively, bulk density for CSHM was 0.60±0.05 g/ml and for TSHM was 0.58±0.01 g/ml and statistically no significant difference ($p \leq 0.05$) between the samples.

According to Balogun and Olatidoye (2010), the development of a porous structure and concurrently reduced moisture content due to high temperature was the reason for reduction in bulk density after roasting. The production of complementary foods was always benefited by the low bulk density. The tapped density of CSHM was 0.80±0.01 g/ml and for TSHM was 0.78±0.05 g/ml.

The TSHM had lesser wheying off with 3.70±0.12 ml/10ml sample than CSHM with 4.67±0.11 ml/10ml sample with statistically significant difference ($p \leq 0.05$) between the samples. The higher wheying off for CSHM was due to the processing's the sample was subjected to. The TSHM had lesser sediment content with 4.06±0.10 ml/10 ml sample than CSHM with 5.65±0.09 ml/10ml sample.

The Carr Index (CI) was 23.32±0.38 per cent and 27.47±0.42 per cent respectively and Hausner ratio (HR) was 1.29±0.01 and 1.38±0.03 respectively for CSHM and TSHM with statistically significant difference ($p \leq 0.05$) between the samples. The TSHM has better reconstitution time with 158.30±0.04 sec than CSHM with 162.20±0.08 sec probably due to less bulk density.

Table 2: Colour analysis of health mixes CSHM and TSHM

Sample	L*	a*	b*	ΔE	C*	h* (degrees)
CSHM	73.03^{c}±0.47	3.96^{b}±0.04	20.49^{a}±0.08	11.17^{b}±0.45	20.86^{b}±0.08	79.06^{b}±0.25
TSHM	75.22^{d}±0.01	2.89^{a}±0.04	21.89^{b}±0.06	14.64^{c}±0.15	22.07^{c}±0.16	82.47^{c}±0.15
Grand mean	74.12	3.42	21.19	12.90	21.46	80.76
SE of Mean	0.31	0.12	0.46	0.76	0.16	0.26
CD	1.58	0.13	2.76	1.32	1.32	1.42
% CV	0.93	1.58	5.50	4.54	4.54	2.54

Note: Values are expressed as mean ± standard deviation of three determinations
Means within the same column followed by a common letter do not significantly differ at $p \leq 0.05$.
CSHM: Control mix TSHM: Test mix

Table 3: Physico-chemical characteristics of health mix CSHM and TSHM

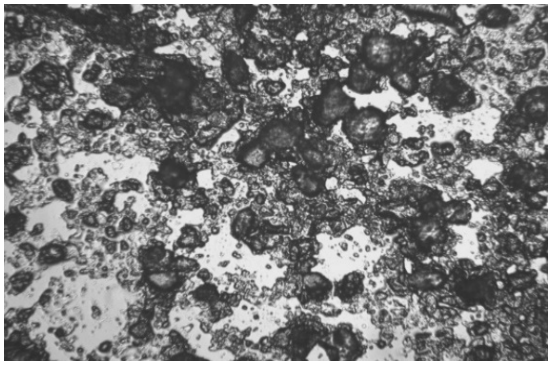
Sample	HC (g)	Swelling Capacity (ml)	BD (g/ml)	TD (g/ml)	WO (ml/10ml sample)	SC (ml/10 ml sample)	CI (%)	HR	RT (Sec.)	Dispersibility (%)	CT (Min.)	TIS (%)
CSHM	$2.74^{a}\pm0.06$	$6.65^{b}\pm0.10$	$0.60^{a}\pm0.05$	$0.80^{a}\pm0.01$	$4.67^{c}\pm0.11$	$5.65^{c}\pm0.09$	$23.32^{c}\pm0.38$	$1.29^{a}\pm0.01$	$162.20^{b}\pm0.08$	$72.79^{b}\pm0.06$	$7.40^{b}3\pm0.09$	$52.37^{c}\pm0.22$
TSHM	$2.73^{a}\pm0.06$	$6.14^{b}\pm0.07$	$0.58^{a}\pm0.01$	$0.78^{a}\pm0.01$	$3.70^{b}\pm0.12$	$4.06^{b}\pm0.10$	$27.47^{d}\pm0.42$	$1.38^{b}\pm0.03$	$158.30^{a}\pm0.04$	$78.95^{c}\pm0.24$	$7.20^{b}\pm0.40$	$42.35^{b}\pm0.16$
Grand Mean	2.74	6.40	0.59	0.79	4.18	4.85	25.40	1.33	160.28	75.87	7.31	47.35
SE of Mean	0.04	0.12	0.02	0.02	0.23	0.09	0.40	0.02	0.06	0.16	0.36	2.02
CD	0.26	0.35	0.04	0.04	0.52	0.38	1.92	0.11	10.52	4.72	2.25	3.95
% CV	4.21	2.42	3.38	2.72	5.50	3.32	3.35	3.80	3.45	2.76	10.61	3.67

Note: Values are expressed as mean ± standard deviation of three determinations
Means within the same column followed by a common letter do not significantly differ at $p\leq0.05$
BVHM: Health mix with BPT 5204 SVHM: Health mix with Siddi
HC: Hydration capacity BD: Bulk density TD: Tapped density WO: Wheying off SC: Sediment content
CI: Carr index HR: Hausner ratio RT: Reconstitution time D: Dispersibility CT: Cooking time
TIS: Total insoluble solids

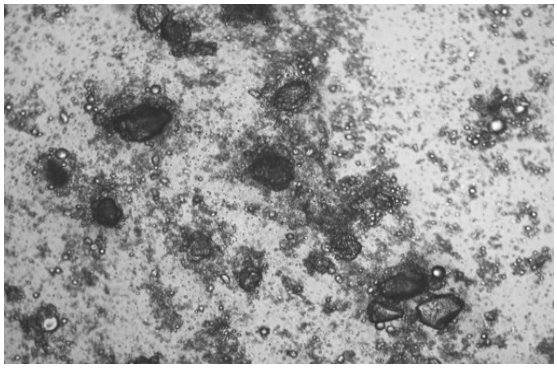
The ease with which the mix dispersed as a single particle in the bulk liquid phase was known as dispersibility. In the absence of fine particles, highly dispersible powders often demonstrated good wettability and agglomerated (Pawar and Thompkinson, 2017; Swaminathan and Guha, 2018). The TSHM had better dispersibility with 78.95±0.24 per cent than CSHM with 72.79±0.06 per cent. There was statistically significant difference ($p\leq0.05$) between samples. The cooking time of CSHM was 7.43±0.09 min and for TSHM was 7.20±0.40 min. The TSHM had lesser TIS with 42.35±0.16 per cent than CSHM with 52.37±0.22 per cent due to high dispersibility of test mix.

Microscopic structure of health mixes*:* The extent of changes in starch as gelatinization and retrogradation were major determinants of its functional properties for food processing during digestion and in industrial applications. These characteristics determined the quality, acceptability, nutritional value and shelf stability of finished products (Wang and Copeland, 2013). The native, pregelatinised, gelatinised and retrograded starches of health mixes for CSHM and TSHM health mixes were visualised under a Lawrence and Mayo binocular microscope to interpret their structural changes after hydrothermal treatments as depicted in Plate 1. The Plate 1a & b depicted the structure of native CSHM and TSHM. Both CSHM and TSHM starch granules were moistened, swollen to a longer extent, and no longer intact when the native starches were hydrothermally treated and pregelatinized as shown in Plate 1c & d.

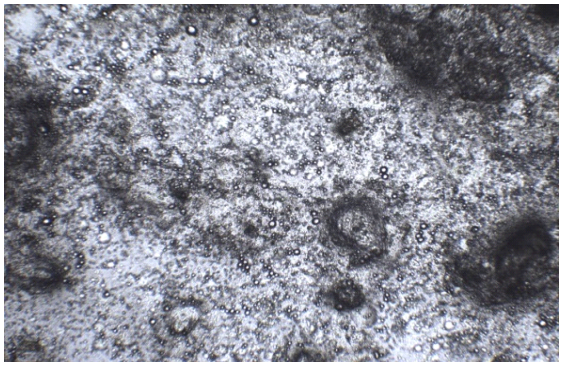
The Plate 1a & b depicted the structure of native CSHM and TSHM. Both CSHM and TSHM starch granules were moistened, swollen to a longer extent, and no longer intact when the native starches were hydrothermally treated and pregelatinized as shown in Plate 1c & d. Prolonged hydrothermal treatment for further starch gelatinization caused the remaining hydrogen bonds to break down, which led to the loss of birefringence, leading to solubilization of the starches and transformation into viscous paste as depicted in Plate 1e & f. When CSHM and TSHM gelatinized starches were completely cooled, the disintegrated starch chains were able to reorganize into partially ordered structures that were different from native granules as depicted in Plate 1g & h that were considered as retrograded starches.



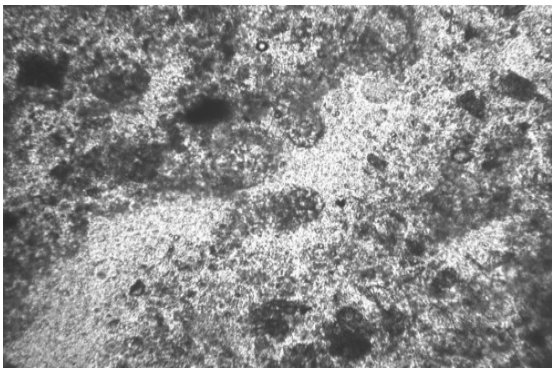
(a) Native CSHM



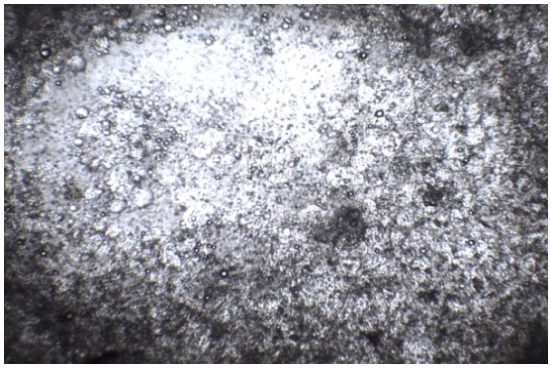
(b) Native TSHM



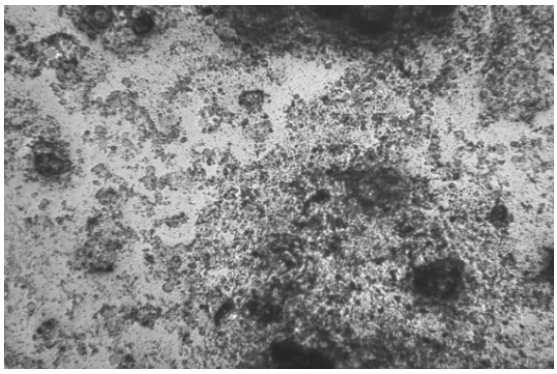
(c)Pregelatinised CSHM



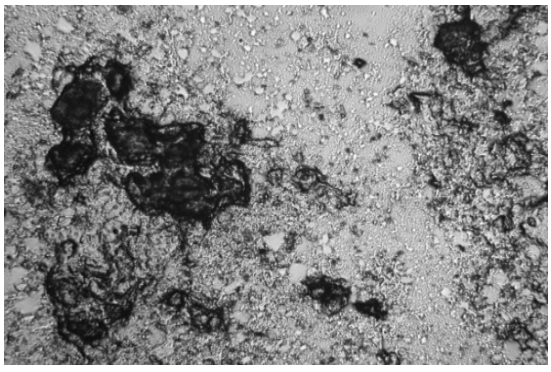
(d) Pregelatinised TSHM



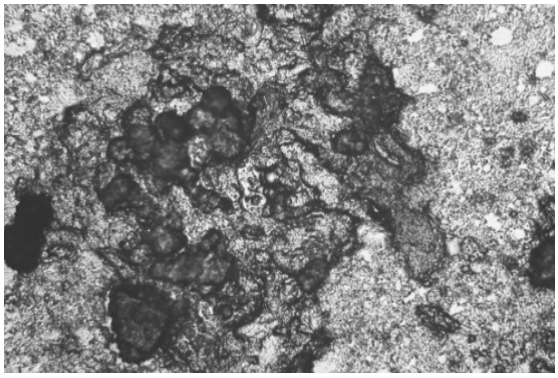
(e) Gelatinised CSHM



(f) Gelatinised TSHM



(g) Retrograded CSHM



(h) Retrograded TSHM

Plate 1: Microscopic structures of porridges made by health mixes
Note: CSHM: Control mix TSHM: Test mix

Table 4: Functional parameter of health mixes CSHM and TSHM

Sample	WAI	WSI	ORC	HLI	FC	EA
CSHM	208.9^{b}±0.07	1.18^{a}±0.01	218.50^{c}±0.06	0.96^{b}±0.06	19.28^{b}±0.08	14.71^{b}±0.30
TSHM	204.50^{a}±0.05	1.28^{a}±0.01	214.60^{b}±0.09	0.95^{b}±0.00	17.27^{a}±0.02	12.85^{a}±0.20
Grand Mean	206.73	1.23	216.58	0.95	18.28	13.78
SE of Mean	0.09	0.02	0.08	0.03	0.05	0.25
CD	9.92	0.03	10.48	0.03	1.98	3.34
% CV	2.11	1.32	3.97	1.52	4.81	10.70

Note: Values are expressed as mean ± standard deviation of three determinations
CSHM: Control mix; TSHM: Test mix; WAI: Water absorption index; WSI: Water solubility index; ORC: Oil retention capacity; HLI: Hydrophilic-lipophilic index; FC: Foaming capacity; EA: Emulsion activity
Means within the same column followed by a common letter do not significantly differ at $p \leq 0.05$.

Functional parameters of health mixes: The mean scores of functional parameters of CSHM and TSHM health mixes were tabulated in Table 4.

The WAI of CSHM was 208.9±0.07 per cent and for TSHM was 204.50±0.05 per cent with a mean SE of 206.73±0.09 per cent. There was statistically significant difference between samples at $p \leq 0.05$. The amount of water available for gelatinization during preparation of porridge was indicated by the water absorption capacity forming thinner gruel if the absorption capacity is lower. The WSI of CSHM was 1.18±0.01 per cent and TSHM was 1.28±0.01 per cent.

The ORC of CSHM was 218.50±0.06 per cent and TSHM was 214.60±0.09 per cent. The HLI of TSHM was 0.96±0.06 and for SVHM was 0.95±0.00 with a grand mean ± SE of 0.95±0.03. The FC of CSHM was 19.28±0.08 per cent and for TSHM was 17.27±0.02 per cent with a grand mean ± SE of 18.28±0.05 per cent. Foaming characteristics were crucial in the maintenance of the texture and structure of certain food products like baked foods and ice creams. The presence of flexible protein molecules in the flour affected its propensity to foam reducing the surface tension of water (Sathe *et al.,* 1982). The EA of CSHM was 14.71±0.30 per cent and TSHM was 12.85±0.20 per cent with a grand mean SE of 13.78±0.25.

Nutritional parameters of health mixes: The mean scores of proximates for CSHM and TSHM were tabulated in Table 5. The amount of free or available water has a significant impact on food stability, chemical changes and microbial contamination than total moisture content. Water activity of about < 0.85 inactivated the majority of enzymes. Bacterial growth stopped at a_w of < 0.75, however some yeast and mould may still develop. All microbial growth was suppressed at a_w of < 0.60. In terms of nutrition, less vitamin C, E, and B was lost (Ball, 2006; Rahman and Labuza, 2007). Water activity for both the samples were analysed at around 20±2 °C. The water activity of

Table 5: Proximate composition of CSHM and TSHM health mixes

Sample	Water activity	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Crude fiber (%)	Carbohydrates (%)	Energy (Kcal/100g)
CSHM	0.47^{a}±0.08	5.53^{b}±0.30	1.52^{a}±0.02	16.25^{b}±0.36	6.15^{a}±0.13	1.48^{b}±0.02	67.59^{c}±0.42	401.7^{b}±0.17
TSHM	0.44^{a}±0.06	3.88^{a}±0.09	1.57^{a}±0.05	15.60^{b}±0.12	6.86^{b}±0.17	1.26^{a}±0.08	69.09^{d}±0.09	415.56^{c}±0.20
Grand mean	0.44	4.55	1.55	15.92	6.51	1.38	68.34	408.63
SE of Mean	0.08	0.42	0.03	0.22	0.18	0.05	0.38	0.18
CD	0.03	0.96	0.08	1.05	0.62	0.05	1.30	9.66
% CV	3.04	9.14	2.35	2.93	4.18	1.67	0.84	1.05

Note: Values are expressed as mean ± standard deviation of three determinations
Means within the same column followed by a common letter do not significantly differ at $p \leq 0.05$.
CSHM: Control mix; TSHM: Test mix

Table 6: Sugars and starch composition of health mixes CSHM and TSHM

Sample	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Total starch (%)	Amylose (%)	Amylopectin (%)
CSHM	24.65^{b}±0.39	1.52^{b}±0.01	23.15^{d}±0.40	63.50^{c}±0.32	34.42^{c}0.35	30.79^{b}±0.26
TSHM	21.20^{a}±0.32	1.47^{a}±0.01	19.73^{c}±0.43	64.35^{d}±0.46	31.16^{b}0.36	31.83^{b}±0.18
Grand Mean	22.92	1.49	21.44	65.42	32.78	32.31
SE of Mean	0.50	0.01	0.42	0.38	0.35	0.26
CD	3.57	0.05	2.98	3.70	3.45	4.90
% CV	6.88	1.66	6.12	2.51	4.63	6.69

Note: Values are expressed as mean ± standard deviation of three determinations
Means within the same column followed by a common letter do not significantly differ at $p \leq 0.05$.
CSHM: Control mix TSHM: Test mix

CSHM was 0.47±0.08 and TSHM was 0.44±0.06. Both samples had lower a_w due to initial drying of them.

The moisture content of CSHM was 5.53±0.30 per cent and TSHM was 3.88±0.09 per cent. The ash content of CSHM was 1.52±0.02 per cent and TSHM was 1.57±0.05 per cent. The protein content of CSHM was 16.25±0.36 per cent and TSHM was 15.60±0.12 per cent. The fat content of CSHM was 6.15±0.13 per cent and TSHM was 6.86±0.17 per cent with a grand mean ± SE of 6.51±0.18 per cent and statistically significant difference ($p \leq 0.05$) was observed between them. The crude fiber content of CSHM was 1.48±0.02 per cent and TSHM was 1.26±0.08 per cent with a grand mean ± SE of 1.38±0.05 per cent. The results are in tune with the findings of Oboh *et al.* (2010), who reported that roasting of maize, dropped the crude fibre content from 1.46±0.90 to 1.26±0.50 for yellow maize variety and 1.32±0.20 to 1.24±0.20 for white maize variety.

The Carbohydrate content of CSHM was 67.59±0.42 per cent and TSHM was 69.09±0.09 per cent The energy content of CSHM was 401.7±0.17 Kcal/100g and TSHM was 415.56±0.20 Kcal/100g with a grand mean ± SE of 408.63±0.18 Kcal/100g.

Total sugars of health mixes CSHM and TSHM: The total and reducing sugars were analyzed from which the non-reducing sugars were calculated as given in Table 6. The total sugar content of CSHM was 24.65±0.39 per cent and TSHM was 21.20±0.32 per cent with a grand mean ± SE of 22.92±0.50 per cent. The reducing sugar content of CSHM was 1.52±0.01 per cent and TSHM was 1.47±0.01 per cent. The non-reducing sugar content of CSHM was 23.15±0.40 per cent and TSHM was 19.73±0.43 per cent with a grand mean ± SE of 21.44±0.42 per cent and there was significant difference ($p \leq 0.05$) between the samples.

Because of low molecular weight oligosaccharides like sucrose, raffinose, and stachyose make up the majority of carbohydrates, this rise in reducing sugar concentration during germination was caused by it. A galactosidase enzyme, is activated during germination, acted on total sugars, primarily represent the non-reducing sugars. Therefore, the generation of reducing sugars was boosted as non-reducing carbohydrates were broken down (Hizukuri, 1985).

Total starch content of health mixes of health mixes CSHM and TSHM: The total starch content of TSHM was 64.35±0.46 per cent and for CSHM was 66.50±0.32 per cent. The amylose content of CSHM was 34.42±0.35 per cent and TSHM was 31.16±0.36 per cent. The amylopectin content of CSHM was 32.79±0.26 per cent and for TSHM was 31.83±0.18 per cent.

CONCLUSION

The present study concluded that the health mixes were standardised using with and without heat treated test Siddi rice flour, roasted greengram flour and roasted groundnut flour and evaluated for sensory properties using 9-point hedonic scale. Based on sensory properties the best formulation of health mix was determined for physico-chemical parameters, nutritional characteristics including sugars and starches with test Siddi health mix. The TSHM had greater L*, b*, ΔE, C* and h* values and lesser a* value than CSHM representing less redness and more yellowness due to

germination and heat treatments. For hydration and swelling capacities there was no significant difference at ($p \leq 0.05$) was observed. The TSHM had lesser sediment content than CSHM due to high dispersibility of TSHM health mix due to formation of simpler molecules during various processings. CSHM had comparatively better flowability and less cohesiveness than TSHM due to relatively high bulk density. The increased temperature-induced structural changes to cell walls may cause weak connections between polysaccharide chains and glycosidic links for fibres to break. The roasting resulted in lower solubilisation of crude fibre in foods due to depolymerisation caused by lowered interaction of fibre molecules. The ash, fat, carbohydrates and energy of TSHM were higher compared to CSHM whereas water activity, moisture, protein and crude fiber contents were lower for TSHM. The lower a_w and moisture content helps in developing shelf stable products for long term usages. There was decline in total sugars, reducing sugars, non-reducing sugars, amylose and increase in total starch and amylopectin contents for TSHM was due to the rapid starch depletion and enhanced amylase activity during germination can be reason for the rise in total sugar content. While roasting increased the total sugar concentration, it's possible because heat caused biochemical changes in complex carbohydrates to simple sugars and activation of amylase enzyme during germination and subsequent starch hydrolysis may be the reason for reduction in starch content.

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Research Article

Information utilization Behaviour of rice growers under Seed Village Programme in District Baramulla (J&K)

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ABSTRACT

The information from the current rice grower report's seed village programme was used in five carefully selected sub-divisions of the Baramulla district that had the rice crops Seed Village Program. The researcher used a well-structured interview schedule to collect the data. The Majority of rice growers from all the five sub-divisions were having medium level of information utilization and majority of them found in sub-division Pattan (74.28%), followed by Baramulla (72.60%), Sopore (59.27%), Tangmarg with more than fifty percent (58.34%) and in sub-division Rohamma (55.00%). The overall information utilization of (65.48%) of the rice growers from all the five sub-divisions had medium level of information utilization.

Keywords: Information, Utilization, Behaviour, Rice, Growers, Seed village

INTRODUCTION

There are two parts to agricultural productivity. There are two types of grains: food grains and non-food grains. In India, the principal food grain crops include paddy, wheat, maize, bajra, jowar, ragi and Bengal gram. All commercial crops are classified as non-food grains. One of the most important food grain crops is paddy. Food grain production is the most important aspect of agricultural output in any country that has been identified as having an urgent need to increase production due to the wide imbalance between demand and supply for food grains. In fact, continuous and rapid agricultural development in India is critical to increasing economic development and eradicating poverty by distributing food grains to all sectors of the country, including the poor. Furthermore, agriculture provides raw materials to a wide range of businesses, including rice, textiles, silk, sugar, flour mills and dairy goods. Within the rural sector, as well as with the general economic growth and development strategy, it has significant forward and backward links. However, because paddy crop has been ignored in India in recent years as a result of both government policies and individual interests, it is critical to examine paddy crop trends and take the required actions to enhance paddy productivity and production in the country (Sekhara and Devarajulu, 2019).

Growers must always be on the look for up-to-date scientific information. As a result, it was believed appropriate to investigate information use behaviour in terms of mode of acquisition, evaluation for worthiness and utilisation by growers in order to increase productivity. The current era is one of scientific advancement, in which new facts are produced on a daily basis and it is critical to communicate this knowledge and information to those end users who require it in the quickest time possible. Effective information is required for this aim. In order for them to be able to use and communicate for the advancement (Choudhary, 2017).

MATERIALS AND METHODS

As incidents had already occurred, the research design applied in this study was ex-post facto. The research

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had been carried out in the Baramulla district of Kashmir valleys, which was considered for a rice seed village programme from 2018 to 2020. In District Baramulla, there are six Agricultural Sub Divisions, five of which are Baramulla, Pattan, Sopore, Rohamma and Tangmarg, which are consisting of twelve designated agricultural zones in twenty-five villages. The study involved a total of 310 growers that were part of the Seed Village Program. The information was gathered on a well-organized basis and the results were analysed using percentages, frequencies, means and standard deviations. The information was gathered on a well-organized basis and the results were analysed using percentages, frequencies, means and standard deviations.

The farmer may use the stored information for various operations related to the cultivation of rice crop. Information utilization behaviour can be operationally defined as the usage of the stored or preserved information for carrying out the various activities for raising the rice crop.

Information utilization behavior was measured by asking the rice growers, they utilize the received/ stored information. Different scores have been rated on the four point continuum i.e. regularly, occasionally, rarely and never. Score 3, 2, 1 and 0 were assigned respectively. On the basis of scores obtained, the respondents were categorised as.

Information utilization behaviour	Score
Low information utilization behaviour	Below Mean-SD
Medium information utilization behaviour	Between Mean±SD
High information utilization behaviour	Above Mean+SD

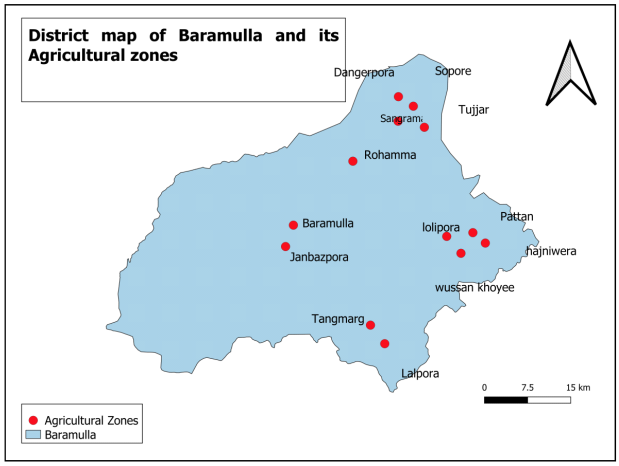

Figure 1: Map of district Baramulla

The final score for information utilization behaviour was calculated by summing up all the corresponding response scores. Then, the respondents were grouped into three categories on the basis of mean and standard deviation.

RESULTS AND DISCUSSION

According to Table 1 and Figure 2, the majority of rice growers in sub-division Pattan (74.28%) had a medium level of information utilization, followed by 14.29 per cent of the rice growers having high level of information utilization and only 11.43 per cent of the rice growers had low level of information utilization. In sub-division Sopore, a majority (59.27%) of the rice growers had medium level of information utilization, followed by 27.40 per cent of the rice growers having high level of information utilization and only 13.33 per cent of the rice growers had low level of information utilization. In sub-division Tangmarg, more than fifty per cent (58.34%) of the rice growers had medium level of information

Table 1: Distribution of rice growers according to their Information Utilization

Information utilization	Sub-Division					*N*=310
	Pattan (n_1=70)	Sopore (n_2=135)	Tangmarg (n_3=12)	Baramulla (n_4=73)	Rohamma (n_5=20)	
Low	08 (11.43)	18 (13.33)	01 (08.33)	09 (12.32)	03 (15.00)	39 (12.58)
Medium	52 (74.28)	80 (59.27)	07 (58.34)	53 (72.60)	11 (55.00)	203 (65.48)
High	10 (14.29)	37 (27.40)	04 (33.33)	11 (15.08)	06 (30.00)	68 (21.94)
Mean±S.D	17.23±3.78	15.97±4.43	13.75±4.00	17.49±2.41	16.05±2.11	16.10±3.35
Observed Range	5-27	2-23	7-19	11-22	12-19	2-27

Figures within parenthesis indicate respective percentage

utilization, followed by 33.33 per cent of the rice growers having high level of information utilization and only 08.33 per cent of the rice growers had low level of information utilization. In sub-division Baramulla, a majority (72.60%) of the rice growers had medium level of information utilization, followed by 15.08 per cent of the rice growers having high level of information utilization and only 12.32 per cent of the rice growers had low level of information utilization. While as, in sub-division Rohamma, more than fifty per cent (55.00%) of the rice growers had medium level of information utilization, followed by 30.00 per cent of the rice growers having high level of information utilization and only15.00 per cent of the rice growers had low level of information utilization. However, the overall information utilization of rice growers from all five sub-divisions, was that a majority (65.48%) of the rice growers had medium level of information utilization, followed by 21.94 per cent of the rice growers having high level of information utilization and only 12.58 per cent of the rice growers had low level of information utilization. So, it is clear from the data, that majority of the rice growers had medium level of information utilization. These results are in line with the findings of Anwar (2016); Kasidurai and Vengatesan (2017); Prashanth *et al.* (2012); Ravi Goud and Daya Ram (2018) and Suresh *et al.* (2012).

From Table 2 it was found, that in sub-division Pattan, the data collected on information processing through information utilization by the respondents, it was observed, that the respondents regularly planned the date for sowing by (50.00%), followed by seed treatment (47.10%), availability of seed (45.70%), post harvest and marketing operations (41.40%), selection of seed material (34.30%), application of fertilizers and manures (34.30%). Whereas, scheduling irrigation (30.00%) and planning for harvesting (30.00%). The respondents occasionally planned for harvesting was 54.30 per cent, followed by selection of seed material (50.00%), application of fertilizers and manures (48.60%), planning the date of sowing (42.90%), seed treatment (41.40%), post harvest and marketing operations (35.70%). Whereas, scheduling irrigation (31.40%) and availability of seed (27.10%). The respondents rarely utilised post harvest and marketing operations (21.40%), followed by availability of seed (17.10%), scheduling irrigation (17.10%), application of fertilizers and manures (15.70%), selection of seed material (12.90%) and planning for harvesting (12.90%). Whereas, seed treatment (11.40%) and planning the date of sowing (05.70%). The respondents never scheduled irrigation (21.40%), followed by availability of seed (10.00%), selection of seed material (02.90%), planning for harvesting (02.90%), planning the date of sowing (01.40%), application of fertilizers and manures (01.40%), post harvest and marketing operations (01.40%).

In case of sub-division Sopore, it was observed that the respondents regularly utilised seed treatment (54.80%), followed by planning the date of sowing (48.90%), selection of seed material (45.20%), availability of seed (43.70%), post harvest and marketing operations (28.10%), application of fertilizers and manures (27.40%), planning for harvesting (20.70%) and scheduling irrigation (14.10%). The respondents occasionally planned for harvesting (46.70%), post harvest and marketing operations (46.70%), followed by application of fertilizers and manures (45.90%), selection of seed material (39.30%), seed treatment (31.90%), availability of seed (31.10%). Whereas planning the date of sowing (29.60%) and scheduling irrigation (29.60%). The respondents rarely planned scheduled irrigation (25.90%), planning for harvesting (25.90%), post harvest and marketing operations (20.70%), availability of seed (20.00%), application of fertilizers and manures (19.30%), planning the date of sowing (17.80%). Whereas, selection of seed material (11.90%) and seed treatment (06.70%). The respondents never planned scheduling irrigation (30.40%), followed by application of fertilizers and manures (07.40%), seed treatment (06.70%), planning for harvesting (06.70%), availability of seed (05.20%), post harvest and marketing operations (04.40%). Whereas, selection of seed material (03.70%) and planning the date of sowing (03.70%), respectively.

In case of sub-division Tangmarg, the respondents regularly planned selection of seed material (41.70%), followed by availability of seed (33.30%), planning the date of sowing (33.30%), seed treatment (16.70%), planning for harvesting (16.70%). Post harvest and marketing operations (16.70%). Whereas, scheduling irrigation (08.30%) and application of fertilizers and manures (08.30%). The respondents occasionally used

Table 2: Distribution of rice growers according to their information utilization

Information utilization	Sub-Division											
	Pattan (n1=70)				Sopore (n2=135)				Tangmarg (n3=12)			
Regularity of contact	Regularly	Occasionally	Rarely	Never	Regularly	Occasionally	Rarely	Never	Regularly	Occasionally	Rarely	Never
Availability of seed	32(45.70)	19(27.10)	12(17.10)	07(10.00)	59(43.70)	42(31.10)	27(20.00)	07(05.20)	04(33.30)	05(41.70)	02(16.70)	01(08.30)
Selection of seed material	24(34.30)	35(50.00)	09(12.90)	02(02.90)	61(45.20)	53(39.30)	16(11.90)	05(03.70)	05(41.70)	02(16.70)	05(41.70)	00(00.00)
Seed treatment	33(47.10)	29(41.40)	08(11.40)	00(00.00)	74(54.80)	43(31.90)	09(06.70)	09(06.70)	02(16.70)	08(66.70)	02(16.70)	00(00.00)
Planning the date of sowing	35(50.00)	30(42.90)	04(05.70)	01(01.40)	66(48.90)	40(29.60)	24(17.80)	05(03.70)	04(33.30)	03(25.00)	04(33.30)	01(08.30)
Scheduling irrigation.	21(30.00)	22(31.40)	12(17.10)	15(21.40)	19(14.10)	40(29.60)	35(25.90)	41(30.40)	01(08.30)	03(25.00)	04(33.30)	04(33.30)
Application of fertilizers and manures	24(34.30)	34(48.60)	11(15.70)	01(01.40)	37(27.40)	62(45.90)	26(19.30)	10(07.40)	01(08.30)	08(66.70)	03(25.00)	00(00.00)
Planning for harvesting.	21(30.00)	38(54.30)	09(12.90)	02(02.90)	28(20.70)	63(46.70)	35(25.90)	09(06.70)	02(16.70)	03(25.00)	04(33.30)	03(25.00)
Post harvest and marketing operations	29(41.40)	25(35.70)	15(21.40)	01(01.40)	38(28.10)	63(46.70)	28(20.70)	06(04.40)	02(16.70)	06(50.00)	02(16.70)	02(16.70)

Figures within parenthesis indicate respective percentage

Table 2 contd...

Information utilization	Sub-Division											
	Pattan (n1=70)				Sopore (n2=135)				Tangmarg (n3=12)			
Regularity of contact	Regularly	Occasionally	Rarely	Never	Regularly	Occasionally	Rarely	Never	Regularly	Occasionally	Rarely	Never
Availability of seed	42(57.50)	19(26.00)	10(13.70)	02(02.70)	11(55.00)	09(45.00)	00(00.00)	00(00.00)	148(47.70)	94(30.30)	51(16.50)	17(05.50)
Selection of seed material	36(49.30)	32(43.80)	05(06.80)	00(00.00)	06(30.00)	11(55.00)	03(15.00)	00(00.00)	132(42.60)	133(42.90)	38(12.30)	07(02.30)
Seed treatment	32(43.80)	21(28.80)	18(24.70)	02(02.70)	09(45.00)	11(55.00)	00(00.00)	00(00.00)	150(48.40)	112(36.10)	37(11.90)	11(03.50)
Planning the date of sowing	35(47.90)	28(38.40)	10(13.70)	00(00.00)	15(75.00)	04(20.00)	01(05.00)	00(00.00)	155(50.00)	105(33.90)	43(13.90)	07(02.30)
Scheduling irrigation.	05(06.80)	13(17.80)	35(47.90)	20(27.40)	01(05.00)	07(35.00)	12(60.00)	00(00.00)	46(14.80)	79(25.50)	93(30.00)	92(29.70)
Application of fertilizers and manures	25(34.20)	47(64.40)	01(01.40)	00(00.00)	01(05.00)	19(95.00)	00(00.00)	00(00.00)	88(28.40)	170(54.80)	41(13.20)	11(03.50)
Planning for harvesting.	26(35.60)	34(46.60)	12(16.40)	01(01.40)	04(20.00)	06(30.00)	10(50.00)	00(00.00)	81(26.10)	144(46.50)	70(22.60)	15(04.80)
Post harvest and marketing operations	52(71.20)	18(24.70)	03(04.10)	00(00.00)	02(10.00)	16(80.00)	02(10.00)	00(00.00)	123(39.70)	128(41.30)	50(16.10)	09(02.90)

Figures within parenthesis indicate respective percentage.

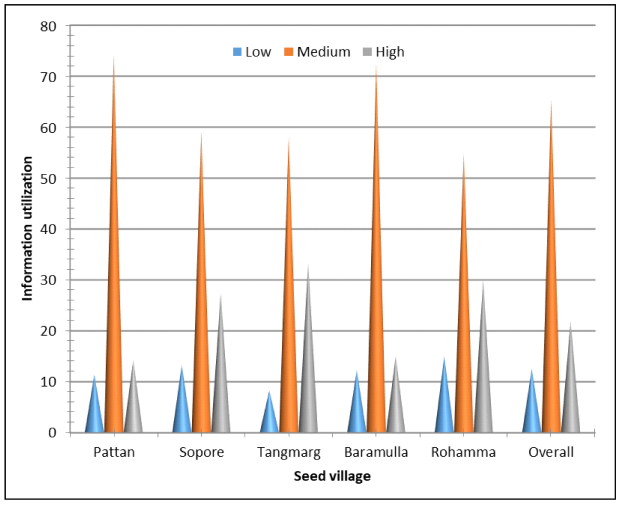

Figure 2: Information Utilization of rice growers under seed village programme

seed treatment and application of fertilizers and manures (66.70%), followed by post harvest and marketing operations (50.00%), availability of seed (41.70%), planning the date of sowing (25.00%), scheduling irrigation (25.00%), planning for harvesting (25.00%) and selection of seed material (16.70%). The respondents rarely selected seed material (41.70%), followed by planning the date of sowing (33.30%), scheduling irrigation (33.30%), planning for harvesting (33.30%), application of fertilizers and manures (25.00%), availability of seed (16.70%), seed treatment (16.70%) and post harvest and marketing operations (16.70%). Whereas, the respondents never scheduled irrigation (33.30%), followed by planning for harvesting (25.00%), post harvest and marketing operations (16.70%), planning the date of sowing (08.30%) and availability of seed (08.30%).

In sub-division Baramulla, it was observed, that the respondents regularly planned post harvest and marketing operations (71.20%), followed by availability of seed (57.50%), selection of seed material (49.30%), planning the date of sowing (47.90%), seed treatment (43.80%), planning for harvesting (35.60%), application of fertilizers and manures (34.20%) and scheduling irrigation (06.80%). Whereas, the respondents occasionally planned application of fertilizers and manures 64.40 per cent, followed by planning for harvesting (46.60%), selection of seed material (43.80%), planning the date of sowing (38.40%), seed treatment (28.80%), availability of seed (26.00%). Whereas, post harvest and marketing operations (24.70%) and scheduling irrigation (17.80%). The respondents rarely planned scheduled irrigation (47.90%), followed by seed treatment (24.70%), planning for harvesting (16.40%), availability of seed (13.70%), planning the date of sowing (13.70%) and selection of seed material (06.80%). Whereas, post harvest and marketing operations (04.10%) and application of fertilizers and manures (01.40%). The respondents never planned scheduled irrigation (27.40%), followed by availability of seed (02.70%), seed treatment (02.70%) and planning for harvesting (01.40%).

In case of sub-division Rohamma, it was observed, that the respondents regularly planned the date of sowing (75.00%), followed by availability of seed (55.00%), seed treatment (45.00%), selection of seed material (30.00%), planning for harvesting (20.00%). post harvest and marketing operations (10.00%), scheduling irrigation (05.00%) and application of fertilizers and manures by (05.00%). The respondents occasionally planned application of fertilizers and manures (95.00%), followed by post harvest and marketing operations (80.00%), selection of seed material (55.00%), seed treatment (55.00%), availability of seed (45.00%), scheduling irrigation (35.00%), planning for harvesting (30.00%) and planning the date of sowing (20.00%). The respondents rarely scheduled irrigation (60.00%), followed by planning for harvesting (50.00%), selection of seed material (15.00%), post harvest and marketing operations (10.00%) and planned the date of sowing (05.00%).

However, the overall information processing through information utilization by the respondents of rice growers from all the five sub-divisions, it was found, that the respondents regularly planned the date of sowing (50.00%), followed by seed treatment (48.40%), availability of seed (47.70%), selection of seed material (42.60%), post harvest and marketing operations (39.70%), application of fertilizers and manures (28.40%), planning for harvesting (26.10%) and scheduling irrigation (14.80%). The respondents occasionally used application of fertilizers and manures (54.80%), followed by planning for harvesting (46.50%), selection of seed material (42.90%), post harvest and marketing operations (41.30%), seed

treatment (36.10%), planning the date for sowing (33.90%). Whereas, the availability of seed (30.30%) and scheduling irrigation (25.50%). The respondents rarely used scheduling irrigation (30.00%), followed by planning for harvesting (22.60%), availability of seed (16.50%), post harvest and marketing operations (16.10%), planning the date for sowing (13.90%), application of fertilizers and manures (13.20%). Whereas, selection of seed material by (12.30%) and seed treatment (11.90%). The respondents never scheduled irrigation (29.70%), followed by availability of seed (05.50%), planning for harvesting (04.80%), seed treatment (03.50%), application of fertilizers and manures (03.50%), post harvest and marketing operations (02.90%). Whereas, selection of seed material (02.30%) and planning the date for sowing (02.30%). These findings revealed, that most commonly used information utilization for information processing by the respondents were availability of seed, followed by selection of seed material and seed treatment, planning the date of sowing, scheduling irrigation, application of fertilizers and manures, planning for harvesting and post harvest and marketing operations.

CONCLUSION

It can be concluded that the majority of rice growers from all the five sub-divisions were having medium level of information utilization, it was found, that in sub-division Rohamma and Pattan, the regularly utilised information by majority of rice growers was planned date of sowing, 75.00 per cent in sub-division Rohamma and 50.00 per cent in sub-division Pattan. In sub-division Baramulla, the regularly utilised information by majority (71.20%) of rice growers was post harvest and marketing operations. In sub-divisions Sopore and Tangmarg, the regularly utilised information found by majority of rice growers was seed treatment, 54.80 per cent in sub-division Sopore and 41.70 per cent in sub-division Tangmarg. However, the overall regularly utilised information by majority of the rice growers was planned date of sowing (50.00%). Apart from that, respondents may be directed to alternative data processing methods for more effective data analysis and processing for future use.

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Research Article

Comparative Study on Women Empowerment through Self-Help Groups in Chhotaudepur District of Gujarat State

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ABSTRACT

The concept of Self Help Group has its roots in rural areas and it has been mooted along rural and semi-urban women to improve their living conditions. In India, this scheme is implemented with the help of NABARD as a main nodal agency in rural development. It is a self-employment generation scheme for especially rural women, who don't have their assets. The proposed investigation was carried out in Chhotaudepur district of Gujarat state. Among six taluka, two taluka were purposively selected for the study, from each of which, two villages were selected. Thus a total of four villages were selected and from each selected village, 10 women involved in self help groups and 10 women not involved in self help groups were selected, making a total sample of 80 women selected for the study. This study revealed that the majority of SHG and Non-SHG members were from middle age groups and joint family, had primary to secondary level of education and had up to Rs. 50000/- annual income. The majority of them were marginal and small farmers had membership in one organization and had agriculture and animal husbandry as their main occupations. The SHG members showed a little bit higher empowerment than Non SHG members. The variables education and annual income showed a significant relationship in the case of SHG members, while education and training received showed a significant relationship in the case of Non SHG members.

Keywords: Self help groups, Non self help groups, Education, Correlation, Annual income

INTRODUCTION

The concept of Self help group has its roots in rural areas and it has been mooted along rural and semi-urban women to improve their living conditions. Though it is applicable to men in our country, but it has been more successful only among women and they can start economic activities through SHG movement. In India, this scheme is implemented with the help of NABARD as a main nodal agency in rural development. It is a self-employment generation scheme for especially rural women, who don't have their own assets. The word 'empowerment' means giving power. According to the International Encyclopedia (1999), power means having the capacity and the means to direct one's life toward desired social, political and economic goals or status. Empowerment provides greater access to knowledge and resources, more autonomy in decision making, greater ability to plan lives, more control over the circumstances which influence lives, and freedom from customs, beliefs and practices. Thus empowerment of women is not just a goal in itself, but a key to all global development goals. Empowerment is an active multidimensional process to enable women to realize their identity and power in all spheres of life.

MATERIALS AND METHODS

The proposed investigation was carried out in Pavi-Jetpur and Bodeli taluka of Chhotaudepur district, from each of which, two villages were selected. Thus

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total four villages were selected for the study and from each selected village, 10 women involved in self help groups and 10 women not involved in self help group were selected, making a total sample of 80 women for the study. Questionnaire was developed in accordance with the objectives and data were collected through personal interview method. The statistical tools used for the analysis of the data were frequency, percentage, mean and correlation coefficient.

RESULTS AND DISCUSSION

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

As is evident from Table 1, majority i.e. 77.50 per cent of SHG members and 72.50 per cent of Non SHG members were from middle age group, whereas 15.00 per cent and 25.00 per cent of SHG and Non SHG members, respectively were from young age category.

The data presented in Table 2 indicate that majority i.e. 80.00 per cent of SHG members and 82.50 per cent of Non SHG members had primary to higher secondary level of education, whereas 17.50 per cent of respondents in both groups were found illiterate.

In the case of a type of family, the perusal of Table 3 reveals that 87.50 per cent of SHG members and 65.00 per cent of Non SHG members were from joint family.

In regards with annual income, majority i.e. 80.00 per cent of SHG and 90.00 per cent of Non SHG members were found to have the annual income up to Rs. 50000/- while 20.00 per cent of SHG and 10.00 per cent of Non SHG members had annual income in the range of Rs. 50,001/- to Rs. 1, 00,000/-.

Table 1: Distribution of respondents according to age groups (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Young age (Up to 25 years)	06	15.00	10	25.00
Middle age (26 to 50 years)	31	77.50	29	72.50
Old age (Above 50 years)	03	07.50	01	02.50
Total	40	100.00	40	100.00

Table 2: Distribution of respondents according to their education (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Illiterate	07	17.50	07	17.50
Primary (1st to 7th std.)	10	25.00	07	17.50
Secondary (8th to 10th std.)	16	40.00	16	40.00
Higher Secondary Education (11th to 12th std.)	06	15.00	06	15.00
Graduation and above	01	2.50	04	10.00
Total	40	100.00	40	100.00

Table 3: Distribution of respondents according to their type of family (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Nuclear family	05	12.50	14	35.00
Joint family	35	87.50	26	65.00
Total	40	100.00	40	100.00

As it is clear from the data presented in Table 5, more than half (55.00%) of the SHG members had marginal land holding followed by small (35.00%) and medium (10.00%) land holding, while in case of Non SHG members, exactly half of the respondents had marginal land holding and 25.00 per cent each had small and medium land holding.

The data depicted in Table 6 indicate that majority i.e. 80.00 per cent of SHG and 95.00 per cent of Non SHG members were married. Only 20.00 per cent and 5.00 per cent of SHG and Non SHG members, respectively were unmarried.

In regards with occupation, the data presented in Table 7 indicate that majority of SHG members (60.00 per cent) had Farming + Animal Husbandry + Labour as their major occupation followed by 27.50 per cent who had Farming + Animal Husbandry as their major occupation. In case of Non SHG members, majority i.e. 70.00 per cent had Farming + Animal Husbandry as their major occupation followed by Farming +

Table 4: Distribution of respondents according to their annual income (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Up to Rs. 50,000/-	32	80.00	36	90.00
Rs. 50,001/- to Rs. 1,00,000/-	08	20.00	04	10.00
Rs. 1,00,001/- to Rs. 1,50,000/-	-		-	
Total	40	100.00	40	100.00

Table 5: Distribution of respondents according to their land holding (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Marginal (up to 1.0 ha)	22	55.00	20	50.00
Small (1.01 to 2.0 ha)	14	35.00	10	25.00
Medium (2.01 to 4.0 ha)	04	10.00	10	25.00
Large (Above 4.0 ha)	-			
Total	40	100.00	40	100.00

Table 6: Distribution of respondents according to their marital status (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Married	32	80.00	38	95.00
Unmarried	08	20.00	02	05.00
Total	40	100.00	40	100.00

Table 7: Distribution of respondents according to their occupation (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Labour	01	2.50	-	
Only Farming	01	2.50	01	2.50
Farming + A.H.+ Labour	24	60.00	11	27.50
Anganvadi worker	03	7.50	-	-
Farming + Animal Husbandry	11	27.50	28	70.00
Total	40	100.00	40	100.00

Animal Husbandry + Labour (27.50%). It is apparent form the Table 8 that cent per cent of Non SHG members and 85.00 per cent of SHG members had membership in one or more than one organizations. Further, none of Non SHG members was observed in the category of 'position holding' and 'no membership', while 7.5 per cent of SHG members were found in each of these two categories

The data presented in Table 9 clearly show that a great majority (97.50%) of the SHG members didn't take any type of training, whereas majority (75.00%) of the Non SHG members were found to have received training.

It is clear from the Table 10 that nearly two-third of SHG members (65.00%) possessed refrigerator, followed by TV set (47.50%), mixer (42.50%), radio (32.50%) and sofa set (27.50%), whereas in case of Non SHG members, the most possessed item was refrigerator (90.00%) followed by mixer (85.00%), radio (77.50%), sofa set (32.50%) and TV set (27.50%). The least possessed items were oven and mill in both the categories.

The perusal of data presented in Table 11 clearly reveals that on all selected aspects of empowerment i.e. confidence building, decision power, economic empowerment and social empowerment, the values of total mean score for SHG members were higher than their counter part in Non SHG members. Thus SHG members were observed to be more empowered than Non SHG members.

As it is evident from the data presented in Table 12, the variable education showed positive and significant relationship with empowerment of women in both the categories. Further, annual income exerted

Table 8: Distribution of respondents according to their social participation (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
No membership	03	7.50	-	-
Membership in one organization	30	75.00	38	95.00
Membership in more than one organization	04	10.00	02	05.00
Position holder	03	7.50	-	-
Total	40	100.00	40	100.00

Table 9: Distribution of respondents according to training received (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Training received	01	2.50	30	75.00
Training not received	39	97.50	10	25.00
Total	40	100.00	40	100.00

Table 10: Distribution of respondents according to their homely material possession (n=80)

Categories	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Refrigerator	26	65.00	36	90.00
Television set	19	47.50	11	27.50
Radio	13	32.50	31	77.50
Mixer	17	42.50	34	85.00
Sofa set	11	27.50	13	32.50
Oven	01	2.50	02	5.00
Mill	00	0.00	01	2.50

Table 11: Comparison of empowerment of SHG and Non SHG members (n=80)

Empowerment Category	SHG Member (n=40)		Non SHG Member (n=40)	
	Frequency	Percentage	Frequency	Percentage
Confidence building	8.05	1.610	7.025	1.405
Decision power	11.4	1.267	6.95	0.772
Economic empowerment	4.90	0.408	4.275	0.356
Social empowerment	5.15	0.644	4.325	0.541

Table 12: Relationships between profile of SHG and Non SHG members and their empowerment (n=80)

Independent variables	Correlation coefficient (r value)	
	SHG members (n=40)	Non SHG members (n=40)
Age	-0.2460	0.2960
Education	0.4610**	0.3720*
Type of family	-0.1040	0.2090
Annual income	-0.315*	-0.0560
Land holding	0.1280	-0.0390
Marital status	-0.0530	0.1700
Social Participation	0.229	0.3000
Training received	0.0150	0.723**

* Significant at 0.05 level of probability** Significant at 0.01 level of probability

negative but significant relationship with empowerment of SHG members while training received showed positive and significant relationship with empowerment of Non SHG members. All other variables showed non-significant relationship with the empowerment of women in both the categories.

CONCLUSION

The present study infers that among all selected aspects of empowerment, SHG women are contributing significantly to increasing the level of confidence building, decision power, economic and social status. Another important finding from the study is that education played a significant role in women's empowerment. It is also observed that the SHG members showed higher empowerment than Non SHG members. Therefore government agencies and private organizations should give due importance to the number of SHG members enrolling and enhancing the activities of SHG, especially for women's empowerment.

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Research Article

Development of Malted Cereal and Legume based Supplementary Biscuits to Combat Malnutrition in Young Children

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ABSTRACT

In this study, supplementary biscuits were developed using combination of malted wheat, finger millet, green gram, carrot powder and flaxseed powder and analyzed for sensory and nutritional evaluation. The effect of biscuits supplementation on nutritional status of sixty malnourished children (3-5 years) was examined. The children were divided into control and experimental groups and the experimental group was supplemented with five biscuits (60±5g), six days a week for 4 months. The malted flours based biscuits were found sensorily acceptable and contains 15.31 g protein, 469.72 Kcal energy, 3.89 g lysine, 1.96 g methionine per 100g. Significant increase ($p<0.01$) in nutrient intake and anthropometric measurements was observed in experimental group after supplementation period. Also, the prevalence of severely malnourished (> -3 SD) children (13.33%) reduced to zero after supplementation of malted flours based biscuits.

Keywords: Malted flours, Nutritional evaluation, Supplementation trial, Malnourished children

INTRODUCTION

Globally, around 45 per cent of the deaths among children under 5 years of age are linked to malnutrition occurs most frequently in low and middle income countries. Malnutrition is a condition that occurs when a body doesn't get adequate amount of calories, protein, vitamins and other vital nutrients which it requires to sustain healthy tissues and proper functioning of organs. When there is an insufficiency in the quantity and nutritional value of the food consumed, the growth of a child gets disturbed attributable to nutrient inadequacies (Kumari *et al.,* 2016). World Health Organization (WHO) defines that malnutrition refers to deficiency, excess or imbalance in a person's energy intake and other nutrients. It affects the children at most critical period such as development stage, which causes permanent destruction in later stage of life (Bala *et al.,* 2014). According to NFHS-4 (2015-16), the percentage of stunted, underweight and wasted children (under the five years of age) was 37, 34 and 22 per cent in India, respectively and as described in recent report of Global Hunger Index (2020), India ranks 94 out of 107 countries.

Adequate nutrition is a key to good health and plays a significant role in healthy growth and development (cognitive and physical) and in improving the socio-economic status of the child. Nutrition during early childhood is significant as it is an establishment for life time wellbeing and strength and it is characterized by rapid growth with increased muscle mass, growth of organs, blood volume expansion and linear increase in the long bones. Children need accurate nutritional care not exclusively to promote but also to sustain their optimal health and nutritional status. Provision of sufficient dietary energy, macro and micro nutrients for growth and development should be the principle determinant of the growing children's diet and protein and carbohydrates are the major macronutrients

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required with regard to the prevention of protein-energy malnutrition. Nutrient-dense foods enable children to consume and maximize the nutrients absorption in order to fulfill their requirements of all essential nutrients. Supplementary feeding may help vulnerable and food insecure people by improving the diet adequacy and nutritional value, improving quality of life and various health parameters of disadvantaged families.

As cereals are the most significant contributor to the human diet and are generally considered as an excellent source of protein, energy, minerals and dietary fiber and wheat is the most widely recognized grain used as a staple food in India and millets are rich in minerals and nutraceuticals and has high amounts of dietary fiber than wheat or rice and contains 70-80 per cent carbohydrates and 9-14 per cent protein. Since a diet consisting of only cereal products is incomplete in terms of the protein quality, therefore the addition of legumes or pulses increases the protein content and overall nutritional profile with improved digestibility of the product. Consumption of the green gram (*mung* bean) combined with cereals has been recommended to significantly improve the quality of protein. *Mung* bean (*Vigna radiate* L.) is one among the essential pulse crops which is a good source of protein (19.1 to 28.3%), minerals (0.18 to 0.21%) and vitamins.

Malting of cereals and legume can be helpful in increasing the overall nutritional value by decreasing the anti-nutritional factors present in such grains and also decreases the bulk density of the formulated foods with increased energy density. Malting also improves the protein and starch digestibility and availability of various minerals. Among vegetables, carrot (*Daucus carota*) is a nutritious and an excellent source of iron, â-carotene, dietary fibre, complex carbohydrates and several minerals like calcium, phosphorus, iron and magnesium (Gazalli *et al.,* 2013) and flaxseed serves as the best and only source of omega-3 fatty acid to the vegetarian diet and contains around 55 per cent alpha-linolenic acid, 28-30 per cent protein and 35 per cent fiber (Rabetafika *et al.,* 2011). Therefore, the combination of malted wheat, finger millet, green gram, carrot powder and flaxseed powder was used in the study to develop biscuits enriched with macro as well as micro-nutrients for malnourished children.

MATERIALS AND METHODS

Bakery products such as biscuits are one among the most popular bakery items. These products are important food snacks for children as well as for adults. Bakery products are mainly prepared by refined wheat flour and 25 per cent of the total wheat produced is used in the manufacturing of bakery items which are rich in fat, starch and energy but lacks in fiber and protein. With the use of different types of malted cereals and legume flours along with the combination of a vegetable and oilseed source, bakery items can be enriched with fiber and protein and can also provide antioxidants and other essential nutrients. Hence, this study was conducted to develop malted flours based biscuits enriched with protein and energy with a vision to combat malnutrition in vulnerable children.

Procurement of ingredients: Wheat (PBW 550) and green gram (SML 668) were procured from Seeds Technology Center, Punjab Agricultural University (PAU), Ludhiana. Finger millet, carrots, flaxseeds along with other ingredients such as sugar, milk, butter, etc. were procured from local market Ludhiana.

Processing of ingredients: Wheat, finger millet and green gram grains were sorted and cleaned thoroughly to remove dust, dirt and foreign particles and soaked in double volumes of water at room temperature (20-25°C) for 12 hours by changing water after every 4 hours to prevent any fungal infections and then water was drained and seeds were allowed to germinate in a moistened muslin cloth for 24-48 hours with periodic sprinkling of water to keep the cloth moist. Then germinated grains were dried in hot-air dryer at 60±5°C for 20-24 hours. After drying, the grains were milled into fine flours using dry milling process in the Department of Food Science and Technology, PAU, Ludhiana.

Development of biscuits: For the development of biscuits, six different combinations were developed and coded as C1, C2, T1, T2, T3 and T4. C1 and C2 were considered as control samples and others were considered as treatment samples. For development of C2 (control) sample, malted wheat flour was used in place of whole wheat flour in C1 (control) sample. For various treatment samples, different ratios of malted wheat, malted finger millet, malted green gram,

Table 1: Amount of flours used for the development of biscuits

Ingredients	Amount (g)					
	C1	C2	T1	T2	T3	T4
Wheat flour	100	-	-	-	-	-
Malted wheat flour	-	100	90	80	70	60
Malted finger millet flour	-	-	1	2	3	4
Malted green gram flour	-	-	5	10	15	20
Carrot powder	-	-	2	4	6	8
Flaxseed powder	-	-	2	4	6	8
Powdered sugar	50	50	50	50	50	50
Fat	60	60	60	60	60	60
Milk (ml)	15-20	15-20	15-20	15-20	15-20	15-20
Baking powder	2	2	2	2	2	2

carrot and flaxseed powder were used as shown in Table 1. Biscuits were developed using standardized recipe (Kochhar and Kaur 2015). The fat (60 g) was rubbed on a clean surface with palm and creamed properly. Sugar (50 g) was added and creamed together until becomes light and fluffy. The flours (100 g) along with baking powder (2 g) were added gradually and smooth dough was prepared by using milk. Dough was sheeted and shape of biscuits were cut and baked at 150°C for 20 minutes. The biscuits were cooled for half an hour at room temperature and stored in low density polythene packs for further analysis.

Sensory evaluation: The semi-trained panel of ten judges carried out the sensory evaluation of developed biscuits. The panelists were asked to score samples on 9-point Hedonic rating scale where scores 1, 2, 3, 4, 5, 6, 7, 8 and 9 represented disliked extremely, disliked very much, disliked moderately, disliked slightly, neither liked nor disliked, liked slightly, liked moderately, liked very much and liked extremely, respectively. All panelists were instructed to rinse their palate with mineral water before testing each sample. The product characterization was carried out under "day light" illumination and in isolated booths within a nutrition laboratory. The different codes were allotted to the samples so as to avoid any preconception. Further, the mean score for each sample was calculated.

Nutrient analysis of biscuits: The biscuits prepared using 100 per cent whole wheat flour and 100 per cent malted wheat flour along with highly acceptable malted flours based biscuits were dried and powdered in a grinder. Dried powdered samples of biscuits were stored in air tight plastic bags for further nutrient analysis. The proximate composition (AOAC, 2000), minerals such as calcium, phosphorus, iron and zinc (Piper, 1950), amino acids-available lysine (Booth, 1971) and methionine (Horn *et al.,* 1946), *In-vitro* protein (Akeson and Stachman, 1964) and starch digestibility (Singh and Jambunathan, 1982), total phenols (Singleton *et al.,* 1999) and phytin phosphorus (Haug and Lantzsch, 1983) were determined using standard procedures.

Supplementation trial: The biscuits were supplemented to the children in the age group of 3 to 5 years from urban slum areas of Ludhiana city. In the present study, a total of 60 malnourished children (3-5 yrs.) were selected from urban slum areas of Ludhiana city on the basis of Z-score. A questionnaire was prepared to collect the information regarding demographic profile, socioeconomic status, diseases and hygiene condition and dietary intake for 3 consecutive days using 24-hour dietary recall method for calculating the nutrient intake of the subjects. The developed questionnaire was pretested by selecting 10 children between age group of 3 to 5 years which were not included in the study. The required modifications were done in the final questionnaire. For supplementation trial, the written consent was taken from parents of selected subjects. The children were divided into two groups of 30 each and named as control and experimental group. The duration kept for supplementation trial was period of 4 months. The subjects of experimental group were supplemented

with malted flours based biscuits and were provided with five biscuits amounting 60±5 g, six days a week.

Data collection: The effect of supplementation was determined by taking data pertaining to nutritional status of the subjects such as anthropometry and dietary intake. The supplementary effect was assessed by observing any increase or decrease in all the parameters used to assess nutritional status of young children. The data were collected at two stages before and after supplementation of biscuits for 4 months.

Dietary intake: Dietary intake was measured using "24 hour recall" method. Data pertaining to nutrient intake was calculated using "Diet Cal" software (Kaur, 2014). The nutrient intake before and after supplementation, was compared with Recommended Dietary Allowances (RDA) given by Indian Council of Medical Research (ICMR, 2010).

Anthropometric measurements: Anthropometric measurements viz. Height, weight, mid upper arm circumference (MUAC), head circumference and chest circumference were measured and recorded before and after supplementation of 4 months using standard methods given by Jellife (1966). The derived anthropometric measurements viz. Body mass index (BMI) was calculated. The z-scores for different indices like weight-for-age (WAZ), height-for-age (HAZ), Body mass index-for-age (BMI-Z) were calculated using 'WHO: Anthro-plus software' (WHO, 2009). The prevalence of malnutrition was calculated on the basis of z-score cut off level by WHO (2006).

Statistical analysis: All the determinations were carried out in triplicate and the results are given in mean and standard error for different parameters. Kruskal-Wallis and Mann-Whitney test was applied for selecting the best formulation of biscuits through sensory evaluation. One-way analysis of variance (ANOVA) was used to compare the significant differences in both control and highly acceptable experimental biscuits. Paired t-test was applied to assess the impact of supplementation on the nutritional status of selected subjects in the experimental group as well as control group ($p<0.01$, $p<0.05$).

RESULTS AND DISCUSSION

Malted flours based biscuits were developed to fulfill the requirements of malnourished children for macro and micro-nutrients. The developed biscuits were sensorily evaluated by a semi-trained panel of ten judges using nine point Hedonic rating scale to ascertain the acceptability of the biscuits. The results for sensory evaluation of biscuits (Table 2 and Figure 1) prepared with different ratios of malted flours, carrot and flaxseed powder revealed that the experimental sample T2 was found to be highly acceptable after control samples with the overall acceptability score of 7.71. T1 and T2 were found non-significantly different from control in all the parameters of sensory evaluation and T3 and T4 were found significantly ($p<0.05$) different. The malted flours based biscuits developed by using malted wheat flour (80 g), malted finger millet flour (2 g), malted green gram flour (10 g), carrot powder (4

Table 2: Sensory scores for malted flours based Biscuits (Mean±SE)

Levels	Appearance	Colour	Texture	Flavour	Taste	Overall Acceptability
C1	8.1^{a}±0.23	8.1^{a}±0.23	8.2^{a}±0.20	8.2^{a}±0.20	8.3^{a}±0.21	8.18^{a}±0.20
C2	7.9^{a}±0.10	7.9^{a}±0.17	7.6^{c}±0.16	8.0^{ac}±0.21	8.1^{a}±0.23	7.9^{ac}±0.14
T1	7.7^{a}±0.15	7.7^{a}±0.15	7.3^{bc}±0.21	7.4^{bc}±0.26	7.5^{ac}±0.30	7.52^{c}±0.19
T2	7.8^{a}±0.20	7.6^{a}±0.22	7.45^{acd}±0.32	7.8^{ac}±0.24	7.9^{a}±0.27	7.71^{ac}±0.23
T3	6.9^{b}±0.10	6.9^{b}±0.23	6.6^{de}±0.22	6.9^{b}±0.27	6.9^{bc}±0.27	6.84^{b}±0.18
T4	6.5^{b}±0.26	6.5^{b}±0.26	6.3^{e}±0.26	6.2^{d}±0.24	6.1^{d}±0.23	6.32^{b}±0.21
χ^2 value	30.94**	25.42**	26.47**	27.48**	28.14**	30.09**

C1- Whole wheat flour - 100g; **C2 -** Malted wheat flour- 100g; **T1-** Malted wheat flour- 90g, malted finger millet flour- 1g, malted green gram flour- 5g, carrot powder- 2g, flaxseed powder- 2g; **T2-** Malted wheat flour- 80g, malted finger millet flour- 2g, malted green gram flour- 10g, carrot powder- 4g, flaxseed powder- 4g; **T3-** Malted wheat flour- 70g, malted finger millet flour- 3g, malted green gram flour- 15g, carrot powder- 6g, flaxseed powder- 6g; **T4-** Malted wheat flour- 60g, malted finger millet flour- 4g, malted green gram flour- 20g, carrot powder- 8g, flaxseed powder- 8g

**Significant at 1% level of significance

Means with different notations (a, b, c and d) indicates significant difference at 5% level of significance.

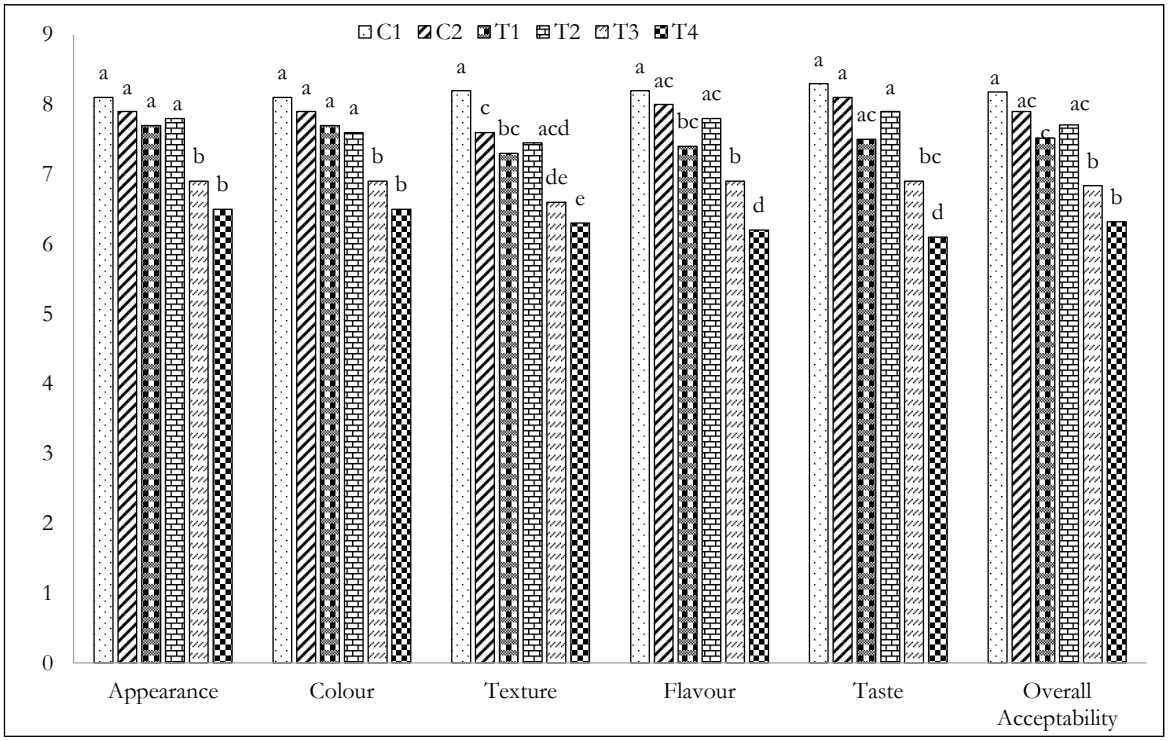

Figure 1: Sensory scores for malted flour based Biscuits

g) and flaxseed powder (4 g) obtained the highest overall acceptability scores in sensory evaluation. Similarly, Banusha and Vasantharuba (2014) carried out a study to develop biscuits by partially replacing the wheat flour with malted flour blends of finger millet and *mung* bean and sensory attributes were evaluated. The biscuits incorporated with 30 per cent malted flour blend (6% malted finger millet flour, 24% malted *mung* bean flour) had the highest median value for flavor and taste and no significant difference was found with control (wheat biscuits) in all other sensory characteristics and concluded that malted flour biscuits can be used as a substitution for wheat flour biscuit in children diet.

Control and highly acceptable experimental samples of biscuits were estimated for nutritional, anti-nutritional content, *in vitro* protein and starch digestibility.

Nutrient analysis: The results for the nutrient analysis of biscuits developed using malted flours (Table 3) revealed that the moisture (5.57%), protein (15.31%), fat (21.84%), ash (1.94%), crude fiber (2.36%) content was found to be significantly ($p<0.05$) increased in malted flours based biscuits sample. Carbohydrate and energy value of malted flours based biscuits (52.98% and 469.72 Kcal, respectively) was lower than control (57.85% and 477.92 Kcal, respectively). Banusha and Vasantharuba (2014) conducted a study to check the feasibility of partially replacing wheat flour by malted flour blends of finger millet and *mung* bean and prepared biscuits with increased level of protein, crude fiber and ash content and lower in carbohydrate and energy value compared to wheat flour biscuits. The results found were also in concordance to the findings of Aziah *et al.* (2012) who prepared biscuits by substituting wheat flour with *mung* bean and chickpea.

Minerals such as calcium, phosphorus, iron and zinc were also estimated in control and experimental biscuits. Significantly ($p<0.05$) increased calcium (107.80 mg) and phosphorus (289.80 mg) was observed in malted flours based biscuits and non-significant difference was observed in iron (4.96 mg) and zinc (3.56 mg) content. Similar results were also reported by Kumari *et al.* (2016) reported that combination of whole wheat flour, *ragi* flour, green gram flour, soy flour and roasted groundnut flour contains high amount of protein with essential amino acids along with vitamins and minerals, will enhance the nutritive value of homemade products which would be considered beneficial for malnourished population. Luo *et al.* (2014) described that among the inhibitors of

Table 3: Nutrient analysis of malted flour based Biscuits (on dry matter basis)

Parameters	C1	C2	T2
Moisture (%)	$4.36^{c}\pm0.006$	$6.18^{a}\pm0.005$	$5.57^{b}\pm0.006$
Crude protein (g)	$13.12^{b}\pm0.005$	$14.00^{ab}\pm0.57$	$15.31^{a}\pm0.005$
Crude fat (g)	$21.56^{b}\pm0.005$	$21.06^{c}\pm0.005$	$21.84^{a}\pm0.005$
Ash (g)	$1.69^{b}\pm0.005$	$1.44^{c}\pm0.006$	$1.94^{a}\pm0.005$
Crude fiber (g)	$1.42^{c}\pm0.006$	$1.64^{b}\pm0.005$	$2.36^{a}\pm0.006$
CHO (g)	$57.85^{a}\pm0.005$	$55.68^{b}\pm0.05$	$52.98^{c}\pm0.57$
Energy (Kcal)	$477.92^{a}\pm0.006$	$468.26^{c}\pm0.006$	$469.72^{b}\pm0.005$
Calcium (mg/100g)	$60.40^{c}\pm0.06$	$91.40^{b}\pm0.06$	$107.80^{a}\pm0.06$
Phosphorus (mg/100g)	$270.40^{c}\pm0.05$	$279.60^{b}\pm0.05$	$289.80^{a}\pm0.05$
Iron (mg/100g)	$4.72^{a}\pm0.05$	$4.60^{a}\pm0.57$	$4.96^{a}\pm0.57$
Zinc (mg/100g)	$3.72^{a}\pm0.6$	$3.46^{a}\pm0.57$	$3.56^{a}\pm0.6$
Lysine (g/100 g protein)	$3.22^{c}\pm0.006$	$3.71^{b}\pm0.006$	$3.89^{a}\pm0.006$
Methionine (g/100 g protein)	$1.60^{a}\pm0.57$	$1.79^{a}\pm0.05$	$1.96^{a}\pm0.005$
In vitro protein digestibility (%)	$67.98^{a}\pm0.57$	$77.50^{a}\pm5.77$	$81.25^{a}\pm0.005$
In vitro starch digestibility (%)	$67.95^{b}\pm0.57$	$80.14^{ab}\pm5.77$	$82.69^{a}\pm0.05$
Total phenols (mg GAE/100g)	$233.33^{a}\pm57.73$	$265.91^{a}\pm0.006$	$317.37^{a}\pm0.05$
Phytin phosphorus (mg/100g)	$245.25^{a}\pm5.77$	$211.66^{b}\pm0.006$	$230.86^{a}\pm0.05$

Values are Mean ± SE

C1- Whole wheat flour (100%), **C2-** Malted wheat flour (100%), **T2-** Malted wheat flour (80%), malted finger millet flour (2%), malted green gram flour (10%), carrot powder (4%), flaxseed powder (4%)

Means with different notation (a, b and c) indicates significant difference at 5% level of significance.

mineral availability inherent in cereal grains and legumes, phytate has been observed to be dominant as compared to either dietary fiber or tannin and these inherent components are subject to alterations as a result of food processing such as germination and heat treatment. Thus enhances the digestibility and availability of various nutrients.

Amino acids such as lysine and methionine showed significant ($p<0.05$) improvement (3.89g, 1.96g/100g protein) in biscuits developed with combination of malted flours as compared to their control sample (3.22g, 1.60g/100g protein). The results for *in vitro* protein and starch digestibility revealed significantly ($p<0.05$) increased content in biscuits prepared with combination of malted flours, carrot and flaxseed powder. Ongol *et al.* (2013) determined the *in vitro* protein digestibility in maize and finger millet and found increased content after germination due to proteolysis and partial solubilization that occurs with seed sprouting as indicated by increased water-soluble proteins and free amino acids in the germinated seeds. Reduction in anti-nutrients content and activity of amylase could explain the improved starch digestibility and reduction of total starch, respectively.

In contrast to control sample, malted flours based biscuits were found to contain increased total phenols content (317.37 mg GAE/100 g) which might occur due to the germination of grains. The essence of germination is the enzymatic process, in which a large amount of enzymes are activated, released and converted various nutrients from the bound state to a free state. Similar results were also reported by Hung *et al.* (2011) and Udeh *et al.* (2018). On the contrary, insignificantly decreased phytin phosphorus (230.86 mg) content was observed in malted flours based biscuits which could be attributed to increased activity of phytase due to malting that progressively degraded phytic acid. The highly acceptable biscuits developed using combination of malted flours, carrot and flaxseed powder were supplemented to the selected subjects and the effectiveness of supplementation on nutrient intake and anthropometric profile was assessed.

Demographic profile and socio-economic status: The data regarding the demographic profile of the selected children is presented in Table 4. Out of total 60 subjects selected for the study, 36 (60%) belonged to 3-4 years of age group and 24 (40%) belonged to the 4-5 years age group. On the basis of gender, the subjects were distributed as 16 (53.33%) males and 14 (46.67%) females in the control group and 13 (43.33%) males and 17 (56.67%) females in the experimental group. Majority of the subjects were found at second place of birth i.e. 43.33 per cent followed by first (28.33%), third (20%) and more than third (including 4^{th} or 5^{th} place) (8.33%). Birth order might affect the nutritional status of children as higher order births are more likely to be unwanted which results in less attention and care from parents and intra-household allocation of food and resources decreases with an increasing number of births in the household. As a result, births of higher order might suffer from various health hazards as well as malnutrition (Khan and Raza, 2014).

The data regarding the food habits of selected subjects revealed that most of children i.e. 91.67 per cent were non-vegetarian followed by vegetarian (6.67%) and ovatarians (1.67%). Most of the children 46.67 and 40 per cent from control and experimental groups were exclusively breastfed upto six months of age. About 33.33 and 23.33 per cent children from control and experimental group, respectively were breastfed for less than 6 months and only 20 and 36.67 per cent children from both groups, respectively were breastfed for more than 6 months.

The data revealed that 73.33 and 83.33 per cent children from control and experimental group, respectively belonged to nuclear family systems. Only 19 households (31.67%) had small family composition upto 4 members while 41 (68.33%) belonged to the medium family i.e. 5 to 8 members. Majority of the subjects were having 2 or 3 siblings. The households of the selected subjects were mainly engaged in the labour work and were mainly the migrant population in Punjab from other states and they were not having any other income sources except their daily wages work. Therefore, 51.67 per cent families had a monthly income of around Rs. 8000 and 48.33 per cent had monthly income between Rs. 8000-12,000. The data regarding the education of father showed that majority of fathers (63.33%) of the subjects were illiterate followed by 16.67 per cent completed their primary education, 16.67 per cent went to high school and only 3.33 per cent completed their senior secondary education. Sinha *et al.* (2008) reported that 7.7 per cent fathers were illiterate and 55.4 and 36.9 per cent completed 10 and more than 10 years of schooling in their lives and concluded that education of father was significantly associated with the nutritional status of the child as educated fathers provided their children good diet without any gender discrimination and involved mothers in decision making regarding the utilization of available resources. Regarding the education of mothers, it was found that 73.33 per cent mothers were illiterate and only 1.67 per cent attended senior secondary school as depicted in the Table 4. Iftikhar *et al.* (2017) determined the impact of maternal education, employment and family size on nutritional status of children and explained that their ability to acquire the health knowledge following the recommended feeding practices and increased command over resources were the suggested conduits through which maternal education influences the child health.

Disease conditions and Hygiene practices: The data pertaining to the general health status of selected children has been depicted in Table 5. The information regarding suffering of the subjects with various common illness and diseases for the last 6 months revealed that 41 children out of total (68.33%) had cough and cold and about 44 (73.33%) suffered from fever. The problem of headache and loss of appetite was quite common in subjects i.e. 40 and 43.33 per cent respectively. Other common illness reported in subjects was diarrhoea (30%) and tiredness (28.33%). Only one child (1.67%) had chicken pox in the last six months and it was reported that only 3 children suffered from typhoid i.e. 5 per cent of the total subjects. Mehta (2012) reported the fever as most common illness (50%) followed by cold (33%) and diarrhea (16%) among children. Poor sanitation, lack of access to clean water and inadequate personal hygiene are responsible for an estimated 88 per cent of childhood diarrhoea in India. Based on current evidence, washing hands with soap can reduce the risk of diarrheal diseases by 42-47 per cent (Lakshminarayanan and Jayalakshmy 2015).

All the subjects were immunized timely. Algur *et al.* (2012) reported that more than 85 per cent children

Table 4: Demographic profile and socio-economic status of the selected children

Parameter	Control (n=30)	Experimental (n=30)	Total (N=60)
Age (years)			
3-4	18 (60)	18 (60)	36 (60)
4-5	12 (40)	12 (40)	24 (40)
Gender			
Male	16 (53.33)	13 (43.33)	29 (48.33)
Female	14 (46.67)	17 (56.67)	31 (51.67)
Birth Order			
1	8 (26.67)	9 (30)	17 (28.33)
2	12 (40)	14 (46.67)	26 (43.33)
3	6 (20)	6 (20)	12 (20)
>3	4 (13.33)	1 (3.33)	5 (8.33)
Food Habits			
Vegetarian	2 (6.67)	2 (6.67)	4 (6.67)
Non vegetarian	27 (90)	28 (93.33)	55 (91.67)
Ovatarian	1 (3.33)	0 (0)	1 (1.67)
Breast feeding pattern			
Upto 6 months (exclusive)	14 (46.67)	12 (40)	26 (43.33)
< 6 months	10 (33.33)	7 (23.33)	17 (28.33)
> 6 months	6 (20)	11 (36.67)	17 (28.33)
Type of family			
Nuclear	22 (73.33)	25 (83.33)	47 (78.33)
Joint	8 (26.67)	5 (16.67)	13 (21.67)
Composition of family			
Small (upto 4)	7 (23.33)	12 (40)	19 (31.67)
Medium (5-8)	23 (76.67)	18 (60)	41 (68.33)
Monthly income of family			
< 8000	17 (56.67)	14 (46.67)	31 (51.67)
8000-12000	13 (43.33)	16 (53.33)	29 (48.33)
Educational status of father			
Illiterate	18 (60)	20 (66.67)	38 (63.33)
Primary	5 (16.67)	5 (16.67)	10 (16.67)
High school	5 (16.67)	5 (16.67)	10 (16.67)
Senior secondary	2 (6.67)	0 (0)	2 (3.33)
Educational status of mother			
Illiterate	18 (60)	26 (86.67)	44 (73.33)
Primary	6 (20)	1 (3.33)	7 (11.67)
High school	5 (16.67)	3 (10)	8 (13.33)
Senior secondary	1 (3.33)	0 (0)	1 (1.67)

Figures in parenthesis represented as percentage

Table 5: General health and hygiene status of the selected children

Illnesses during past six months	Control (n=30)	Experimental (n=30)	Total (N=60)
Cough and cold	21 (70)	20 (66.67)	41 (68.33)
Fever	23 (76.67)	21 (70)	44 (73.33)
Diarrhea	10 (33.33)	8 (26.67)	18 (30)
Chicken pox	1 (3.33)	0 (0)	1 (1.67)
Typhoid	2 (6.67)	1 (3.33)	3 (5)
Headache	13 (43.33)	11 (36.67)	24 (40)
Tiredness	11 (36.67)	6 (20)	17 (28.33)
Loss of appetite	12 (40)	14 (46.67)	26 (43.33)
Immunization	30 (100)	30 (100)	60 (100)
Hygiene practices			
Hand wash before meal	30 (100)	30 (100)	60 (100)
Hand wash after meal	21 (70)	23 (76.67)	44 (73.33)
Hand wash after using toilet	30 (100)	30 (100)	60 (100)
Cutting of nails			
Weekly	8 (26.67)	11 (36.67)	19 (31.67)
Fortnightly	22 (73.33)	19 (63.33)	41 (68.33)
Habit of eating clay			
Yes	4 (13.33)	6 (20)	10 (16.67)
No	26 (86.67)	24 (80)	50 (83.33)
Cleaning of teeth			
Daily	22 (73.33)	16 (53.33)	38 (63.33)
Sometimes	8 (26.67)	9 (30)	17 (28.33)
Never	0 (0)	5 (16.67)	5 (8.33)
Combing of hair			
Twice a day	8 (26.67)	11 (36.67)	19 (31.67)
Daily	22 (73.33)	19 (63.33)	41 (68.33)
Bath in summer			
Twice a day	12 (40)	10 (33.33)	22 (36.67)
Daily	18 (60)	20 (66.67)	38 (63.33)
Bath in winter			
Daily	18 (60)	20 (66.67)	38 (63.33)
Once in two days	12 (40)	10 (33.33)	22 (36.67)
Head bath			
Daily	11 (36.67)	4 (13.33)	15 (25)
Twice a week	3 (10)	8 (26.67)	11 (18.33)
Weekly	16 (53.33)	18 (60)	34 (56.67)
Change of clothes			
Twice a day	5 (16.67)	7 (23.33)	12 (20)
Daily	25 (83.33)	23 (7.67)	48 (80)

Figures in parenthesis represented as percentage

under-five years of age were immunized at Kallalgali District. On the contrary, Banteman *et al.* (2014) reported that in Northwest Ethiopia, most of the children under-five years of age were not immunized with BCG and suffered from frequent diarrhea, fever and measles due to poor environment and sanitation facilities along with poor dietary intake and poor access to safe drinking water. Ahmed *et al.* (2019) reported the malaria (57.7%) and anemia (26.9%) the most common associated co-morbidities in Gadarif, Sudan. About 65.4 per cent of the children were recovered and discharged with good condition while 5.1 per cent of the children died due to hypothermia, severe dehydration and hypovolemic shock and concluded that protein energy malnutrition occurred due to low socioeconomic status, illiteracy and large family size.

The practice of washing hands before meal and after using toilets was observed in almost all the subjects (100%) but the practice of washing hands after meals was observed only in 73.33 per cent subjects. More than half around 41 subjects (68.33%) had habit of trimming nails fortnightly and only 19 (31.67%) subjects trimmed their nails on weekly basis. Only 16.67 per cent subjects were found to be habitual of eating clay. Majority of the subjects (63.33%) used to brush their teeth on daily basis followed by 28.33 per cent who brush their teeth sometimes and 8.33 per cent subjects never brushed their teeth. Out of total, 68.33 per cent subjects combed their hair only once and 31.67 per cent were found with the practice of combing hair twice a day. Moreover, the personal hygiene practices observed among children were satisfactory which included bathing in summers daily (63.33%) and twice a day (36.67%), bathing in winters daily (63.33%) and once in two days (36.67%). Majority of subjects used to wash their heads weekly (56.67%) followed by daily (25%) and twice a week (18.33%). The data further revealed about the habit of changing clothes and it was observed 80 per cent of subjects were used to change their clothes on daily basis followed by 20 per cent who changed their clothes twice a day. Similarly, Kageni (2011) concluded in the study that 53.1 per cent children never washed their hands before meals or feeds and also observed about 56.6 per cent of children not used to wear footwear all the time and 52.9 per cent water supply points were not protected. Fink *et al.* (2013) stated that the improved health and hygiene practices in fewer incidences of diseases helped to reduce the mortality rates in children age group of under-five years.

Supplementary effect of biscuits on nutritional status of selected children: The effect of supplementation of biscuits on nutritional status of selected children was expressed in terms of food and nutrient intake and anthropometric measurements.

Food and nutrient intake: The data regarding the average daily food intake and per cent adequacy of food intake of selected children before and after supplementation is given in Table 6 and revealed that the intake of almost all the food groups after supplementation increased significantly in experimental group except for milk and milk products, sugars, fats and oils. The per cent adequacy of daily nutrient intake (Figure 2) illustrated an inadequate nutrient intake in both groups before supplementation. After supplementation of biscuits developed from malted flours, carrot and flaxseed powder, for a period of 4 months, significant ($p<0.01$) increase in almost all the nutrients except niacin was observed in experimental group. An average energy intake was found 836.48±56.50 Kcal and 806.03±81.75 Kcal in control and experimental groups, respectively which was found to be increased significantly ($p<0.01$) in both groups (control: 913.86±61.38 Kcal and experimental: 1035.13±58.55 Kcal) with the per cent increase of 9.25 per cent in control group and 28.42 per cent in experimental group. The per cent adequacy was found to be 67.69 per cent in control and 76.67 per cent in experimental group with a positive impact on calories intake after supplementation of 4 months. The average daily intake of protein by the control and experimental groups was observed 14.42±1.68 g and 16.80±1.23 g, respectively. It was observed to be non-significantly increased to 15.49±1.99 g in control group and significantly ($p<0.01$) increased to 28.86±1.09 g in experimental group after supplementation for a period of 4 months with the per cent adequacy of 143.58 per cent which was found to be adequately met in case of experimental group after supplementation. Higher average daily fat intake was observed in the

selected subjects of the experimental group after supplementation i.e. 31.86±1.82 g whereas in control group it was observed to be 19.91±1.92 g. The per cent adequacy of fat intake by control and experimental group was found to be 79.64 and 127.44 per cent after supplementation and the per cent adequacy was found to be adequate of experimental group when compared with RDA.

In addition, the results of the study revealed that the intake of thiamine, riboflavin, calcium, iron and zinc was observed to be significantly ($p<0.01$) increased in the experimental group after a supplementation period of 4 months but even after supplementation intake was found inadequate as compared to RDA. Similarly, Khader and Maheswari (2012) reported that supplementation of amylase rich porridge significantly enhanced the nutritional profile of preschool children because it provided extra energy, protein and fat. Castro *et al* (2017) investigated the effects of a vitamin and mineral fortified powder product supplemented with inulin on the iron and vitamin A status of 110 pre-schools children in Vicosa, Minas Gerais, Brazil. The supplement (30 g) was provided daily as part of the afternoon snack, diluted in 100 ml of water, 5 times a week and it supplied 30 per cent of the recommended daily doses of iron, zinc, copper and vitamins A and C. The prebiotic-containing supplement significantly increased the intake of energy, macro and micronutrients and also found effective in improving the iron and anthropometric status.

Anthropometric profile: The anthropometric data of the selected children from urban slum areas of Ludhiana city is presented in Table 7. Based on the data collected, the average height of selected subjects of control group was 93.30±1.15 cm and experimental group was 92.83±1.18 cm which was found to be improved in control group i.e. 93.87±1.07 (0.61%) and significantly ($p<0.01$) increased in experimental group to 94.05±1.17 cm with per cent increase of 1.31 per cent after supplementation period of 4 months. Similarly in case of weight, significant ($p<0.01$) increase was observed in experimental group from 12.17±0.19 cm to 14.43±0.17 cm with the per cent increase of 18.57 per cent whereas in control group increase was only 6.04 per cent with the values of 12.40±0.34 cm to 13.15±0.33 cm before and after supplementation. A weight gain was observed by Mahfuz *et al.* (2014) in children of experimental group when provided with ready to use food and *pushti* packets while significant changes were not observed for the subjects who were not provided with any supplements (control group) in slum areas of Bangladesh. Body Mass Index (BMI) is a standardized ratio of weight to height and is often used as a general indicator of health. From the data depicted (Table 7), it is clear that BMI also improved after supplementation due to increase in height and weight of the subjects. BMI of control group improved from 13.24±0.19 to 13.86±0.17 while in experimental group, it was increased from 13.12±0.17 to 15.02±0.10 after supplementation. Significant increase ($p<0.01$) was observed in both groups but per cent gain was more (14.48%) in experimental group as compared to control group (4.68%). Similarly weight gain and increments in length and weight-for-height were reported higher in children supplemented with Amylase Rich Flour (ARF) based food (Hossain *et al* 2005). The study was conducted to assess the impact of adding Amylase rich flour (ARF) from germinated wheat to supplementary food on food intake among children in nine rural Community Nutrition Centers under the Bangladesh Integrated Nutrition Project (BINP).

Poor musculature and wasting are cardinal features of protein energy malnutrition in early childhood. Therefore, mid upper arm circumference (MUAC) is recognized to indicate the status of muscle development. The improvement in MUAC of control group was insignificant i.e. 14.37±0.19 to 14.68±0.24 cm while in experimental group it was found to be significantly improved from 14.33±0.16 to 14.89±0.18 cm with the per cent gain of 3.90 percent. Similar results were observed in case of head circumference of control and experimental group which was found to be significantly increased from 46.60±0.31 to 48.49±0.26 cm in experimental group with the per cent gain of 4.05 per cent while in control group it was observed to be improved from 47.52±0.27 to 47.82±0.31 cm (0.63%). Significant ($p<0.05$) increase was observed in chest circumference of both groups with 0.68 and 0.95 per cent increase in control and experimental group, respectively. Positive impact of supplementation was found on the anthropometric profile of selected subjects.

Prevalence of malnutrition among children: The data given in Figure 2 revealed the prevalence of

Table 6: Average and per cent adequacy of daily food intake among selected subjects before and after supplementation

Food groups (g/day)	Control Group (n = 30)					Experimental Group (n = 30)					SDI#
	Before		After		t-value	Before		After		t-value	
	AV	% A	AV	% A		AV	% A	AV	% A		
Cereals and millets	72.83±5.81	60.69	80.24±5.80	66.87	2.79**	77.96±13.38	64.97	105.06±14.84	87.55	4.62**	120
Legumes	16.90±2.21	56.33	17.02±4.64	56.73	0.06^{NS}	17.95±2.39	59.83	31.03±5.21	103.43	6.92**	30
Green leafy vegetables	17.67±2.31	35.34	18.02±2.03	36.04	0.14^{NS}	17.90±2.16	35.80	20.38±1.63	40.76	2.83**	50
Roots and tubers	29.48±9.13	29.48	31.73±9.83	31.73	0.57^{NS}	31.52±7.96	31.52	41.25±10.59	41.25	2.34*	100
Other vegetables	36.26±8.09	36.26	37.68±10.28	37.68	0.33^{NS}	40.00±11.19	40.00	45.30±9.85	45.30	0.97^{NS}	100
Fruits	29.00±5.97	29.00	30.11±10.36	30.11	0.26^{NS}	28.01±3.82	28.01	31.31±4.51	31.31	2.12*	100
Milk and milk products	270.21±12.12	54.04	274.62±11.43	54.92	0.25^{NS}	211.68±9.84	42.34	254.80±4.87	50.96	1.81^{NS}	500
Sugar	19.96±2.62	99.80	20.59±2.75	102.95	0.96^{NS}	17.27±2.98	86.35	19.48±6.31	97.4	0.89^{NS}	20
Fats and oils	17.12±0.75	68.48	17.27±1.11	69.08	0.36^{NS}	16.45±3.23	65.80	19.28±7.06	77.12	1.11^{NS}	25

Values are expressed as Mean ± SE

AV: Average daily food intake, % A: per cent adequacy of daily food intake

**Significant at 1% level of significance, *Significant at 5% level of significance, NS: Non-significant difference

#Suggested Dietary Intake (SDI) by ICMR (2010)

Table 7: Mean anthropometric profile of selected children before and after supplementation

Anthropometric Indices	Control Group (n = 30)				Experimental Group (n = 30)			
	Before	After	t-value	% change	Before	After	t-value	% change
Height (cm)	93.30±1.15	93.87±1.07	2.63*	0.61	92.83±1.18	94.05±1.17	9.79**	1.31
Weight (kg)	12.40±0.34	13.15±0.33	5.83**	6.04	12.17±0.19	14.43±0.17	21.28**	18.57
BMI (Kg/m^2)	13.24±0.19	13.86±0.17	5.72**	4.68	13.12±0.17	15.02±0.10	16.73**	14.48
MUAC (cm)	14.37±0.19	14.68±0.24	1.53^{NS}	2.15	14.33±0.16	14.89±0.18	5.25**	3.90
Head circumference (cm)	47.52±0.27	47.82±0.31	1.75^{NS}	0.63	46.60±0.31	48.49±0.26	9.27**	4.05
Chest circumference (cm)	48.56±0.48	48.89±0.44	2.24*	0.68	49.30±0.45	49.77±0.42	2.35*	0.95

Values are expressed as Mean ± SE

* Significant at 5% level of significance ($p<0.05$); **Significant at 1% level of significance ($p<0.01$)

NS - Non-significant

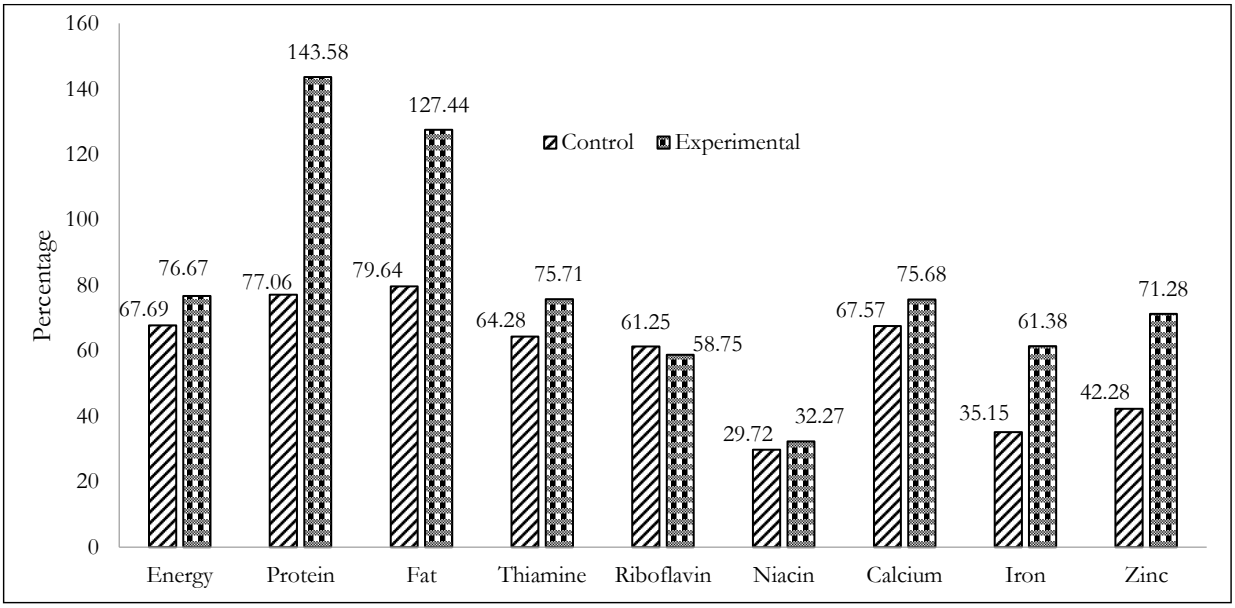

Figure 2: Per cent adequacy of nutrient intake among the selected subjects (N = 60)

malnutrition before and after supplementation and per cent distribution of selected children for the different nutritional indices z-scores. A reduction in the prevalence rate of the malnourished subjects was observed in the experimental group after supplementation. The prevalence rate of mild weight-for-age subjects was increased from 16.67 to 40 per cent while the rate of moderately malnourished reduced from 66.67 to 56.67 per cent in experimental group after supplementation of 4 months. Similarly, the rate of prevalence of stunting was also found to be reduced in moderately malnourished category with the value of height-for-age (43.33 to 36.67%). At the same time the prevalence rate of mild height-for-age increased from 33.33 to 53.33 per cent in experimental group after supplementation. Adeladza (2009) surveyed the influence of socio-economic and nutritional characteristics on child growth in Kwale District of Kenya and reported that 34 per cent of children aged 12-23 months were underweight and 51 per cent stunted and concluded that demographic and socio-economic factors such as occupation, education level of mothers, gender, occupation of household heads and household size were strongly associated with child nutritional status in the study area. Inappropriate child feeding practices such as early cessation of breastfeeding and early introduction of complementary foods predominates in the area and also contributes to the poor nutritional status of children.

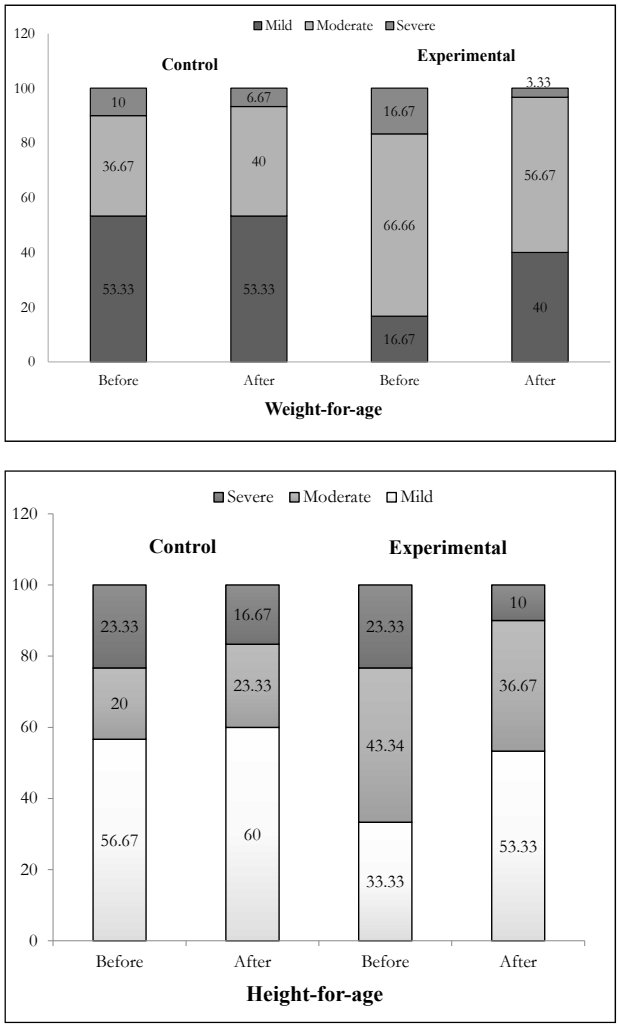

Figure 3: Prevalence of malnutrition among selected young children

CONCLUSION

The present research work inferred that biscuits developed by using combination of malted wheat, finger millet, green gram, carrot and flaxseed powder were found acceptable, cost effective and nutritious with good amounts of energy, protein, calcium and *in vitro* protein and starch digestibility. The supplementation of biscuits improved nutrient intake and anthropometric profile of malnourished children after period of four months and the prevalence of malnutrition found to be reduced with the decreased rate of moderately and severely malnourished children. Consequently, the findings of the study suggested that a variety of low cost malted flours based bakery products may be developed and recommended for its inclusion in feeding programs to improve the nutritional status of young children.

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Ethical Approval

The research was carried out after the approval by the ethical committee of Punjab Agricultural University, Ludhiana (No. DR-8323-32-19-4-19).

Disclosure statement

The authors declare no conflict of interest.

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Research Article

Situation Analysis of Khasi Mandarin Value Chain in Meghalaya: Growers' Perspective

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ABSTRACT

Citrus is the third largest fruit sub-sector economy in the country after mango and banana. In Meghalaya, Khasi Mandarin is one of the key commercial citrus fruit crops that has started establishing its presence in domestic as well as foreign markets, and has been a profitable venture to the growers. The study was taken up in two selected districts *i.e.*, East Khasi Hills and West Jaintia Hills of Meghalaya during 2022-2023 to analyse the situation of the Khasi Mandarin value chain. SWOT analysis and TOWS matrix were applied to examine the internal and external factors. The opinions of 60 Khasi Mandarin growers towards selected SWOT factors were recorded. From the strength group important factor was "Low capital investment and maintenance and high returns to Mandarin orchard growers" and the weaknesses was "No proper irrigation design facilities in orchards". While for opportunities, two factors were highly perceived i.e., "GI tagging provides employment and export facilities", and "more opportunities for food processing enterprises" had the highest scores and for threats, "regular disease and pest incidence" had the highest score. The study suggests the need to reduce involvement of middlemen through formation of organized value chain for unprocessed as well as processed fruits by facilitating formation of farmer-based groups (FPC/ FPO/PG), establishment of community managed food processing centres, branding and certification for obtaining maximum benefit to producers and processors by selling the produce both in processed and unprocessed form directly to consumers/ distribution centres or export.

Keywords: Khasi mandarin, Value chain, GI tag, Export, SWOT analysis

INTRODUCTION

Fruits have always had an importance in human nutrition as they provide proteins, vitamins, minerals, enzymes and organic acids and hence they have been regarded as protective food. Horticulture plays a significant role and is an important sub sector of Agriculture, which is rapidly growing till date and contributes 28 per cent share in the Indian Economy (Saryam and Jirli, 2020). It is of great pride for the country to place it on record that during 2021-22, horticulture sector has recorded a production of 331.05 MT annually which is the highest ever in the entire history of Indian Horticulture (National Horticulture Board, 2022). Citrus is the third largest fruit sector in the country after mango and banana. Among citrus fruits, mandarin orange (*Citrus reticulata*), sweet orange (*Citrus sinensis*) and acid lime (*Citrus aurantifolia*) are the important commercial species in India occupying 43.6, 27.9 and 24.9 per cent respectively. Mandarin is the most cultivated citrus fruit in India. During 2021-22 the total production mandarin was 6219.38 thousand MT from 476 thousand ha, and is mostly grown in states like Madhya Pradesh, Punjab, Maharashtra and the north-eastern states (Government of India, 2022). In the north east region of the country states like Assam, Manipur, Mizoram and Meghalaya are the leading producers in the region. Khasi Mandarin of Meghalaya one of the famous citrus fruit of North

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East India, having good acceptance and high demands from consumers. Locally known as *'Soh-niamtra'* in Khasi, it is different from other oranges as it has a thin, tight, and loose peel skin and is sweet & juicy. Past experimental studies have also showed that its bioactive compounds such as (flavonoids, phenolic acid, terpenoids etc) have tremendous pharmaceutical activity, which clearly indicates the potential of this fruit crop in pharmaceutical industry (Singh *et al.*, 2016). The investment in cultivating mandarins is seen as a profitable venture with high returns to the growers in the state. In 2015, Meghalaya succeeded in obtaining the Geographical Indication (GI) tag status for Khasi Mandarin, which today have definitely promoted branding and marketing of this fruit's uniqueness both in domestic and international market (APEDA, 2015). In December 2022, Mandarin growers hold great pride in being able to export 4 tonnes of Khasi Mandarin to middle-east facilitated by the State Department of Agriculture along with the assistance from Agricultural and Processed Food Products Export Development Authority (Government of Meghalaya, 2022). In India only 2-2.2 per cent of fruits are being processed and, in the state, there is an under developed post-harvest value chain which needs proper interventions (Ministry of Food Processing Industries, 2022). However, for reaching the potential consumers far and wide, value-addition of the produce and increasing the profit of the producers depends on a well-developed functional value chain.

According to Porter (1985) value chain framework is "an interdependent system or network of activities, connected by linkages". Value chain includes all the input suppliers, technology delivering agencies, market intermediaries, all who directly or indirectly are engaged in developing new appropriate technologies and extension functionaries, which are involved in capacity building and provide various services to farmers. The actors involved in value chain invest time, effort and financial resources, support one another to increase their overall efficiency and competitiveness and build relationships of trust with other actors to reach a common goal of satisfying consumer needs and increasing their own profits. Products pass through all activities of the chain in order and at each activity the product gains some value. Developing horticultural value chain is regarded as one of the most powerful tools for horticulture growth, particularly if farmers are able to produce those products that are having a high potential for value addition and are able to access the processing and distribution facilities that enhances the value of the final product. In this scenario, understanding and evaluating the internal and external conditions that affect the value chain of Khasi mandarin becomes imperative. Thus, the study was initiated with the objective of carrying out situation analysis of the existing value chain of the Khasi mandarin in Meghalaya state. Lucidspark (2020) described that situation analysis as a methodical look at the internal and external factors influencing businesses at any given time. Situational analysis helps to identify the current positive and negative factors affecting an organization, service or product. This in turn helps devise strategies to move forward from the existing situation to the desired situation (Athuraliya, 2023).

MATERIALS AND METHODS

The study was conducted in two purposively selected districts of Meghalaya viz., East Khasi Hills districts and West Jaintia Hills which have the highest productivity of Khasi Mandarin (GoM, 2021). From the selected districts one block each viz., Pynursla and Laskein respectively were selected purposively because these blocks has the highest area under Khasi Mandarin under each district. From each of the selected blocks, two village clusters were selected purposively based on the maximum number of growers and high production as per the recommendation of the line department officials in respective C&RD Block. From Pynursla block the two village clusters were Wahkhen & Nongkwai and Nongjri & Nohwet. Likewise, from Laskein block the two selected clustered villages were Shangpung & Raliang and Mynska & Khonshnong. Total of 60 Khasi Mandarin growers were sampled randomly from the 4 village clusters as respondents of the study.

For carrying out situation analysis, SWOT analysis was employed. According to Swayamprava (2022), SWOT analysis is a strategic planning technique which puts business in perspective using the perspectives of Strengths, Weaknesses, Opportunities, and Threats. It studies internal strength and weaknesses; and also, the external opportunities and threats that affect the performance of a firm. A list of 8 strengths items, 12

weaknesses items, 7 opportunities items and 7 threats items were prepared through pilot survey, consultation with experts and review of literature. The identified SWOT statements were sent to experts for rating the framed statements on a three-point continuum as relevant, somewhat relevant and not relevant with a score of 3, 2, and 1, respectively. The statements were sent to 8 judges who were Subject Matter Specialists from KVKs, District horticulture officers from Directorate of Horticulture, Chairman of Khasi Mandarin FPO, Officer from Directorate of Food processing and Horticulture, scientist from ICAR RC for NEHR. All the judges responded and their responses were used to calculate the item-level content validity index (I-CVI), to determine if an item needs to be revised or deleted. A criterion of more than or equal to 0.75 of I-CVI (Lawshe, 1975) was set as benchmark for inclusion of an item in the final list. The final SWOT items (which are also referred to as factors) which consist of 5 factors from strength group, 6 weakness, 5 opportunity and 4 threats, were administered to the sampled respondents who were then asked to rate the items in a three-point continuum of 1, 2 and 3 which stand for "does not agree", "agree" and "strongly agree" respectively.

For SWOT analysis the weighted mean score (WMS) for each SWOT categories and factors of Khasi Mandarin value-chain was obtained by multiplying the frequencies with their respective scores, adding them up and dividing by the total number of respondents as follows:

$$WMS = \frac{\Sigma sifi}{n}$$

where, f_i = frequency of the respondents for i^{th} item
s_i = score of the i^{th} item (i = 0, 1, 2, 3, 4 or 5)
n = total number of respondents

The WMS of each factor is normalized by totalling the mean scores of all the factors under each SWOT category and then dividing each factor WMS by the category sum to yield its normalized score which yielded the factor priority score. The overall mean score of each category is then divided by the sum of all category scores to yield the overall priority score of each SWOT quadrant.

TOWS matrix devised by Weihrich (1982) was used to bring out four categories of conceptually unique strategies namely (S-O) Strength-Opportunity, (S-T) Strength-Threats, (W-O) Weaknesses-Opportunities, and (W-T) Weaknesses-Threats. S-O strategies are suggested to use certain techniques to seize opportunities that fit with one's strengths, W-O tactics are to take advantage of opportunities by reducing weaknesses; using internal strengths as a foundation, S-T strategies lessen sensitivity to external threats, and W-T techniques diminish both weaknesses and threats.

RESULTS AND DISCUSSION

The perceived opinion of the grower respondents on the final SWOT factors is presented in Table 1, and the discussions are hereunder.

Strengths of Khasi Mandarin value chain: The most important strength of the Khasi Mandarin value chain was "low capital investment and maintenance and high returns to Mandarin orchard growers" (WMS, 3.00; rank 1st) which has really helped growers obtained maximum profits from their sales to markets and middlemen despite low capital and less management involved in orchards. Second closely followed strength was "high commercial value and demand of their fruits in the domestic and international market" (WMS, 2.88; rank 2nd) with this fruit becoming popular in the markets, demand has risen from various actors for supply in domestic and international markets. "Suitable climatic conditions for growing Khasi Mandarin in the state as standing trees produce true to type fruits and have distinctive quality and high nutritional value" (WMS, 2.87; rank 3rd) reflected on the suitable climate that these Khasi Mandarins thrive in growing for yielding unique fruit quality. The next strength factor was "growers are skilled in propagating new plants in their orchards" (WMS, 2.82; rank 4th), where it was seen that most of the growers propagate mandarins on their own through seeds, but some growers have also learned grafting and layering from trainings and demonstrations they have attended. The other strength factor was "good shelf life of Khasi Mandarin" (WMS, 2.27; rank 5th), where growers/actors in the chain, after harvest, during transportation or during handling reported that the fruit can last for a week and help them in selling during favourable conditions and need not stress of it being spoiled.

Table 1: Overall priority scores of SWOT factors (n=60)

SWOT Group	No.	Factors	WMS	Rank	Factor Priority Score	Overall Priority Score
Strengths	S1	Low capital investment and maintenance and high returns to Mandarin orchard growers	3.00	1	0.2168	0.0545
	S2	High commercial value and demand of their fruits in the domestic and international market	2.88	2	0.2081	0.0523
	S3	Growers are skilled in propagating new plants in their orchards	2.82	4	0.2038	0.0512
	S4	Suitable climatic conditions for growing Khasi Mandarin in the state as standing trees produce true to type fruits and have distinctive quality and high nutritional value	2.87	3	0.2074	0.0521
	S5	Good Shelf life of Khasi Mandarin	2.27	5	0.1640	0.0412
		Mean Strength Score	13.84	Normalized Value		0.2512
Weaknesses	W1	Lack of knowledge and facilities for post-harvest and value addition	2.92	2	0.1789	0.0442
	W2	No proper irrigation design facilities in Orchards	3.00	1	0.1838	0.0454
	W3	Undulated land (steepness)	2.62	5	0.1605	0.0396
	W4	Poor road facilities to the Mandarin producing villages	2.80	3	0.1716	0.0424
	W5	Improper handling of the fruits	2.33	6	0.1428	0.0352
	W6	Weak / no direct linkage with the service providers	2.65	4	0.1624	0.0401
		Mean Weakness Score	16.32	Normalized Value		0.2469
Opportunities	O1	GI tagging provides employment & export opportunities	3.00	1	0.2125	0.0545
	O2	More opportunities for fruit processing enterprises	3.00	1	0.2125	0.0545
	O3	Promotion of farmers for establishment of new orchards	2.82	2	0.1997	0.0512
	O4	Availability of institutions & schemes to support and uplift Khasi mandarin growers	2.55	4	0.1806	0.0463
	O5	Formation of farmers-based organisations/groups	2.75	3	0.1948	0.0499
		Mean Opportunity Score	14.12	Normalized Value		0.2563
Threats	T1	Regular disease and pest incidence	3.00	1	0.2773	0.0681
	T2	Lack of organised value chain activities	2.92	2	0.2699	0.0663
	T3	Dominance of middle men in the value chain	2.52	3	0.2329	0.0572
	T4	Competition from other fruit industry	2.38	4	0.2200	0.0540
		Mean Threat Score	10.82	Normalized Value		0.2455

(*SWOT- Strength, Weakness, Opportunities and Threats, WMS – Weighted Mean Score)

Weaknesses in Khasi Mandarin value Chain: The rank wise important weaknesses of Khasi Mandarin value chain as perceived by respondents were "no proper irrigation design facilities in orchards" (WMS, 3.00; rank 1st). Growers reported low yield as rainfed irrigation did not fulfilled trees required nutrients, the findings which are similar in the report of (Baral *et al.*, 2021). It was followed by "lack of knowledge and facilities for post-harvest and value addition" (WMS, 2.92; rank 2nd) which emphasized, awareness of different value addition trainings in farmers was low and facilities for post-harvest centres in the study area

is not up to the mark. While "poor road facilities to the Mandarin producing villages" (WMS, 2.80: rank 3rd), indicated the under developed road and transport infrastructure which created difficulty in linking actors and grower's orchard which were similar to the findings of Hemambara and Yogesh (2014). The respondents also perceived that "weak / no direct linkage with the service providers" (WMS, 2.65; rank 4th) as there is no quality & timely inputs or adequate information from different service providers which made Mandarin production and marketing not properly efficient. The next weakness was (steepness) or "undulated land in the study area" (WMS, 2.62; rank 5th) which revealed the hilly topography conditions in the study area and difficulty of cultivating Mandarins in terrain slopes especially in carrying of produce to homes or till vehicle accessible roads, similar results were found by Passah and Tripathi (2020) stating that growers had to carry their fruits from far hills and deep valleys till transporting area. And lastly the perceived weakness was "improper handling of the fruits" (WMS, 2.33; rank 6th) where after harvest from orchards, fruits are passed on from one actor to another till it meet the end consumers, often results in bruising and possibilities of contact with damaged fruits during the chain.

Opportunities in Khasi Mandarin value chain: There were 6 factors in the opportunities with high weight items such as "GI tagging provides export & employment opportunities" (WMS, 3.00; rank 1st) and "more opportunities for food processing enterprises" (WMS, 3.00; rank 1st) together both perceived as first rank in opportunity group as the GI tagged mandarins have evolved to national and abroad markets it has created an employment platform to many people right from production to harvest stage and many chain actors in the value chain which indicated that they have a strong perception on livelihood security and socio-economic development, (Kumar *et al.,* 2023) also stated similar strengths. State line departments in collaboration with APEDA has recently assisted farmer producer groups in exporting Mandarins, as was the case in December 2022 when 4 tonnes of Khasi mandarin were exported to Middle-East. It was then followed by "promotion of farmers for establishment of new orchards" (WMS, 2.82; rank 2nd) as respondents perceived that there was very little surplus from the current production, in order to meet the increased demand of Mandarins there was a need to increase establishment of new orchards or expand existing ones and line departments awareness on registration of growers in supply of saplings and area expansion have immensely helped. The next factor was "formation of farmers-based organisations/groups" with score of (WMS, 2.75; rank 3rd) as creation of farmers-based groups gives way for collective and improved cultivation & production. Knowledge sharing on farming activities between members was reported high. The next factor perceived with score of WMS, 2.55 and rank 4th was "availability of national/state schemes to support and uplift Khasi mandarin growers", as benefits from schemes and input supplies have assisted many growers at large.

Threats in Khasi mandarin value chain: In this section the highest perceived threat was "regular disease and pest incidence" (WMS, 3.00; rank 1st), as reported by all farmers from their orchards. Diseases such as root rot, powdery mildew, citrus greening and citrus canker. Whereas pest like aphids, thrips and leaf miners were found to cause problems at orchards. The findings which were similar to the study report of (Enarth, 2014). The next perceived threat was "lack of organised value chain activities" (WMS, 2.82; rank 2nd), where growers and actors find difficulty in selling the fruits due to unorganized market in the state, this issue was also a major problem found out by (Kakki *et al.*, 2022). "Dominance of middle men in the value chain" (WMS, 2.75; rank 3rd), was perceived by growers as they feel weight deduction by middlemen for their produce during selling was done too frequent and not able to get better prices for their fruits. "Competition from other fruit industry" (WMS, 2.55; rank 4th), was a threat to the value chain actors as the growth of other fruit industry like pineapple, banana and poor post-harvest value chain in the state is a concern for the VC actors.

The mean and normalized scores of the overall factors and categories in the SWOT analysis indicated that growers viewed the highest perception for Opportunities (group weight 25.63%), followed by Strengths (group weight 25.12%), Weakness (group weight 24.69%) and Threats (24.55%). From the above Table 1, it is seen that the most important factor to be highly considered of all the SWOT categories is regular

Table 2: Overall perceptions towards internal, external, positive and negative SWOT categories

SWOT Categories	Priority scores	Perceptions (%)
Internal/External		
Internal (Strengths and Weaknesses)	0.4981	49.81
External (Opportunities and Threats)	0.5019	50.19
Negative/Positive		
Positive (Strengths and Opportunities)	0.5075	50.75
Negative (Weaknesses and Threats)	0.4925	49.25

disease and pest incidence from threats group, having the highest overall priority value of 0.0681. Similar threats to Khasi Mandarin growers were also found in the study of Grant Thorton India LLP (2016).

The overall combined Opportunities & Threats factors are considered as external prospects while Strengths and Weaknesses are internal prospects of SWOT analysis, the combined priority value (50.19%) of external (opportunities and threats) as shown in Table 1 prevailed over the combined priority value (49.81%) of internal (strengths and weaknesses) factors by some small margin. It depicts that internal prospects of the growers needs to be addressed so that it overcomes the uncontrolled external environment that they face, by improving the factors that are in their controllable environment.

While the strength and opportunity is considered as (positive prospects) whereas that of weaknesses and threats are considered as (negative prospects). From the above Table 2 we can see that the combined priority scores of positive prospects (50.75%) prevailed over the combined priority values of challenges or the negative prospects (49.25%), where it is seen that the helpful factors overlap the harmful factors. For creating a more positive environment for Mandarin growers vis-à-vis the existing value chain the potential strengths need to be combined with promising opportunities to tackle the critical weaknesses and threats that are present in the value chain. It is a good sign for growers and the value chain that positive prospects outweigh the negative aspects, but the internal factors need to be properly emphasized in order to tackle the existing external factors that hinders the grower's potential in the value chain.

According to the outcome of the SWOT analysis, the TOWS matrix strategies were formulated and are presented in Table 3.

S-O strategies: Better branding and marketing of these GI tag Khasi mandarins will help growers and

Table 3: TOWS matrix for Khasi Mandarin growers

		External Factors	
		Opportunities	**Threat**
Internal Factors	**Weakness**	SO1: As mandarins are high commercial fruits better branding and marketing of these GI tagged Mandarins will bring more employment and export opportunities. (S1, O1) SO2: Promoting and facilitating farmers for expansion of orchards can meet the high demand in markets. (S2, O2, O3) SO3: Provision of quality saplings from certified agencies will provide true to type and better yield in orchards. (S4, O3)	ST1: Good shelf life of mandarins assists the market intermediaries for sales of the fruits during favorable price situation. (S5, T3) ST2: Highly demanded fruits need proper regulated market from the government for maximum benefit to producers. (S2, T2)
	Strength	WO1: Providing interventions from government for better irrigation facilities in orchards. (W2, O4) WO2: Maximizing existing ones and setting up of more Fruit Processing Centre's/cold storages for reducing wastage of fruits. (W5, O2) WO3: Formation of FPO's, for ease in facilitating linkages for marketing of fruits. (W6, O5)	WT1: By reducing the number middlemen in the value chain quality of the fruit remains intact. (W5, T3) WT2: Strong involvement of expert service providers will ease growers' control of pest & diseases in orchard effective. (W6, T1) WT3: Creation or facilitation of setting up regulated market will provide stable market for the producers (W4, T3).

actors avail more profit and at the same time provide employment and export potential. Proper execution of schemes and provision of quality saplings will help in meeting high demands in the markets. These suggestions are in line with the findings of (Kishore, 2018).

W-O strategies: As orchards in Meghalaya have poor irrigation facilities, intervention from different government or agencies will make the production and productivity of growers increase by tackling the irrigation problems, similar. (Roy *et al.*, 2018) also highlighted the irrigation problems in their study which need to addressed. Formation of FPO's and developing better post-harvest value chain will ease facilitating linkages in reducing wastage and profitable marketing.

S-T strategies: Mandarins have good shelf life for about a week or more and it gives the farmers and actors ample amount of time for transacting these fruits from one place to another. High commercial crop like mandarins needs facilitation from government in setting up of regulated markets and an organized value-chain to boost citrus industry (Mahajan *et al.*, 2016) also recommended similar suggestions.

W-T strategies: In orchards, pest and disease problems have been a nightmare for every Mandarin grower so strong involvement of expert service providers needs to be more competent, and regular follow up to tackle the problem. Many growers are also easily exploited by middlemen so facilitation of regulated markets in the region will increase the profit of growers and avoid distress sales during unfavourable conditions. (Rana *et al.,* 2022) also suggested similar strategies by creation of favourable market environment to secure economic empowerment of small and marginal farmers.

CONCLUSION

Khasi Mandarin cultivation is a profitable venture with high potential for export. To reap the benefit of the crop, there is need for a well developed and efficient value chain. The current study gave an insight on the situation of Khasi Mandarin value chain in the study area, emphasizing on the identified internal and external factors to develop effective tactical strategies. Strong impactful factors like GI tagging, coordination of FPOs, high demands and export opportunities of Khasi mandarin needs to be utilized to its full potential. And also exploring of disposal channels by growers where middlemen is less, tackling the problem of pest and diseases, poor irrigation in orchards needs to be addressed and follow up regularly to boost production and productivity in the region. The suggested strategies obtained from the analysis will be helpful in developing an organized Khasi Mandarin value chain which will be a benefit to both producers and different actors in the value chain.

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Research Article

A Scale to Measure Attitude of Farmers Towards ICT to Seek for Agricultural Information

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ABSTRACT

Attitude is considered a psychological construct. It is a mental and emotional entity that would characterize an individual. An ICT tool's success or failure hinges on the attitude of farming community towards its use for seeking agricultural information. Based on Likert's technique of scale construction a scale was developed to measure the attitude of the farmers towards ICT. The final scale consisted of 17 statements including 9 positive and 7 negative statements, which were selected based on the 't' values. Scale reliability was examined using Cronbach's alpha. Reliability co-efficient of the scale was found to be 0.75. The reliability and validity of the scale indicates the consistency and precision of the results using the developed scale. The standardized attitude scale will fill the gap in the literature about the evaluation of ICT adoption in farming communities. It will also serve as a valuable tool for further attitude studies by academicians, extension workers and social organizations working to promote ICTs among farmers.

Keywords: Likert scale, Farmers, Attitude, ICT, Validity, Reliability

INTRODUCTION

Agricultural extension experts and institutions around the world are promoting the use of Information and Communication Technology (ICT) which rapidly changed the mechanism of delivering agricultural knowledge, information and advices to farmers during pandemic (Chander and Rathod, 2020). The farmers are producers of food and they must have an enabling environment for access of knowledge and easy availability of agricultural information through ICT for realizing the full potential of modern technology and should be empowered in taking initiatives and decisions which will help in shaping the future of farmer's economy. The public extension in present conditions cannot possibly fulfill qualified manpower as one extension officer served 1162 operation holding, i.e. the ratio of extension workers to operational holding is low at 1:1162 at the national level as against recommended 1:750 which is inadequate to address the information needs of farmers (Nandi and Swamikannu, 2019). The qualified manpower cannot adequately address the complex demand of the farmers by reaching the millions of farmers because needs of farmers are more diversified and the knowledge required to address them is beyond the capacity of the grass root level extension functionaries. The need of the moment is the use of modern and quick communication channels like ICTs to disseminate and create awareness about latest farm technologies among rural mass. Under Bharat Net Programme; internet-enabled devices in the rural market are believed to flourish rapidly as government plans to fiberize all villages by year 2025 (Anonymous, 2022). Total number of farmers using ICT such as WhatsApp and Facebook is likely to increase substantially in near future due to its fast delivery of information. India had 1.2 billion mobile subscribers in 2021, of which about 750 million are

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smartphone users (Anonymous, 2022). Smartphones have become widely used ICT devices across the globe (O'Dea, 2020) and mobile phones with internet connectivity have increased from 744 million users in 2020 from 930 million users by the year 2022 (Tanushree, 2022). Attitude is an important component of human behavior and plays a pivotal role in influencing one's behavior with respect to a particular psychological object. As corollary of this fact, the farmer's attitude towards information and communication technology largely determines the nature and extent of acceptance of modern technology in modernizing agriculture. Thus, attitude of farmers forms essential components for better implementation and success of ICT. In order to utilize ICT for the benefit of farmers and to upgrade extension network, it is necessary to understand the attitude of the farmers who are using modern ICT tools for agricultural information. Attitude is defined as the degree of positive or negative affect associated with some psychological object (Edwards, 1969). Also it is a predisposition to think, feel, perceive, and behave towards a cognitive object (Kumar and Ratnakar, 2011). Attitude in this study was operationally defined as the degree of positive or negative feeling of farmers towards ICT. Therefore, present study is focused on standardizing scale to report the processes used to develop and validate a scale that focuses on the features of the ICT to be used by the farmers of the Punjab state. The technique adopted to develop the attitude scale was Likert's method of summated ratings. All the procedural steps followed in developing a standardized attitude scale to measure the farmer's attitude towards digital technologies are discussed in this paper.

MATERIALS AND METHODS

A step-by-step procedure of Likert's summated ratings was followed to develop a standardized attitude scale. Likert rating scale is a scale construction technique by which statements (items) that are favourable or unfavourable to the psychological object are standardized for the purpose of assessing attitude for a group of individuals about a particular object (Likert, 1932). Each respondent is asked to respond to each item according to their perceived attitude intensity towards the items usually on five point continuum (Strongly agree, Agree, Undecided, Disagree and Strongly disagree). The step-by-step procedure includes Item Collection, Relevancy Test and Selection of Items, Item Analysis, Reliability Test and Validity Test.

In item collection process, pool of items related to the study was collected from the review of literature as well as consultation with agricultural scientists, extension experts and personal experience. The published resources provided an initial framework for the item pool that was expanded after discussions with the expert committee. Initially a total of 100 items were collected from the pool of scientific sources as well as information covering most of the area related to Information and Communication Technology. The set of 100 items collected were subjected to screening using the 14 criteria for editing of items as suggested by Edwards (1969) for attitude scale construction. Hence, a set of 64 items were retained from pool of collected items for further analysis.

Relevancy test is the procedure by which the selected items were sent to the experts in the field of ICT for their expert judgment on the relevancy of the statement selected. The set of 64 statements that satisfied the item collection procedure were sent to 100 judges. The judges were asked to estimate the relevancy of each item, on a five point continuum, *viz.* Highly Relevant (HR), Relevant (R), Some What Relevant (SWR), Irrelevant (IR) and Highly irrelevant (HIR) against each item. The judges were also asked to make necessary modification, addition or deletion of the statement based on their judgments.

A pilot survey was conducted in Mansuran village of Punjab state, India. The selected items were administered to 60 farmers during the survey. The data was collected through personal interview method. The respondents were asked to indicate their degree of agreement on a five point continuum namely; Strongly agree, Agree, Undecided, Disagree and Strongly disagree with scores of 5 to 1 for each positive statements and 1 to 5 for each negative statements respectively. Data were coded on an excel sheet which were later exported to SPSS for analysis. The analysis of data was done using relevant statistical tools and techniques such as Arithmetic mean, median, variance as well as t-test for item analysis.

The t-test procedure in method of summated rating scale was followed to calculate the t-value for each item. The scores obtained by the respondents were summed up and arranged in descending order. The 25 percent of the respondents with highest total score (the high group) and 25 percent of the respondents with the lowest total score (the low group) were selected for the analysis to calculate the t-value. The mean score and variance of the high and the low group were calculated and t-value for each of the 34 statements was calculated using the formula for item analysis as given below.

$$t = \frac{XH - XL}{\sqrt{\sum(XH - XH)2 + (XL - XL)2 \,/ n(n-1)}}$$

Where X_H = the mean score on a given statement for the high group, X_L = the mean score on a given statement for the low group, $\Sigma (X_H - x_H)^2$ = the variance of the distribution of responses of the high group to the statement, $\Sigma (X_L - x_L)^2$ = the variance of the distribution of responses of the low group to the statement and t = the extent to which a given statement differentiate between high and the low group.

The value of *t* is a measure to which each item differentiate between the high and the low group. In method of summated ratings, the focus is to have set of items (20-25) which differentiate between the high and the low groups. The final statements for scale were selected by calculating the t value for each item and rearranging the items in rank order according to their t-value. The statements with the t-value equal to or more than 1.75 were selected for the attitude scale.

The designed scale was tested for its reliability using Cronbach's alpha method which is called coefficient of reliability for measuring internal consistency of scale and to identify how closely set of items are related. It was measured to determine correlation among set of items in scale. Validity of scale was found using content validity to ascertain that the scale is a representative of all aspects of construct and to make conclusions about trustworthiness of scale and to know how accurately scale will test what it intends to measure.

RESULTS AND DISCUSSION

In order to frame the statements an item pool of 100 items was prepared initially by reviewing attitude scales related to study on use of ICT, as well as discussion with agricultural scientists and extension scientists. Some irrelevant statements were discarded from the list of raw statements and 80 statements were retained and selected from the 100 items collected. A conscious effort was taken to include approximately equal number of positive and negative statements, capable of differentiating the feeling of farmers towards use of ICT. The retained set of 80 statements were carefully analyzed by a panel of six experts in the field of scale construction techniques, senior extension education scientists and two experienced sociologists from Punjab Agricultural University. Finally after rigorous discussions with experts, a total of 64 items that are phrased specifically towards measure of construct were retained out of 80 statements. Each statement was checked on the basis of 14 criteria suggested by Edward (1957).

The set of retained 64 items was administered to 100 judges through individual visits, e-mail as well as Google survey form. The selected judges were experts (Agricultural scientist) in the field related to scale construction techniques, Information and Communication Technology and Extension Education Expert. The responses were received from judges in a time span of 30 days and judge's responses were scored as highly relevant (5), relevant (4), somewhat relevant (3), and irrelevant (2) to highly irrelevant (1). The results of mean relevancy test analysis reveals that among 64 items that were subjected to relevancy test, 34 statements made it to the cutoff point of mean relevancy score (Table 1).

Accordingly, statements having 'relevancy percentage' of 62 per cent and above and mean relevancy score of 3.13 and above were considered for final selection of statements. Hence, 34 attitude statements were retained after scrutiny and on basis of relevancy test. These statements were suitably modified and written as per the comments of the judges wherever applicable.

The results of the item analysis as shown in Table 2 revealed t-value of the items for the summated rating scale. The set of 34 statements that satisfied the criteria for relevancy test (i.e. above relevancy mean score) were administered on 60 respondents i.e. farmers from non sampled area. The respondents were asked to indicate their degree of agreement on a five point continuum

Table 1: Relevancy percentage (RP) and Mean relevancy score (MRS) of the statements based on the response of the judges

S.No.	Statements	RP	MRS
1.	I like to use ICT tools	42.33	2.11
2.	I am not interested to use ICT based information services *	66.33	3.31
3.	Mobile phone facilitates transactions	39.00	1.95
4.	I find it difficult to access ICT devices	58.00	2.9
5.	ICT can be accessed all the time (24/7days)	54.33	2.7
6.	Browsing the internet is confusing*	89.66	4.48
7.	Farmers get confused with large number of information obtained through ICTs	31.00	1.55
8.	Agricultural information available through ICTs is misleading*	78.33	3.91
9.	ICT infrastructure is costly and difficult to maintain*	77.66	3.88
10.	ICTs are changing so fast, it is difficult to keep up with it*	70.33	3.51
11.	ICTs can be accessed from any part of globe without any geographical barriers*	66.66	3.33
12.	The information available through ICTs is reliable*	74.33	3.71
13.	Information received through ICT does not match real field situation*	82.00	4.1
14.	ICT can provide practical oriented information*	80.66	4.03
15.	ICT tools can increase confidence level	51.66	2.58
16.	Use of ICT increases confidence of farmers to communicate with agricultural experts	59.66	2.98
17.	Use of ICT is cost effective*	65.66	3.28
18.	Mobile phone is the cheapest form of ICT to use	54.00	2.7
19.	Initial cost of ICT tools are very high*	76.33	3.81
20.	ICT devices are expensive to purchase	48.00	2.4
21.	Sometimes the information on ICT is not updated*	63.66	3.18
22.	One wastes precious time by browsing unnecessary sites on internet*	62.66	3.13
23.	ICT saves my time*	63.33	3.16
24.	ICT provides timely information*	65.66	3.28
25.	Use of ICT is mentally tiring*	64.66	3.23
26.	ICTs creates addiction	40.33	2.01
27.	I lack time to use ICTs for browsing agricultural information*	85.66	4.28
28.	Use of ICT creates physical stress	47.66	2.38
29.	ICT helps in easy decision making*	62.00	3.1
30.	ICT based information services saves my labor time*	75.00	3.75
31.	ICT provides timely solution for the problems faced by the farmers*	82.33	4.11
32.	Information from ICT can result in better farming*	65.00	3.25
33.	Use of ICT is not safe	59.66	2.98
34.	Internet is threat for farming community	61.33	3.06
35.	One has to keep ICT tools up to date with security software	55.33	2.76
36.	ICT usage requires skills	58.33	2.91
37.	I need technical training on ICT use	59.33	2.96
38.	ICT tools are easier for farmers to learn how to use	58.33	2.91
39.	ICT are easy to use*	65.66	3.28
40.	I can get daily update of agricultural commodities in local markets through mobile*	63.00	3.15

Table 1: contd....

S.No.	Statements	RP	MRS
41.	Illiteracy will not stop farmers in availing ICT based agricultural services	57.66	2.88
42.	The information available through ICTs is reliable and adequate	59.66	2.98
43.	One can earn money by using ICT tools for agricultural activities	47.00	2.35
44.	ICT reach farmers in a short period of time	46.66	2.33
45.	ICT are fastest way to exchange information among various client groups*	70.66	3.53
46.	ICT is the potential tool to reach needy farmers	56.33	2.81
47.	ICT reach the unreached farmers	48.66	2.43
48.	Modern ICT tools cannot reach all the people*	62.00	3.1
49.	ICT are the best means to collect latest information about market prices*	82.66	4.13
50.	Farmers can get remunerative prices to their produce through ICT based market intelligence	57.00	2.85
51.	ICT based pest/disease outbreak warning system facilitate farmers to take preventive measures	61.00	3.05
52.	I can enhance marketing of produce through ICT use*	63.33	3.16
53.	ICT based extension services is more satisfying than the personal extension contact*	76.33	3.81
54.	Use of ICT enlarges the social communication of farmers	56	2.80
55.	ICT alone can solve the problems of farmers	50	2.50
56.	Language is big constraint in getting information through electronic media	53	2.65
57.	Information provided by ICT is not available in Punjabi language*	66	3.30
58.	Young farmers have more access to ICT tools*	78.66	3.93
59.	Use of ICT tools by rural women is difficult	55	2.75
60.	ICT helps in risk management in agriculture	30.66	1.53
61.	The disadvantages of using ICT are more than advantages*	83.33	4.16
62.	Socio-cultural barriers can be overcome through ICT*	65.66	3.28
63.	The internet is useful forum for continuous self-learning*	66.33	3.31
64.	ICT can contribute towards the overall development of farmers*	75.66	3.78

*selected statements on basis of relevancy test

namely; Strongly agree, Agree, Undecided, Disagree and Strongly disagree with scores of 5 to 1 for each positive statements and 1 to 5 for each negative statements respectively. The score for their response was summed up and arranged in a descending order. The high and low group was selected which were the 25 percent of the respondents with highest total score and the 25 percent respondents with lowest total score respectively. Among the 34 statements for the item analysis, the 17 statements with the t-values more than 1.75 were selected for the final attitude scale while the other 20 statements were rejected from the scale. The results of the item analysis shows that the statements were able to differentiate between the high and the low group as the range of the item selected was between 8.06 and 0.00 t-value.

According to Guilford (1954), reliability is the proportion of the true variance in obtained test scores. Kerlinger (1964) refers reliability as the accuracy or precision of measuring score of an instrument. Kumar (2016) opined that when a test gives consistently the same results when applied to the same sample, the test is said to be reliable. This is most crucial to attitude scale construction as it shows the strength of the attitude scale. The designed scale was tested for its reliability using Cronbach's alpha method. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. The value of Cronbach's alpha was found to be 0.75 showing that the scale has good internal consistency measurement and thus, the scale was reliable.

Table 2: Item analysis of statements administered to the farmers of non-sample area

S.No.	Statements	t-value
1.	I am not interested to use ICT based information services (-)	2.96
2.	Browsing the internet is confusing (-)	1.75
3.	Agricultural information available through ICTs is misleading (-)	1.02
4.	ICT infrastructure is costly and difficult to maintain (-)	1.10
5.	ICTs are changing so fast, it is difficult to keep up with it (-)	0.23
6.	ICTs can be accessed from any part of globe without any geographical barriers (+)	0.00
7.	The information available through ICTs is reliable (+)	2.90
8.	Information received through ICT does not match real field situation(-)	1.83
9.	ICT can provide practical oriented information (+)	0.87
10.	Use of ICT is cost effective (+)	1.80
11.	Initial cost of ICT tools are very high (-)	1.15
12.	Sometimes the information on ICT is not updated (-)	4.32
13.	One wastes precious time by browsing unnecessary sites on internet (-)	1.92
14.	ICT saves my time (+)	0.41
15.	ICT provides timely information (+)	1.95
16.	Use of ICT is mentally tiring (-)	-1.67
17.	I lack time to use ICTs for browsing agricultural information (-)	4.06
18.	ICT helps in easy decision making (+)	1.90
19.	ICT based information services saves my labor time (+)	0.27
20.	ICT provides timely solution for the problems faced by the farmers (+)	-1.17
21.	Information from ICT can result in better farming (+)	1.79
22.	ICT are easy to use (+)	-2.04
23.	I can get daily update of agricultural commodities in local markets through mobile (+)	0.67
24.	ICT are fastest way to exchange information among various client groups (+)	0.55
25.	Modern ICT tools cannot reach all the people (-)	-3.04
26.	ICT are the best means to collect latest information about market prices (+)	-0.83
27.	I can enhance marketing of produce through ICT use (+)	-4.64
28.	ICT based extension services is more satisfying than the personal extension contact (+)	0.83
29.	Information provided by ICT is not available in Punjabi language (-)	1.77
30.	Young farmers have more access to ICT tools (+)	-2.92
31.	The disadvantages of using ICT are more than advantages (-)	2.02
32.	Socio-cultural barriers can be overcome through ICT (+)	-1.80
33.	The internet is useful forum for continuous self-learning (-)	1.09
34.	ICT can contribute towards the overall development of farmers (+)	-1.66

According to Chovatia *et al* (2017), the validity of the scale was examined for its content validity by determining how well the content of the scale represented the domain subject matter under study. The 17 final statements were given to 20 judges for their expert guidance in the scale construction. The suggestions given by the experts were included in the scale and therefore the scale satisfied content validity. Also intrinsic validity is found to be 0.59. Hence, 17 items which satisfied procedural conditions of Likert's summated ratings were selected for the final attitude scale. The statements of the attitude scale were derived

Table 3: The Final Attitude scale with 17 statements for measuring attitude of farmers towards ICT

S.No.	Statements	t-value
1.	I am not interested to use ICT based information services (-)	2.96
2.	Browsing the internet is confusing (-)	1.75
3.	The information available through ICTs is reliable (+)	2.90
4.	Information received through ICT does not match real field situation (-)	1.83
5.	Use of ICT is cost effective (+)	1.80
6.	Sometimes the information on ICT is not updated (-)	4.32
7.	ICT provides timely information (+)	1.92
8.	I lack time to use ICTs for browsing agricultural information (-)	4.06
9.	ICT helps in easy decision making (+)	1.90
10.	Information from ICT can result in better farming (+)	1.79
11.	ICT are easy to use (+)	-2.04
12.	Modern ICT tools cannot reach all the people (-)	-3.04
13.	I can enhance marketing of produce through ICT use (+)	-4.64
14.	Information provided by ICT is not available in Punjabi language (-)	1.77
15.	Young farmers have more access to ICT tools (+)	-2.92
16.	The disadvantages of using ICT are more than advantages (-)	2.02
17.	Socio-cultural barriers can be overcome through ICT (+)	-1.80

from books, journals, newsletters, bulletins and consultations with concerned experts in the field. The 't' values were significant for all the 17 statements which reflect high discriminating values. It indicated that the scores obtained by utilizing the present scale would measure the intended item. Thus the scale is considered as valid based on the content validity criterion.

The final standardized version of the scale contains 17 items consisting of both positive (9) and negative statements (8) which will be placed randomly in the scale in order to obtain most honest responses. All the items are framed on five point Likert scale. In case of positive statements, strongly agree, agree, neutral, disagree and strongly disagree were scored as 5, 4, 3, 2, 1 respectively, while reverse coding was done for negative statements.

CONCLUSION

The present study describes the construction and standardization of attitude scale towards ICT for farmers. It is a contribution to the body of knowledge in the field of social sciences and behavioral science. This scale is prepared with the aim to understand the feelings of farmers towards using ICT in India for agricultural purpose. Past studies suggested that most of the existing tools are designed in context to developed countries have less relevance for developing countries. Therefore, to overcome the limitations, it was decided to design a new scale to understand the viewpoint of farmers in present scenario. Total 17 items were included in the final scale out of which 9 were positive statements while 8 were negative statements. The scale was checked for its content validity by taking the opinion of experts during its construction process and found to be having good internal consistency of 0.75. Like any other tool it has certain limitations like prior standardization that need to be considered before its use outside India. The standardized attitude scale will fill the gap in the literature related to assessment of attitude towards Information and Communication Technologies uptake among farming communities. It will also serve as a valuable tool for further attitude studies by academicians, extension workers and social organizations involved in promoting ICTs at farmers' level. Hence, the psychometric analysis of the scale has indicated that this tool is reliable and valid, and can prove valuable in assessing the attitude of farmers towards ICT.

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Research Article

A Study on Factors Determining Participation of Women in Dairy Self-help Groups in Rajasthan

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ABSTRACT

The present study was conducted to assess the determinants of probability of participation and extent of participation of women in dairy self-help groups in Rajasthan. Primary data from 360 respondents were collected through pre-tested interview schedule. PROBIT and TOBIT regression was done to assess the determinants of probability of participation and extent of participation of women in dairy self-help groups, respectively. The results shows that the variables yearly income had significantly negative influence while number of dependents per household, self-employment in off-farm activities and prior indebtedness had significantly positive influence on probability of participation of women in SHGs. The variables number of dependents per household and prior indebtedness had significant and positive influence, while yearly income and self-employment in off-farm activities had significant and negative influence on extent of participation of members in an SHG. The study suggests organizing awareness programs for the women to promote their participation in SHGs.

Keywords: Dairy, Self-help groups, Participation, Women

INTRODUCTION

Poverty is prevalent in our country as thousands of people die due to lack of livelihood resources (Feroze, 2009). It is a situation where a family cannot fulfill their basic needs like shelter, food, and clothing. It can lead to other major issues like lack of education, malnutrition, credit etc. Till 1970's, it was considered that 'trickle-down effect' of GNP growth will gradually eradicate poverty, but despite the high GNP growth of East and South-East Asian countries, problem of poverty continued to affect large section of population (Borbora and Mahanta, 2001). According to World Bank group (2016), about 734 Million of world population lives under the $1.90-a-day poverty measure. Considering poverty an alarming issue at the global level, United Nations in 2015 have taken a major step by setting seventeen Sustainable Development Goals (SDGs) in which poverty eradication is taken as a prime goal. India is also focusing on achieving these Sustainable Development Goals as India is not an exception to the global menace of poverty.

There are several causes of poverty, but nowadays the most dangerous cause of poverty is insufficient household income due to unemployment (Khawari, 2004). Unemployment results in lack of sufficient income in a household. In this direction, Government of India has taken a number of initiatives since independence by launching the programs viz., Integrated Rural Development Programme (IRDP), *Jawahar Rozgar Yojana* (JRY), Employment Assurance Scheme and *Sampoorna Gramin Rozgar Yojana* (SGRY). These programs were launched considering poverty alleviation as the major goal by generating better work opportunities for the unemployed. However, they were not completely successful in achieving their targets because of several flaws in implementation, monitoring,

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delivery and design of these programs. Moreover, only one time credit support was given under these programs without any follow-up plan.

Against the backdrop of failure of poverty eradication schemes, two types of strategies can be followed: either asset creation or wage labour. Asset creation is more sustainable than wage labour, but for asset creation, credit is a limiting factor. Hence, provision of credit becomes a necessary component to address the problem of poverty. In this regard, various policy measures for easy accessibility of credit to rural poor were already adopted by Indian government since independence. This includes enhancement of rural credit delivery systems through nationalization of scheduled commercial banks, service area approach, priority sector lending, cooperative credit societies, lead bank scheme, regional rural banks and national bank for agriculture and rural development (NABARD, 2015). But like poverty alleviation schemes, these reforms too could not meet the credit needs of the rural poor. Hence, the concept of SHG-based microfinance has emerged as the most important poverty eradication and empowering tool which has made a visible impact on the livelihood of rural poor. The term microfinance refers to the provision of financial services targeting small businesses and low-income group, including self-employed. Microfinance is a program that provides credit services to poor for their self-employment and other business and financial services (Ledgerwood, 1998). Self-help group is a small, homogenous and informal group of poor people belonging to same socio-economic status. They voluntarily form this group to save and mutually agree to contribute to a common fund to be lent to its members as per group decision for their socio-economic development (NABARD, 2017).

Currently, dairy is the top-ranking commodity in India in value terms. About one third of rural people are dependent upon dairying and 75 per cent of rural households own, on an average, two to four animals (20th Livestock Census, GoI, 2019). Also, dairying provides a source of regular income. This regular income from dairy has a huge impact on minimizing risks to income. Some previous studies indicate that areas where dairy is well developed have less incidence of farmer's suicide (Jagannath and Singh, 2014).

Keeping in view the importance of self-help groups in poverty alleviation and employment generation, the present study has been undertaken exclusively on dairy self-help groups.

MATERIALS AND METHODS

Selection of study area: For the study Rajasthan state has been selected purposively. Rajasthan is India's second largest producer of milk (20th Livestock Census, GoI, 2019). It possesses 10.59 per cent of the total animal population of the country and contributes to almost 12.60 per cent of the milk production (20th Livestock Census, GoI, 2019). Income from livestock averages 22.50 per cent of the total household income, whereas in arid region the contribution of livestock sector is even more than 50 per cent of the total household income (Department of Animal husbandry, GoR, 2018). The status of SHGs in Rajasthan indicates that out of 83,054 SHGs, 13,136 SHGs (15.80%) are defunct (*Rajasthan Grameen Aajeevika Vikas Parishad*). Although 15.8 per cent of SHGs are defunct in Rajasthan, the SHGs which are functioning well in the state have significant impact on the livelihoods of their members. According to previous study conducted in Rajasthan, more than 97 per cent of member households reported timely availability of the credit while 79 per cent of member households reported reduced dependence on moneylenders due to participation in SHGs (Jagannath abd Singh, 2014).

Out of 33 districts in Rajasthan, two districts, namely, Baran and Jhalawar, which have the highest number of dairy SHGs in the state (*Rajasthan Grameen Aajeevika Vikas Parishad*) were selected purposively. Two blocks from each district were selected randomly. Anta and Baran were the two blocks selected from Baran district and Pirawa and Bakani were selected from Jhalawar district.

Selection of individual members: Two members were selected randomly from each of the selected dairy SHGs. Thus, 80 members from a district and a total of 160 SHG members from both the districts were selected. Individuals who had received loans for dairy farming were selected as individual members.

Selection of control groups: 160 non-members were also selected from the same village, who come from the same socio-economic status as the members in terms of number of animals and land holding.

Data: Primary data from 160 SHG members and 160 non-members were collected with the help of pre-tested interview schedule. Data were collected with respect to the socio-economic characteristics of the households (e.g. age, education, marital status, family size, extent of social participation etc.), involvement of members in off-farm activities, ownership of assets (land and livestock) and occupation. Information on trainings received, meetings attended, leadership work, and participation in marketing activities, seminar and conferences were also collected from the SHG members.

Analytical framework: Berhanu and Swinton (2003) argued that participation decisions and extent of participation decisions are not necessarily made jointly. The decision to participate may precede the decision on the extent of participation, and the factors affecting each decision may be different. Therefore, double hurdle model Cragg (1971) was used to analyze the factors that affect the probability of participation and extent or intensity of participation. According to this model, a farmer faces two hurdles while deciding whether or not to participate in the dairy SHGs. In the first hurdle, the decision-maker decides on participation in the dairy SHGs. The second hurdle is related to the level or extent of participation. The most important underlying assumption of the model is that these two decisions are not made simultaneously, but at two different stages. The reason of treating the two decisions independently lies in the fact that the factors that affect one's decision to join the SHGs may be different from those affecting the extent of participation. Since, at the beginning, a farmer may decide to participate in the SHGs, even without making perfect plans about the activities of SHGs, hence, the first hurdle corresponds to factors affecting participation in SHGs and the second to the extent of participation. A different latent variable was used to model each decision process, with a PROBIT model to determine participation and a TOBIT model to determine the extent of participation.

Participation decision is

$$I_i^* = \alpha X_i + v_i$$

Extent of participation decision is

$$Y_i^* = \beta w_i + u_i$$

Where, I_i^* is a latent variable describing the women's decision to participate in the SHGs

Y_i^* is a latent variable describing extent of participation of members in SHGs

x_i is a vector of variables explaining the participation decision

w_i is a vector of variables explaining extent of participation

v_i and u_i are the respective error terms assumed to be independent and normally distributed

1st Hurdle: Explaining SHG membership: To analyze the factors influencing farmers' participation in the SHGs, PROBIT model was used. Variable 'participation' was used as the dependent variable, which is a binary variable. It takes value equal to 1, if a household decides to join a SHG and 0, if a household decides not to join any SHG. We assumed that sample variance was normally distributed and therefore PROBIT regression model was employed.

PROBIT model: Given the assumption of normality of I with $E(I/X)=0$ and $Var(I/X)=1$, the pdf (probability density function) is

$$f\,(I_i^*) = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$$

and cdf (cumulative density function)

$$F\,(I_i^*) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{I_i} e^{-z^2/2}\, dz$$

$$F\,(I_i^*) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\alpha X_i} e^{-z^2/2}\, dz \qquad \ldots. (1)$$

Now, to obtain information on I_i^* and on α, we take the inverse of equation 1

$$I_i^* = F^{-1}\,(I_i^*)$$

$$I_i^* = \alpha X_i + v_i$$

$I_i = 1$, if $I_i^* > 0$ and $I_i = 0$ if $I_i^* < 0$

Where, I_i^* is latent variable that takes the value 1 if the farmer participates in SHG and 0 otherwise

I_i is observed utility index

F^{-1} is inverse of the normal CDF

α is vector of parameter

X_i is vectors of variables explaining decision to participate

v_i is error term

Marginal effects of the PROBIT model were estimated as the slope of the probability curve relating X to Pr (I= 1/X), holding all other variables constant.

2nd Hurdle: Explaining extent of participation: Extent of participation was measured in the form of participation index. For measuring participation index, five indicators viz., meetings attended out of total meetings conducted, trainings attended out of total trainings conducted, whether participated in any marketing activities, whether worked as executive member and whether represented their SHG in any seminar/conference were considered. To construct participation index, firstly normalization was done and then principal component analysis (PCA) was used to assign weights to each indicator.

TOBIT model: To assess the determinants of extent of participation of members in SHGs, truncated regression model was used in the following form:

The function for participation index is

$Y = f(X)$

X = vector for group and community variables.

The function is defined for *PRTN>0*, the assumption is that

$$\lim_{PRTN \to 0} PI = 0$$

Where, *PI* is participation Index

PRTN is the participation decision

This is a reasonable assumption, since participation index on decision to not participate in SHGs is likely to be zero. Here, the dependent variable is truncated at zero when the respondents do not participate in SHGs, the equation is specified as

$$Y_i^* = \beta X_i + u_i \quad \text{.... (2)}$$

Where,

$Y_i = Y_i^*$ if $Y_i^* > 0$ and $I_i^* > 0$

$Y_i = 0$, otherwise

Y_i^* is a latent variable, observable when it takes a positive value.

Equation 2 was estimated using the maximum likelihood technique.

Where,

Y_i^* is latent variable describing level of participation in terms of participation index

Y_i is observed level of participation in SHG

β is vector of parameters

X_i is vector of variables influencing participation index

u_i is error term

If both decisions are made by the individual farmers independently, the error terms are assumed to be independently and normally distributed as:

$\nu_i \sim N(0, 1)$ and $u_i \sim N(0, \sigma^2)$

The explanatory variables that were used are mentioned in Table 1.

RESULTS AND DISCUSSION

Determinants of participation of members in SHGs: The average values of the independent variables used in PROBIT regression are presented in Table 2.

Table 1: Explanatory variables used in regression

Explanatory Variable	Measurement	Expected Sign
Age of respondent	Years	-
Education level of respondent	0- Illiterate; 1- Primary; 2- Secondary; 3-Higher Secondary; 4- University	+/-
Number of dependents	Total number of dependents per household taken as number of children and elderly	+
Annual income	Rupees	-
Self-employment in off-farm activities	Dummy 1 if engaged in off-arm activities and 0 otherwise	
Prior indebtedness	Rupees	+

Table 2: Average values of explanatory variables used in PROBIT regression

Explanatory Variable	Unit	Member	Non-member	Mean difference	Z-statistics
Age of respondent	Years	34.1497	33.5158	1.3250**	2.3507
Education level of respondent	Categorical variable	0.5625	0.7813	0.2188**	-2.3606
Number of dependents per household	Number	4.1063	3.5063	0.6000**	4.1453
Annual income	10000 Rupee	6.0532	7.6031	1.5499**	-5.3141
Self-employment in off-farm activities	Dummy	0.2125	0.0813	0.1313**	3.3651
Prior indebtedness	10000 Rupees	2.2454	1.2698	0.9756**	5.7572

**P≤0.01

Source: Author's estimation from primary data collected through field survey

As shown in the Table 2, non-members were relatively younger than members. Average age of members was 34.1 years compared to 33.5 years for non-members. Non-members were slightly more educated than the members. Number of dependents in a household was higher in member households than that of non-member households and it was 4.1063 for members and 3.5063 for non-members. Average annual income in case of member households was Rs. 60532 compared to Rs. 76031 for non-member households.

To analyze self-employment in off-farm activities, dummy variable was used. Dummy 1 was assigned to the respondents engaged in off-farm activities and zero was assigned otherwise. It was observed that out of total respondents, 21.25 per cent members and 8.13 per cent non-members were engaged in off-farm activities. Prior indebtedness was found to be higher for member households as compared to non-member households. For members, prior indebtedness was Rs 22454, whereas for non-members, the corresponding figure was Rs. 12698.

Estimated PROBIT model for determinants of participation of members in SHGs: PROBIT coefficients and predicted marginal effects were estimated and are being presented in Table 3.

The Table shows that 'number of dependents per household' had positive and significant effect on probability of participation, implying that as number of dependents in a household increases, the probability of being a member also increases. The marginal effect of the coefficient for the SHGs indicated that as the

Table 3: Estimated PROBIT coefficients of factors determining participation of members in SHGs

Variables	Estimated coefficient	Predicted marginal effects (dF/dx)
Constant	-0.8423 (0.6241)	-
Age of respondents	0.0213 (0.0154)	0.0085
Education level of respondents	-0.1437 (0.0934)	-0.0573
Number of dependents per household	0.1477* (0.0617)	0.0589
Annual income	-0.1227** (0.0238)	-0.0489
Self-employment in off-farm activities	0.5255* (0.2291)	0.2031
Prior indebtedness	0.2420** (0.0517)	0.0965
Number of observations	320	
Log likelihood	-182.5141	
Pseudo R-square	0.2177	
LR Chi-square (6)	78.5900**	

*P≤0.05, **P≤0.01, Figures in parentheses are standard errors

Source: Author's estimation from primary data collected through field survey.

number of dependents increases by one unit, with other variables at the mean level, the probability of participation in SHGs increases by 0.0589. This is because higher number of dependents may increase money requirement to fulfill basic needs of their family which motivate them to join SHGs.

The variable 'annual income' had negative and significant effect on women's participation in dairy SHGs. The marginal effect of coefficient indicated that as annual income of respondents increases by Rs 10000, with other variables at mean level, the probability of participation in an SHG decreases by 0.0489. This implies that, households with higher annual income may not find SHGs worthy. Therefore, their probability of participation in SHGs was less. Anyiro *et al.* (2014) also found that the farm income had negative effect on participation of women in SHGs.

'Self-employment in off-farm activities' had significant positive relation with participation of women in the SHG programme. The marginal effect of coefficient shows that as self-employment in off-farm activities increases by one unit, with other variables at mean level, the probability of being a member increases by 0.2031. The possible explanation may be that the variable 'involvement in off-farm activity' can capture various unidentified qualities of households for bearing risk; therefore it depicts the entrepreneurial behaviour of the households. A similar result was obtained by Sarangi (2007) and Feroze (2009).

The variable 'prior indebtedness' had positive and significant effect on probability of participation. The marginal effect of coefficient indicated that as outside loan amount in the household increases by Rs. 10000, the probability of participation of women in the SHGs increases by 0.0965. This implies that women with high amount of previous loan are more likely to be members of SHGs. The possible explanation may be that prior indebtedness or indebtedness trap may lead to prevalence of more poverty in a household. Besides, loans taken from informal sources are charged at high rate of interest. Therefore, person with prior indebtedness had more probability to participate in SHGs.

Variables 'age of respondents' and 'education level' were not significant but sign of the coefficient of these variables can be examined. It was hypothesized that age of respondents had negative influence on probability of participation in SHGs. But sign of estimated coefficient was not as per hypothesis. This is because in our study area older women were less educated; hence they did not have any other work opportunities. Therefore, older women had more probability of participation in an SHG.

The sign of coefficient of variable 'education level' was negative, which implies that as level of education increases, the probability of being a member decreases. This is because higher education may increase opportunities for the respondents to work in other organization where they can get higher income than from SHGs. This finding is in line with the findings of Sarangi (2007) and Feroze (2009), but contradictory to the findings of Khandker (2003), who reported positive influence of education on participation in an SHG.

The likelihood ratio Chi-square of 78.59 with $p<0.01$ shows that model as a whole is statistically significant, i.e., this model fits significantly better than a model with no regressors.

Factors determining extent of participation of members in SHGs: Average value of indicators used to construct performance index is being presented in Table 4.

On an average, 'participation index' was calculated as 0.5293. The average of variable 'meetings attended

Table 4: Average value of dependent and independent variables used in TOBIT model

Dependent variable	Unit	Average value
Participation index		0.5293
Explanatory variable		
Meetings attended out of total meetings conducted	Ratio	0.9901
Trainings attended out of total trainings conducted	Ratio	0.3667
Whether participated in any marketing activities	Dummy	0.7250
Whether worked as a leader	Dummy	0.2813
Whether represented their SHG in any seminar/conference	Dummy	0.3438

Source: Author's estimation from primary data collected through field survey.

out of total meetings conducted' shows that members were regular in attending about 99 per cent of SHG meetings out of total meetings conducted. About 36.67 per cent of trainings were attended by members out of total trainings conducted and 72.50 per cent of members participated in marketing activities to sell their products. Besides, 28.13 per cent of members worked as a leader and 34.38 per cent of members represented their SHGs in seminars and conferences.

Estimated TOBIT model for factors determining extent of participation of members in SHGs: The results of the truncated regression carried out to identify the factors determining extent of participation of members in SHGs are being presented in Table 5.

Table 5: Estimated TOBIT coefficients of factors determining extent of participation in SHGs

Variable	Estimated coefficient
Constant	0.2040 (0.0997)
Age of respondents	-0.0019 (0.0026)
Education level of respondents	0.0129 (0.0143)
Number of dependents per household	0.0506** (0.0094)
Annual income	-0.0131** (0.0036)
Self-employment in off-farm activities	-0.0038 (0.0290)
Prior indebtedness	0.0448** (0.0075)
Number of observation	160
Log likelihood	78.2498
Pseudo R-square	0.2676
LR Chi-square (6)	113.9200**

*P≤0.05, **P≤0.01, Figures in parentheses are standard errors

Source: Author's estimation from primary data collected through field survey.

The variable 'number of dependents per household' had positive and significant effect on extent of participation of members, which implies that the SHG members actively participated in SHG activities with the increase in number of dependents in their family because higher number of dependents increases their money requirement to fulfill basic needs which enhances their active participation in SHGs to earn more.

'Annual income' had negative and significant effect on the extent of participation of members. This implies that women with high household income were not actively participating in SHGs because they had sufficient income, which limited their active participation in different income-generation activities conducted by SHGs. Variable 'prior indebtedness' was significantly and positively related with the participation index of the members. This is because members with large loan amount require more income to repay their old debts. Therefore, these members actively participated in SHGs so that more income could be generated through different SHG activities.

Though the variables 'age of respondents', 'education level' and 'self-employment in off-farm activities' did not have significant influence on participation index, yet the signs of coefficients of these variables can be examined. The variables 'age of respondents' and 'self-employment in off-farm activities' had negative effect, while 'education level' had positive influence on extent of participation of members in SHG activities.

The likelihood ratio Chi-square of 113.92 (p-value <0.01) shows that together all the independent variables have a significant impact on the extent of participation of members in SHGs, i.e., this model fits significantly better than a model without regressors.

CONCLUSION

Poverty is the most dangerous curse in our society. According to World Bank report (2016), 224 Million of Indian population lives under the $1.90-a-day poverty measure. Most obvious manifestation of poverty is insufficient household income due to unemployment. Considering the poverty, low income and unemployment as alarming issue at global level, United Nations has taken major step by setting the seventeen Sustainable Development Goals (SDGs). India is also focusing on achieving these SDGs as India is not an exception to the global menace of poverty. For that government can follow two types of strategies, either asset creation or wage labour. Asset creation is more sustainable than wage labour. But in this path credit is a limiting factor. Hence, concept of microfinance using SHG is the best way to achieve these goals. Concept of SHG is a credit plus approach which helps the poor to have an easy and continued access to credit. SHGs not only provide credit to poor women but also make them self-reliant by generating

employment. Therefore, the present research paper studied the factors determining the participation of women in dairy SHGs. The results shows that number of dependents per household and prior indebtedness had significantly positive influence and yearly income had significantly negative influence on probability of participation and extent of participation of women in dairy SHGs. On an average, the 'participation index' was 0.5293. The variable 'self-employment in off-farm activities also had significant and positive influence on probability of participation of members in an SHG. Therefore it can be concluded that the self-employed women with large family size and prior debt are more likely to be the member of dairy SHGs. Moreover, they have active involvement in different activities of SHGs.

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Research Article

Assessing the Effectiveness of Education and Training in Mitigating Clinical Mastitis Incidence among Farmer Herds

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ABSTRACT

The recent study was conducted with the objective to assess the various management factors related to clinical mastitis in dairy animals. Total 100 farmers of 5 different blocks of district Fatehgarh Sahib, Punjab were targeted for data survey generation. Data regarding education classification of farmers, dairy training, information of the species (Cattle. Buffalo) and incidence of clinical mastitis were generated. Chi-square analysis was performed to test the influence of various observed parameters on incidence of clinical mastitis in farmers herd. Education classification, species information, block-wise animal distribution did not reveal significant influence ($P>0.05$) on control of clinical mastitis. However, effect of dairy training revealed the significant effect ($P<0.05$). Out of 100, 45 per cent farmers were educated upto secondary education. Out of these 45.00, 55.56% (25) farmer's animals were affected with clinical mastitis. The animals of 44.44 per cent (20) farmers were non-affected. On the other hand, 19 per cent farmers were education above higher secondary level. 42.11% (8) farmer's animals of them had affected and 57.89 per cent (11) of them had non-affected by clinical mastitis. Among the 100 farmers, 24 per cent of them attended the training of dairy farming. 8 (33.33%) of them had affected and 16 (66.66%) of them had non-affected. 76 per cent farmers didn't attend the training and animals of 40 per cent farmers were affected and animals of 36 per cent farmers were non-affected by clinical mastitis. The baseline data generated from farmers flock revealed that education and dairy farming training of dairy farmers for the control of clinical mastitis is prerequisite for profitable dairy farming.

Keywords: Mastitis, Farmers, Chi-square, Dairy

INTRODUCTION

Livestock production, particularly the dairy sector, plays a crucial role in India's food and nutritional security, as well as the livelihoods of many farmers and the country's economy. The contribution of the dairy industry to India's economy has been extensively studied, with estimates suggesting that it contributes around 4 per cent to India's GDP (KPMG, 2021). Education and training are well-known to contribute significantly to the expansion and well-being of national economies, as human capital is a crucial element in explaining disparities in productivity and income between countries. Numerous studies have shown that higher levels of education and training are associated with higher productivity and income levels in individuals and countries (Hicks, 1987; Mankiw *et al.,* 1992; Barro, 2001). Investment in education and training is widely considered to be the single most effective long-term lever for governments to upgrade industry (OECD, 2017). It is essential to note that both formal education and informal on-the-job training are important components of human capital. Learning is a fundamental process, and information is the most critical resource in the modern economy. Knowledge advancements and information diffusion are the most significant factors influencing productivity

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development, followed by changes in the quality of labour, of which education and training are major components (Glaeser *et al.*, 2002; OECD, 2019).

Mastitis is a condition that affects dairy cows and is caused by an infection in their mammary glands. This infection leads to inflammation, swelling, and pain in the udder, which can reduce milk production and quality (Huijps, 2009; Kamaldeep *et al.,* 2021). Mastitis is a common and costly disease in the dairy industry, as it can affect milk yields, quality, and profits (Nurhayati and Martindah, 2015). Mastitis is one of the most frequent diseases of dairy cattle, and it has important economic implications for the industry due to costs associated with reduced milk production and milk quality, premature culling of animals, veterinary treatment, and animal welfare (Lescourret and Coulon, 1994; Hogeveen *et al.,* 2011; Siivonen *et al.,* 2011; Heikkila *et al.,* 2012; Magotra *et al.,* 2016; Magotra *et al.,* 2020). Some studies have been reported that the incidence of sub clinical mastitis ranged from 19.20 to 83 per cent in cows. In India, about 70-80 per cent economic loss has been attributed due to sub clinical mastitis alone (Dua, 2001). A cow is considered to have clinical mastitis (CM) if it presents abnormal milk secretion from one or more quarters, with possible signs of inflammation of the udder tissues (e.g., heat, swelling, or discoloration of the skin) (Kelton *et al.,* 1998; Magotra *et al.,* 2019). There are several genetic and non-genetic factors that influence incidence of clinical mastitis in dairy animals. Preventing mastitis is a key to maintain the health of dairy cows and maximizing milk production (Gussmann *et al.,* 2019). Good milking hygiene is essential, including regularly cleaning the milking equipment and properly sanitizing the udder before milking (Putri *et al.,* 2015). Proper nutrition, adequate ventilation, and comfortable housing can also help reduce stress on the cows and minimize the risk of mastitis. Five states, namely Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, and Maharashtra had estimates of Sub clinical mastitis of 53.52, 51.18, 39.58, 62.49 and 35.11 per cent, respectively (Kumari *et al.,* 2018) The present study was conducted with the objective to assess the various management factors related to clinical mastitis in dairy animals reared by dairy farmers of district Fatehgarh Sahib, Punjab, India.

MATERIALS AND METHODS

The current study was carried out in 5 different blocks of district Fatehgarh Sahib, Punjab namely Sirhind, Khera, Bassi Pathana, Khamano and Amloh. Out of these 5 blocks 100 dairy farmers were selected randomly. Data regarding education classification of farmers, dairy training, information of the species (Cattle, Buffalo) and incidence of clinical mastitis were generated. The district Fatehgarh Sahib is situated between 30 degree-38' North and 76 degree-27' East and is 50 kilometers towards the west of Chandigarh, the capital of Punjab. According to cattle census 2019, the population of the buffalo 113268 and cattle 68655. The literacy rate of Fatehgarh Sahib district as per census 2011 is 83.45 per cent of which males and females are 86.69 and 79.59 per cent literates respectively.

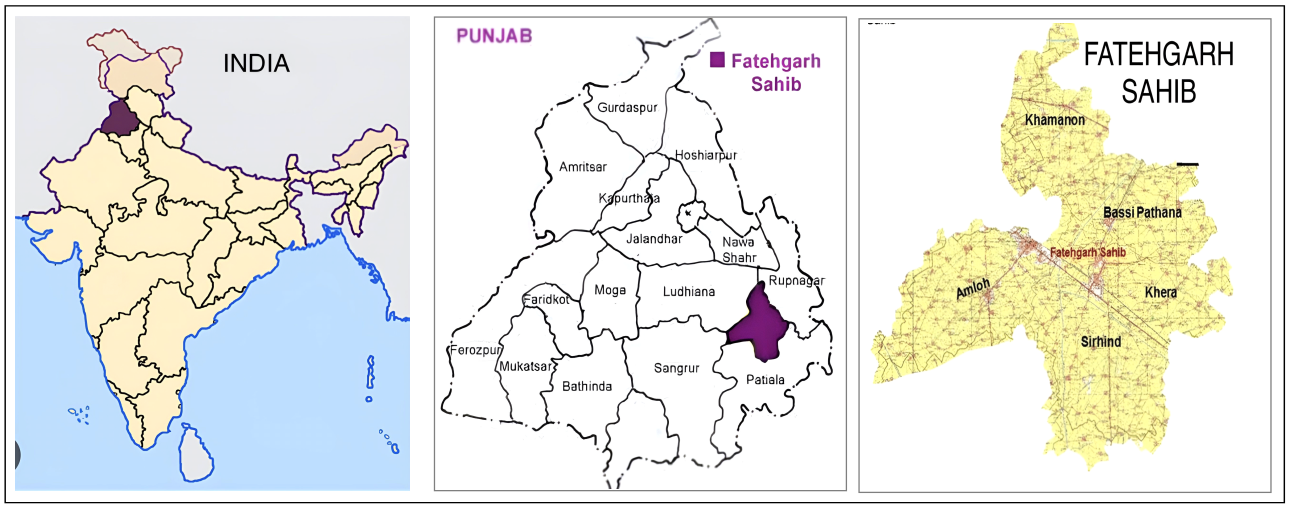

Figure 1: Location of study area

The study has adopted mixed method approach. Qualitative and quantitative collection approach placed equal weightage in data collection (Creswell, 2014). As such both qualitative and quantitative data were required for primary data collection. For generating these primary data, the main approach applied was questionnaire survey method. This method has been effective in acquiring district response from the people and provides a way in comparing the results generated out of each respondent (Martin, 2004).

Generation of data was done on the basis of education classification of farmers, dairy training, information of the species (Cattle, Buffalo) and incidence of clinical mastitis. Chi-square analysis was performed to test significance of observed parameters on incidence of clinical mastitis. Chi-square is a statistical test that examines the differences between categorical variables from a random sample in order to determine whether the expected and observed results are well-fitting. Formula for Chi-Square Test:

$$x_c^2 = \frac{\sum(O_i - E_i)^2}{E_i}$$

Where, c = Degrees of freedom, O = Observed value, E = Expected value. All statistical analysis was done by using IBM SPSS-23 statistical software (Wagner and William, 2019).

RESULTS AND DISCUSSION

About 70 per cent of India's population is engaged in agriculture and livestock keeping. India has the highest number of dairy animals in the world including about 300 million bovines. Milk production is by buffaloes (56% of total milk production) and dairy cows, depending on the region. The animals are mostly kept by small-scale farmers, and according to Kurup 2001, also mentioned in the FAO report on "*Impacts of mastitis in small scale dairy production systems*", these farmers own over 60 per cent of all milk animals in the country. Few farmers (about 5%) own more than 5 animals. The per capita milk consumption varies across states but is said to be high in urban areas. About 50 per cent of the milk is consumed at the farm level. Cost and quality are issues in the sector. Animal disease surveillance is less developed and infrastructure to support delivery of services is inadequate. Several groups are known to offer animal health services. Mastitis remains a problem in many dairy herds with about 70 per cent of all losses being perceived to be due to the infection. Those funding, running, facilitating and participating in training are involved because they expect the training to influence the behavior of training participants, and hence impact on variables such as profit and sustainability of the farm business. The positive relationship between education and training and farm profitability is confirmed by data collected from the farmers. This research showed that, for a given size of farm business (measured by value of assets), farm businesses with mangers who had participated in more education and training were more profitable than businesses with managers who had participated less. As education and training does impact on farm business outcomes such as profit and sustainability, hence it is vital to understand how training impacts on farm management decisions.

Education classification, species information, block-wise animal distribution did not reveal significant influence ($P>0.05$) on incidence of clinical mastitis as shown in Table 1 respectively. Although this finding is in disagreement with the study of other researchers (Kayitsinga *et al.,* 2016), which stated that it is important or very important to recruit good employees (85%) and retain good employees (89%) thus highlighting the importance of educated and trained staff. However, in our current study also, incidence of mastitis is comparatively less in farmer's herds that are more educated. Also, in our study, dairy farming training component revealed significant effect on incidence of clinical mastitis in farmer's herd ($P<0.05$) which is in agreement with the study of some researchers (like Dufour *et al.,* 2011, 2012; Kayitsinga *et al.*, 2016).

Effect of level of education on the management of clinical mastitis has been depicted in Figure 1 showing less number of infections in higher educated farmer's herd as compared to less educated. Species-wise incidence of clinical mastitis (Figure 2) showed higher level of incidence in cattle and buffalo both. Block-wise percentage of affected and non-affected farmers are shown in figure 3 representing higher number of clinical mastitis affection in Khamano and Amloh blocks as compared to Sirhind, Khera and Bassi. Figure 4 showing effect of dairy farming training on the management of clinical mastitis clearly depicted that the herds whose farmer had any training have good management and less number of infections.

Table 1: Chi-square tests

Variables	Chi square test	value	df	Asymptotic Significance (2-sided)
Education wise incidence of Mastitis	Pearson Chi-Square	0.982[a]	2	0.612
	Likelihood Ratio	0.984	2	0.612
	Linear-by-Linear Association	0.839	1	0.360
Species-wise incidence of clinical mastitis	Pearson Chi-Square	0.010[a]	1	0.921
	Likelihood Ratio	0.010	1	0.921
	Linear-by-Linear Association	0.010	1	0.921
Block-wise incidence of Mastitis	Pearson Chi-Square	2.644[a]	4	0.619
	Likelihood Ratio	2.657	4	0.617
Training-wise incidence of Mastitis	Pearson Chi-Square	2.722[a]	1	0.099
	Likelihood Ratio	2.769	1	0.096
	Linear-by-Linear Association	2.694	1	0.101

Number of valid cases = 100; 0 cells (0.0%) have an expected count less than 5

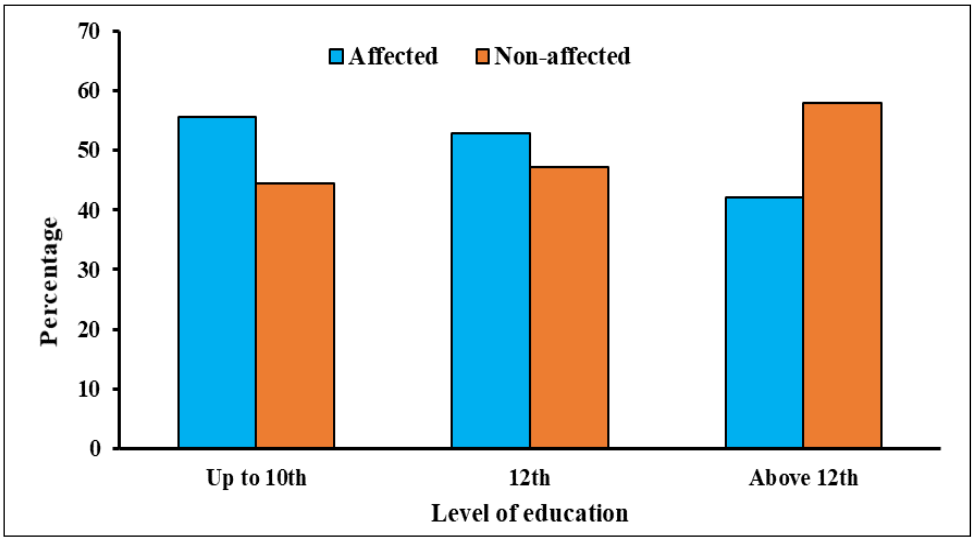

Figure 2: Effect of level of education on the management of clinical mastitis

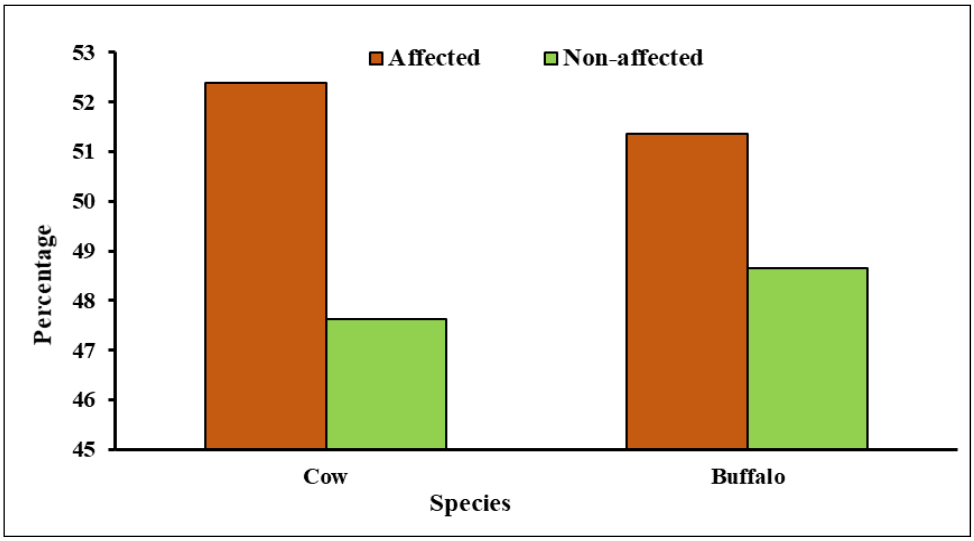

Figure 3: Species-wise incidences of clinical mastitis

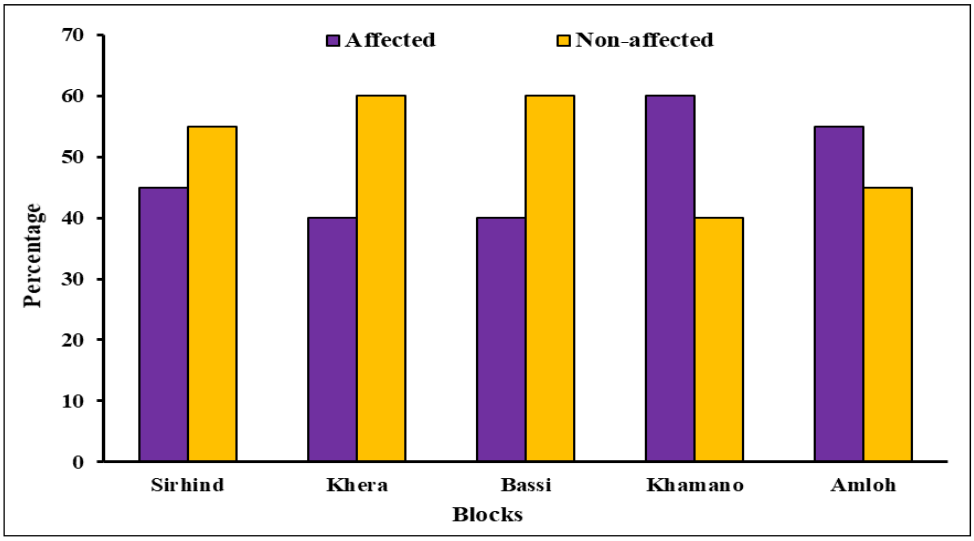

Figure 4: Block-wise percentage of affected and non-affected farmers in case of clinical mastitis

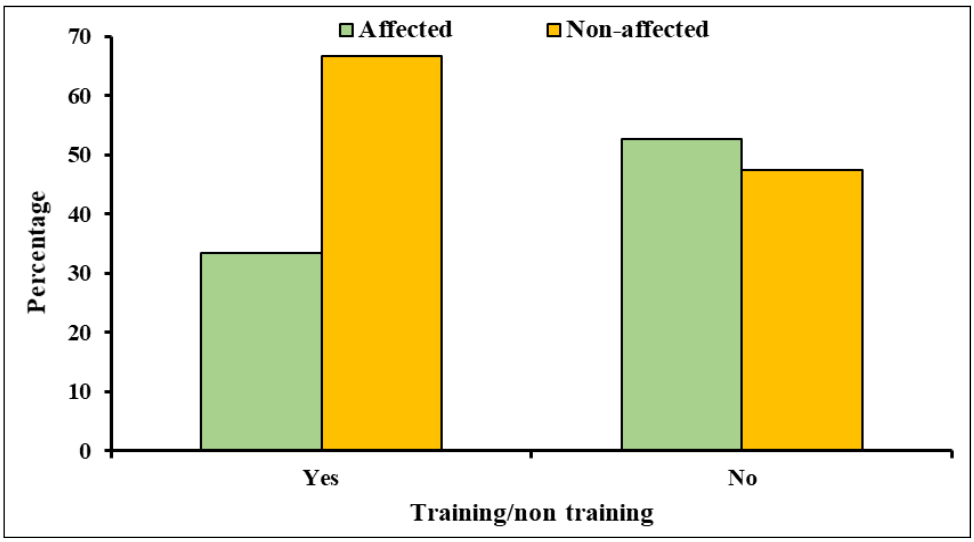

Figure 5: Effect of dairy training on the management of clinical mastitis

Comparatively incidence of mastitis is less in training group (33.33%) than in the farmer's herd of farmers performing dairy farming without training (52.63%) as shown in Figure 5. This result is also in line with the study of the (Dillon *et al.,* 2015) farmer uptake of agricultural training and herd management practices such as milk recording as well as liaison with extension services are positively related to cell count reduction, all else being equal thus leading to decrease in number of incidences of mastitis in farm. Further our study lacked the detection of sub clinical mastitis in which milk appears normal and visible abnormalities such as udder swelling, hardness of the affected quarter, pain, and watery milk remains absent, but physical and chemical changes occurs in the milk, which helps in the detection of SCM by various diagnostic tests otherwise effect of education and training on the incidence of mastitis at farmers herd would have been more profound and the results would have been far better but this was a pilot study and further research is being conducted taken further considerations.

CONCLUSION

It is clear from the analysis that improving animal health, specifically in the case of mastitis, can have significant economic benefits for the dairy industry. This underscores the importance of educating and training dairy farmers in best practices for within herd health management. The study validates the effectiveness of education and extension programs in promoting the adoption of best practices by farmers, and highlights the need for ongoing training and support to ensure continued success. The baseline data generated from the study suggests that education and training are

essential prerequisites for profitable dairy farming. By empowering farmers with the knowledge and skills necessary to manage clinical mastitis effectively, they can minimize the impact of the disease on their herds and maximize their productivity and profitability. Overall, the study underscores the importance of ongoing education and training for dairy farmers to improve within herd health management and highlights the significant economic benefits that can be achieved through such efforts.

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Research Article

Prevalence and Area-Specific Etiology of Prostate Cancer (PCa) in Bathinda City, Punjab, India

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ABSTRACT

Prostate cancer appears to be the leading malignant cause of mortality in men, worldwide. However, studies of the specific etiology in the region, referring to socio-demographic and lifestyle characteristics, have been sparse. This study was conducted to assess the prevalence of PCa in Bathinda city, as well as attest to its causative factors. For this purpose, two distinct groups of study populations were selected. For the PCa prevalence, 150 men (aged above 30 years) were invited to take part in the screening for PCa in the 50 districts of Bathinda city. For area-specific etiology of PCa, 200 PCa post-operative cases were interviewed after surgery regarding their socio-demographic, lifestyle, and disease characteristics. The obtained data were expressed as frequencies and percentages. Findings showed the prevalence of PCa in Bathinda city as 4.67 per cent during the current investigation. As far as area-specific etiology is concerned, the prevalence of PCa was indicated to be an elderly-specific disorder, since 43.7 and 31 per cent of respondents were from 60-70 years of age and 70-80 years, respectively. In addition, 61 per cent of respondents were from middle-income groups. Regarding lifestyle practices, practice of ordinary plastic containers, drinking untreated water, and consumption of unsafe vegetables and milk among respondents were higher. Disease characteristics showed that family history of PCa at 13 per cent. Most respondents (72%) reported that disease onset was gradual. It may be summarized that aging and genetic factors are considered unavoidable factors for PCa occurrence, however, aspects of lifestyle may be, improved to prevent PCa.

Keywords: Prostate cancer, Prevalence, Socio-demographic, Lifestyle, Disease characteristics

INTRODUCTION

Worldwide, Prostate Cancer (PCa) is the second most prevalent cancer among men, with large variations in occurrence and different mortality rates in different regions (Landberg *et al.,* 2010). It has been estimated that in the year 2020, there were 14,14,249 new cases of PCa and 3,75,000 deaths, internationally (Sung *et al.,* 2020). The disease is ranked sixth position among all the common cancers in the Asian population by the year 2012 (International Agency for Research on Cancer, 2012) and the fourth leading cause of death among males, cancer (Mattiuzzi and Lippi, 2019). The rates for PCa incidence among East and South-Central Asian populations were reported as 10.5 and 4.5 per cent, respectively. Among all types of cancer, prostate cancer (PCa) is the common instinctive malignancy prevalent in males, with an average increase of 39 cases per year in Punjab (Socio-Economic statistical information about India, 2015). Even though the occurrence of PCa is considered a result of hereditary factors, significantly more than several other kinds of

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tumors but risk factors such as levels of androgen, age, race, and lifestyle patterns have emerged, presently (Tang *et al.,* 2005). Apart from these, some other causes, viz. contaminated water supply, and the use of insecticides and pesticides on food crops are too considered accountable for the progression of the disease. Studies have also been undertaken to study the risk assessment of dietary contamination through pesticide residues in the "Cotton belt of Punjab" (Battu *et al.,* 2005), nevertheless, the area-wise etiology of prostate cancer and its correlation with socio-demographic and lifestyle characteristics is not clear yet. For that reason, basic health determinants such as social and physical environment have also been treated as essential (Public Health Agency of Canada, 2006; Ratzan, 2001).

Overall, PCa is a multi-faceted ailment and research evidence on the area-specific etiology of PCa remains scanty. Hence, through the current investigation, we assessed the prevalence of PCa in Bathinda City with a set of 150 males (above 30 years of age); and also investigated diverse causative factors of PCa, from a different set (200 males with PCa) of the sample, to have area-specific etiology, for further implications in PCa prevention or ceasing its progression, when it is localized.

MATERIALS AND METHODS

The present study was planned to investigate the prevalence and area-specific etiology of Prostate Cancer (PCa) in Bathinda City, Punjab, India using a socio-demographic survey and lifestyle-related information. The materials and methods for present investigations have been discussed under the following heads:

Location/place of work: Three different hospitals in Bathinda City.

Selection of the respondents:

a) Sample selection for PCa prevalence: The survey was undertaken in 50 wards under Municipal Corporation, Bathinda City, to find out the prevalence of prostate cancer.

i) Sampling method: Multistage systematic sampling.

ii) Study population: By working out the formula given below, the sample size was calculated, to identify the prevalence of prostate cancer.

$$N = \frac{z2\ P\ (1\text{-}P)}{e2}$$

Where, N = Sample size
z = Statistics for α error
P = Estimated prevalence of the disease during the last review
e = Margin of Error

Assumption: If we set the alpha error at 5%, z would be 1.96.

According to NCRP (2013), the prevalence of prostate cancer in males was 8 per cent in Bathinda District.

$$N = \frac{1.962 \times 0.08\ (1\text{-}0.08)}{0.052}$$

Therefore, N was calculated as 114 according to the formula mentioned above. A total number of 150 respondents (from randomly selected households in each ward) who fulfilled the inclusion criteria were invited to participate in the prevalence survey to ensure the prevalence rate of prostate cancer.

Inclusion criteria: Males above the age of 30 years.

b) Selection of the respondents for studying the etiology of PCa: A sample of 200 outdoor, post-operative adult males with PCa, were selected from three differently located hospitals of Bathinda city, employing cluster design, to explore area-specific etiology of PCa in Bathinda City. An informed consent form was got signed by each participant and information about respondents and hospitals have been remained confidential.

Development of questionnaire cum interview schedule: An open-ended questionnaire cum interview schedule, consisting of different questions on demographic and lifestyle-related information, etc. was devised. The face validity of the questionnaire cum interview schedule was performed by the expert panel, consisting of an Assistant Scientist, Food and Nutrition, Punjab Agricultural University, Ludhiana, and Dietitians of concerned hospitals. Based on the comments received, necessary modifications were done, therefore, the modified questionnaire was used to record the research information.

Collection of data: Personal interaction was made to collect detailed data related to respondents to ensure first-hand authenticated information.

a) Prevalence of PCa: To study the prevalence of PCa, a total number of 150 males, who fulfilled the inclusion criteria, from randomly selected households in 50 wards of Bathinda City, were invited for PCa screening.

b) Area-specific etiology of PCa: Data concerning socio-demographic, lifestyle, and disease characteristics was collected under the following sub-heads:

i. Socio-demographic characteristics: Information on age, educational level, occupation, type and composition of the family, socio-economic status, etc. was noted.

ii. Lifestyle characteristics: Lifestyle-related information, in terms of, sleeping span; household practices *viz.* food storage containers, source of drinking water, the method for cleaning fruits and vegetables, practice of kitchen garden and source of fruits, vegetables and milk was recorded.

iii. Disease characteristics: Information concerning, PSA level, family history of the disease, clinical signs, and symptoms of prostate cancer, and the onset of the disease was noted.

6. Statistical analysis: Obtained data were subjected to frequency distribution and percentage of all the parameters recorded throughout the investigation using the software Graph Pad Prism (version 5.01).

RESULTS

a) Prevalence of PCa: To study the prevalence of prostate cancer (PCa), a total number of 150 males (above the age of 30 years) from randomly selected households, belonging to 50 wards of Bathinda City, were invited for the screening of prostate cancer. The findings indicated that 7 respondents were suffering from PCa. Therefore, the incidence of PCa was observed as 4.67 per cent in Bathinda City.

b) Area-specific etiology of PCa: An interplay between social and genetic factors, may be a cause for the development and progression of PCa. Further, the incidence of prostate cancer may be affected by lifestyle practices, too (Cheng *et al.,* 2009).

i. Socio-demographic Characteristics: The major age group afflicted with the disease, was observed as 60-70 years with 43.5 per cent males, followed by 70-80 years among 31 per cent of respondents. Further, it was reported that 13, 8.5, and 4 per cent of respondents were between the age of 50-60,80-90, and 40-50 years, respectively (Figure 1). About education level, most (35.5%) of the respondents were illiterate. Regarding occupation, 59 per cent of males belonged to the farm community. It was also noted that 69 per cent of males were based in rustic households, whereas only 21.5 and 9.5 per cent of the respondents, were residing in urban and semi-urban settings.

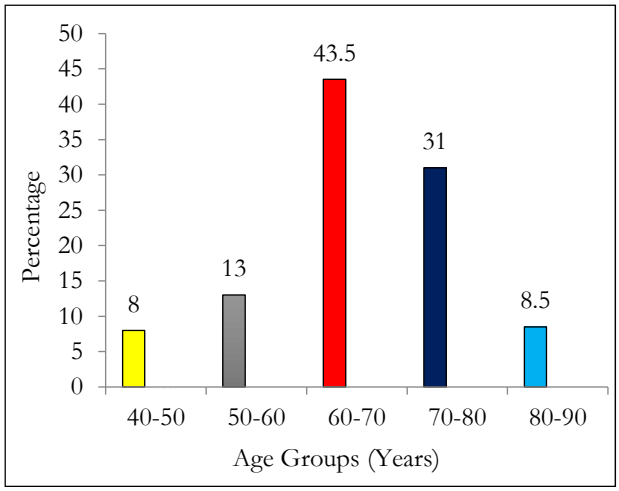

Figure 1: Age-wise distribution of adult males with PCa

Further, the familial system of the respondents reflected that joint family setup was common, as the corresponding value was 90 percent, along with the majority (55%) of the family size reported from 5 to 7 members, respectively. Results on socioeconomic status, when compared with Kuppuswamy socioeconomic classification (2016) showed that 61 percent of the respondents were categorized under middle-income strata, having per capita income between INR 9794-19605 and 31 per cent of respondents in the low-income group, with per capita income between INR 1964-9793, respectively. On the contrary, only 8 percent of respondents were from the high-income group, with a per capita income of INR 19606- 39377 (Figure 2).

ii. Lifestyle Characteristics: Table 1 illustrates the contributory factors for the occurrence and progression

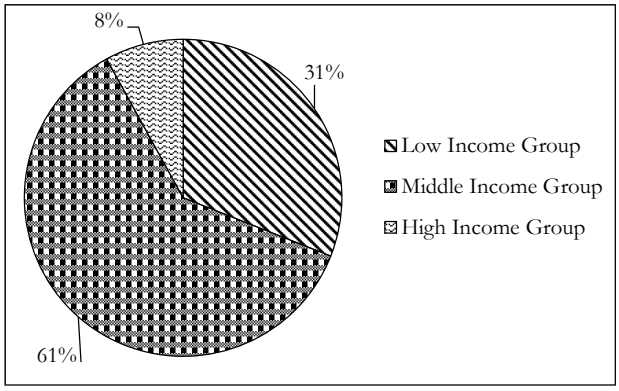

Figure 2: Socio-economic status of adult males with PCa

Table 1: Lifestyle Characteristic of adult males with PCa in Bathinda City (N= 200)

Characteristics	No. of respondents
a. Sleeping span	
<6	00 (00)
6-8	174 (87)
>8	26 (13)
b. Storage containers for food commodities	
Empty pesticide containers (EPC)	00 (00)
Food-grade plastic (FGP)	26 (13)
Steel containers (SC)	50 (25)
Ordinary plastic (OP)	46 (23)
SC + OP	58 (29)
EPC + SC	08 (04)
EPC + OP	00 (00)
FGP + SC	12 (06)
c. Source of drinking water	
Treated source	86 (43)
Untreated source	114 (57)
d. Method for cleaning of fruits and vegetables (Washing)	200 (100)
e. Kitchen garden	
Practised	44 (22)
Not practised	156 (78)
f. Source of fruits and vegetables	
Kitchen garden	44 (22)
Farm	44 (22)
Organized Food Outlets	00 (00)
Vendors	112 (56)
g. Source of milk	
Livestock	115 (57.5)
Commercial Dairy	85 (42.5)

Figures in parentheses represent the percentages

of PCa. Data regarding sleeping span showed that most (87%) of the respondents had a normal sleeping span (6-8 hours) and rest (13%) used to have their sleep time as more than 8 hours a day, which reflects a lower physical activity level among respondents. Concerning household practices, it was observed that food-grade containers for procurement of food grains were not much popular, as only 13 percent of respondents were using the same, however, ordinary plastic was in trend.

Access to potable water from untreated sources such as municipal water supply, submersibles, and hand pumps were observed among the majority (57%) of the respondents. Moreover, no effective and scientifically recommended method other than washing was exercised, to remove the pesticide residues present in fruits and vegetables. Additionally, organic farming practices, in the form of kitchen gardens, were not seen to intensified and vendors (56%) were the main sources of fruit and vegetable consumption. Hence, the presence of pesticide residues on foods could be, one of the causative factors for the development of PCa. Apart from this, livestock rearing was observed among more than half (57.5%) of the total population. The rest (42.5%) of the respondents relied on commercial dairy products, to meet their daily requirements for milk. The use of oxytocin injection for dairy cattle was also reported in 5.5 per cent of respondents' households.

iii. Disease characteristics: Mean PSA level of respondents was observed as 17.82±18.94ng/ mL, which was pretty much higher than the reference value, up to 4 ng/ mL (Table 2). Among disease characteristics, family history of PCa in specific and other types of cancer was observed as 13 and 08 percent, respectively. Under signs and symptoms, lesser urine output and exertion during urination were experienced by all (100%) of the respondents, while pelvic pain and enlargement of the prostate were common in most (88 and 91%) of the respondents, respectively.

Constipation was also reported as a major complication by 37.5 per cent of respondents. History of piles was also noted in 05 percent of the respondents. Frequent urination and off odor during urination were experienced by few (05 and 04%) respondents. The onset of the disease as explained by

Table 2: Disease Characteristic of adult males with PCa in Bathinda City (N= 200)

Characteristics	No. of respondents
a. Family history of the disease	
Prostate Cancer	26 (13)
Other Cancers	16 (8)
b. Clinical signs and symptoms of PCa	
Pelvic pain	176 (88)
Lesser urine output	200 (100)
Exertion during urine	200 (100)
Enlargement of prostate	182 (91)
c. Other complications	
Constipation	75 (37.5)
Piles	10 (05)
Frequent urination	10(05)
Off odour during urination	08 (04)
d. Onset of the disease	
Gradual	144 (72)
Sudden	23 (11.5)
Off and on	33 (16.5)
e. Aggravating factor	
Exertion	120 (60)
Diet	60 (30)
Both	20(10)

Figures in parentheses represent the percentages

the majority (72%) of the respondents, was gradual, since most common irrespective of some exceptions. In contrast to this, some (16.5%) respondents experienced the same off and on. Further, exertion (60%) and diet (30%) had been reported as aggravating factors in disease progression. In addition, 10 percent of the respondents, were experiencing both (exertion and diet) factors.

DISCUSSION

The range from 5.0 to 9.1/ 1,00,000 annual prevalence rate of prostate cancer in Indian males was reported (Hebert *et al.,* 2006). PCa has been reported to be the leading malignancy among all types of cancers in males with a prevalence of 8 percent in Bathinda District, as per findings of NCRP (2013). However, during the current study, the incidence rate was reported as little more than half (4.67%) in Bathinda City as compared to the whole district, mentioned above.

The peak incidence of prostate cancer was observed in the age group above 65 years, and thus, considered a the disease of elderly (Lalitha *et al.,* 2012). Similar findings have been reported during our study. We observed a lower level of education among the respondents. Bidoli *et al.* 2009 too reported the maximum percentage of prostate cancer respondents below the middle (49.6) and matric (29.9) levels of education. Likewise, Shahmoradi *et al.* (2009) also observed during their study that the majority (82%) of the respondents were educated upto the secondary level.

It was stated that farmers and other agriculture workers have a 7 to 12 per cent increased risk of developing cancer (Sharma-Wagner *et al.,* 2000). In our study, more than half of the respondents were self-employed as farmers. Further, the percentage reported for rural whereabouts of the respondents during the present investigation corroborates with the figures (68.84%) reported by Hariharan and Venugopal 2016, on scrutinizing the MEDLINE database from 1990 to 2014, for demographic information of PCA respondents in India.

In determining the nutritional as well as the health status of an individual, socioeconomic status, based on the per capita income of the family, is considered an important factor (Ankitha *et al.,* 2016). A survey on the socio-demographic background of American-Black and American-White men reported that the prevalence of PCA was found higher among the respondents, belonging to low and moderate-income strata in the American-Black population while an opposite trend was found among American-Whites (Hayes *et al.,* 1999). The findings of the present study were, in agreement with, the American-Black population in the above-mentioned study. In addition to these, similar findings were reported by Cheng *et al.* (2009) while summarizing the data from California Cancer Registry (A population-based surveillance, epidemiology, and end results [SEER] registry), which focused on the relationship between socioeconomic status and prostate cancer. A study on 147 males with prostate cancer in Cordoba, Argentina (during the year 2008 to 2012) revealed that the majority (41.50 and 34.01%) of the respondents were belonging to low and middle-income groups, respectively, while, only 24.49 per cent of respondents were reported in the high socioeconomic group (Niclis *et al.,* 2015).

Ordinary plastic containers and untreated groundwater were observed during the present investigation. Storage of food commodities in plastic containers causes the release of carcinogenic agents such as bisphenol from plastic containers which can result in prostate cancer (Ho *et al.*, 2006). Poor groundwater quality in the Malwa belt is one of the prominent reasons for the incidence of cancer (Mittal *et al.,* 2014). Six times higher concentrations from the reference range of 0.1 ìg/ g and more than double lead, uranium, and barium were found in the hair samples of breast cancer respondents as compared to healthy individuals in the Malwa region of Punjab, which could be, due to increased metal burden in soil and water resulted from overuse of phosphate fertilizers during cultivation (Blaurock-Busch *et al.,* 2014). The kitchen garden was not so popular among the respondents in our study. A significant association between the use of pesticides (chlorinated pesticides and methyl bromide) and prostate cancer was observed by Alavanja *et al.* (2003).

In our study, dairy cattle were injected with oxytocin in some households, hence, this practice may also be a contributing factor, concerning the rise in the concentration of estrogen level which overwhelms the production of androgen and testosterone levels in the human body. A rise in the concentration of estrogen can cause direct mutagenic effects and unprepared proliferation in prostate cells, to a certain extent, due to endogenous estrogens (E1-estrone and E2-estradiol) metabolism, by enzyme CYP - cytochrome P450, with the successive formation of electrophilic intermediates and extra powerful estrogens (Hamilton-Reeves *et al.,* 2007).

The mean PSA level reported during the present study was found more than the value reported by Amin et al. 2008 as 13.4 ìg/ L in males with prostate cancer. Further, a cohort undertaken by Karunasinghe *et al.* (2022) attested a significant association between PSA level and socio-demographic, lifestyle, and clinical/ disease characteristics while studying 2779 males suffering from PCa, in three diverse geographical situations viz. New Zealand, the United States, and Taiwan. Investigators revealed that age and ethnicity were modifying factors in PCa cases. This analysis established that for each cohort, contributing factors were specific, with special reference to the PSA level. Alike observations were recorded in our study, thus, these two recent observations suggest PSA screening, given demographic, lifestyle, and genetic factors, to curtail the PCa incidence, in coming years.

CONCLUSION

It is irrefutable that aging, heredity, and socio-economic status as key factors in developing PCa. Besides, this study attests to the role of occupation, untreated drinking water, and perishable food commodities, in PCa progression. Further, it has been scrutinized that the use of ordinary plastic containers for storage of food grains and oxytocin injection for dairy cattle, could be, contributing towards PCa progression.

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Research Article

Maize in India- A Case Study of FPO-led Marketing in Karnataka

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ABSTRACT

The study was undertaken to assess the impact of Farmer Producer Organization (FPO)-led maize marketing on Farmers' income in the year 2021-22. Bai-Perron structural break analysis in area and productivity was carried out from the year 1990-2020 to find out year of shift in the crop. Major break in area was found in the year 2002 and break in productivity was found in the year 2006. Primary data was collected from two taluks in Davanagere district of Karnataka. Cost of cultivation, net income, B:C ratio and market efficiency among different channels were computed. Among three channels, Channel III (FPO-led marketing) showed highest B:C ratio of 2.17and market efficiency of 1.7. Regression adjustment model was used to compare effect of FPO-led marketing with traditional market channels. Farmers' following channel III received 6307 ₹ /ha more net income than other channels.

Keywords: Bai-perron structural break analysis, FPO (Farmer producer organization), Maize marketing, Regression adjustment model, Binary logit regression model

INTRODUCTION

Maize crop (*Zea mays* L.) has an important place in the food grain basket of our country and is the third most crucial food grain crop in India because of its contribution to food, feed, specialty corn, starch, etc. India ranks 4th and 7th in global maize acreage and production, contributing to 4.6 per cent and 2.4 per cent, respectively. It directly contributes almost 10 per cent to the Indian food basket and 5 per cent to the world's dietary energy supply. After the agricultural revolution in the 1960s, dramatic changes in the production and productivity of maize have taken place. The adoption of single-cross and double-cross maize hybrids has revolutionized maize production (Kumar, 2013). In the aspect of providing gainful employment and doubling farmers' income, maize has a higher potential than rice and wheat (Maize vision, 2022). Maize can be used as food, feed, fodder, and as raw material in industries and bio-ethanol production. It has gained popularity in silage and fodder preparation. An increase in maize area and production led to growth in poultry and allied sectors. Fast progress in maize production led to the growth of the starch industry.

The Government of India launched a pilot programme called Farmer Producer Organizations (henceforth, FPOs) through the Small Farmers' Agribusiness Consortium (SFAC) in 2011–12 to integrate small farmers with the agricultural market for more lucrative prices with low transaction costs and encourage them to sell their surplus production. The goal of the establishment of FPOs is to organise farmers, particularly small producers, at various levels across many states in order to promote technology adoption, boost productivity, enable better access to inputs and services, and raise farmer incomes, strengthening their reliance on sustainable agriculture for a living (Government of India, 2013).

FPOs' main goal is to improve small farmers' forward and backward linkages by giving them access to technology, inputs, and the market (Singh 2019).

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Karnataka is contributing 14.88 per cent and 14.80 per cent to all India area and the production of maize. Many feed industries and other maize processing industries are located in Davanagere supplying maize-processed products intra-state, inter-state and abroad. Karnataka has the highest concentration of promoting institutions which includes farmer Producer Organizations making up around 8.9 per cent of all promoting agencies operating in the nation (Manaswi, 2018). The study was undertaken in Davanagere district for the above mentioned reasons.

MATERIALS AND METHODS

The production pattern of maize is seen to have shifted from traditional maize growing north states to the south states in the last decade. Bai-Perron structural break analysis was used by using data on area and production of maize from 1990-91 to 2019-20.

Sample state and district was purposively selected based on highest area and production of maize and well-developed markets in the area. Existence of several processing companies and FPOs added essence of the study in area for clear understanding of maize market channels. Two sample taluks and four villages were selected based on convenience sampling. Farmers following different market channels were surveyed from 4 villages belonging to two taluks of Davanagere district in Karnataka. Total 120 farmers were surveyed. Snow-ball sampling was followed in sample area. Data from farmers following FPO-led marketing was calculated from other than sample area to fit Regression Adjustment Model. Data from other marketing intermediaries such as village traders, wholesalers, retailers, poultry feed companies, FPOS, feed dealers were collected based on snow ball sampling.

Cost A_1 = It includes inputs such as seed, fertilizer, labour, packaging material, pre-cooling, freight. manures, insecticides and pesticides, depreciation on implements and farm buildings, irrigation charges, land revenue, interest on working capital, marketing cost paid by farmers.

Cost A_2 = Cost A_1 + rent paid for leased inland

Cost B_1 = Cost A_1 + interest on value of owned fixed capital assets (excluding land).

Cost B_2 = Cost B_1 + rental value of owned land.

Cost C_1 = Cost B_1 + imputed value of family labour.

Cost C_2 = Cost B_2 + imputed value of family labour.

Farm business income = Gross income – Cost A_2

Family labour income = Gross income – Cost B_2

Net income over Cost C_1 = Gross income – Cost C_1

The total cost incurred on marketing by producer seller and various intermediaries involved in sale and purchase of the commodity till it reaches the ultimate consumer was taken under this head (Acharya, 2004).

$$C = C_f + C_{m1} + C_{m2} + C_{m3} \ldots\ldots\ldots C_{mi}$$

Where, C = Total cost of marketing of the commodity,

C_f = Cost incurred by the producer from the time the product leaves the particular stakeholder,

C_{mi} = Cost incurred by the i^{th} middleman in the process of buying and selling the product.

It is the price received by the farmer (P_f) expressed as a percentage of the retail price (the price paid by the consumer). If P_r is the retail price, the producer's share in consumer's rupee (P_s) may be expressed as follows.

$$P_s = (P_f/P_r) \times 100$$

Price spread was worked out separately for marketing channels identified in the study area. In general, price spread is defined as the difference between price paid by the consumer and price received by the producer for an equivalent quantity of farm produce. Price spread was calculated using the formula.

Price spread = Consumer price - Producer's price

Marketing efficiency is the effectiveness of the marketing system with which it operates. For calculating the marketing efficiency, modified method as suggested by Acharya (2004) was used.

$$MME = FP \div (MC + MM)$$

Where, MME = Modified measure of marketing efficiency

FP = Price received by the farmer

MC, MM = Marketing costs and Marketing margins

To study the impact of value chain on farmers income, Regression adjustment model for treated variables was used. Marketing maize through FPO was selected as treated channel assigned 1 and marketing

through village traders is considered as traditional channel and assigned 0 against which impact was assessed.

RESULTS AND DISCUSSION

In India, shift in area and production of maize has been presented in Table 1. Area under maize started to increase after the year 2002. Increase in demand for maize because of flourishing poultry sector, shift in consumption pattern of urban people and more utilization. Increase in productivity of maize was after year 2006. Main reasons for increase were usage of improved varieties and hybrids, mechanization etc.

As maize is widely spread and marketing has also been well developed in the area. Maize produced in the area is used for various purpose like maize-based food products, raw material for other industries, starch production, poultry feed, cattle feed etc. This makes the marketing channel diverse in the area. The value chain map of the existing area is represented in Figure 1. Though various market channels for various purpose exists for maize, most of the maize produced in the area was used for poultry feed. Poultry feed being one major input for poultry industries and maize is important constituent of poultry feed, lot of demand of maize for poultry feed is found. The present study focuses on poultry feed-based value chain in Davanagere district and market channels operating for maize with respect to poultry feed. Three major channels were identified for maize marketing which is used for poultry feed as presented in Table 2. Channel I was where producer/farmer sells produce to village trader, village trader to wholesaler, wholesaler to feed processing company from which the poultry feed reaches consumer through either poultry contractor or feed dealer of company. In the Channel II maize is sold to wholesaler from which it reaches consumer through intermediaries like feed processing company and contractor or dealer. In channel III maize is sold from producer to FPO, FPO to poultry feed company, company to contractor/feed dealer and finally to consumer. In the fourth channel the feed processing company themselves go to the farmers field and purchase produce from farmers by offering extra price than prevailing market price with on cash payment which is later processed and reached to consumers through contractors/dealers.

Table 2: Major market channels of maize with respect to poultry feed in Davanagere district of Karnataka

Channels	Stakeholders
Channel I	Producer-Village trader-Wholesaler-Processor-consumer
Channel II	Producer-Wholesaler-Processor-Consumer
Channel III	Producer-FPO-Processor-Consumer

Three channels comparison of farm income measures is presented in Table 3. Costs of farmers following channel III was lowest and costs for farmers following channel I was highest in general. Cost C_1 for farmers following channel I, II, and III Rs. 46822, Rs. 44036 and Rs. 43568 per ha respectively. Cost of production per quintal for the farmer following channel I was highest (Rs. 1016/ha) and lowest for the farmers following channel III (Rs. 869/ha). Channel III involves FPO for marketing. Farmers who were members of the FPO also had provision of inputs

Table 1: Break years in area and production of maize in India

Particulars	Break year	Trend	Reasons
Maize area	2002	Increasing	a) Poultry farming increased demand more maize for poultry feed
			b) Urbanization and more income led to more demand for processed foods of maize
			c) Starch and other maize based industries flourished
			d) Yield of paddy and wheat started to decline encouraging farmers to shift to maize production
Maize productivity	2006	Increasing	a) Improved varieties and cultivars, hybrids, composites with higher yield potential b) Entry of private firms in supplying seeds c) Better irrigation facilities d) Mechanization

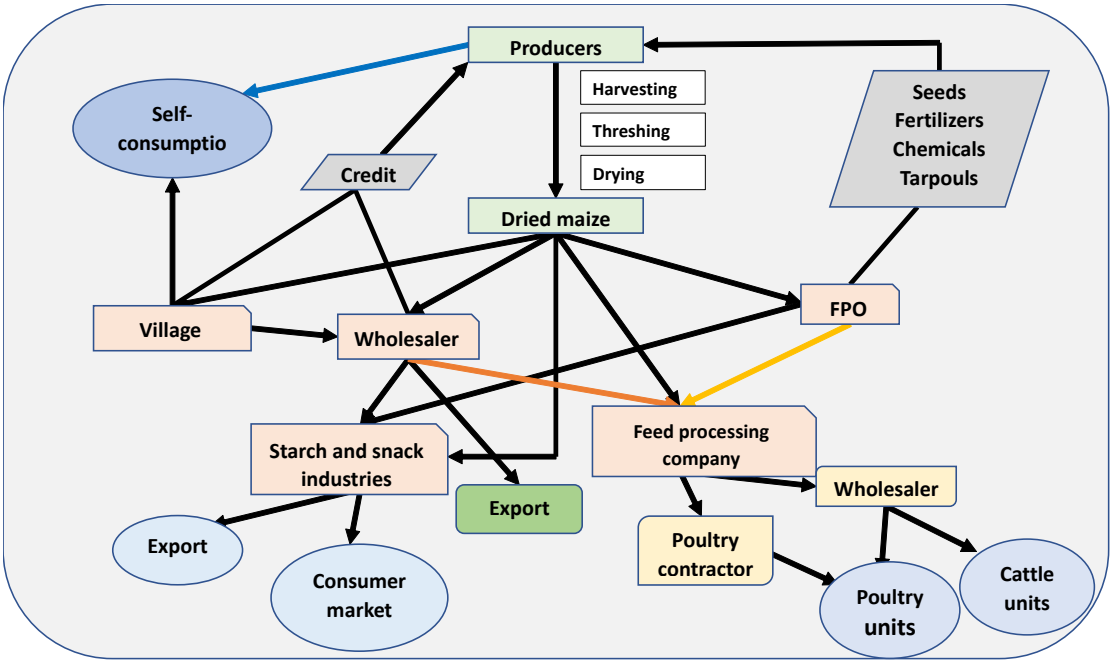

Figure 1: Value-chain map of maize in Davanagere district of Karnataka

Table 3: Farm income measures of different channels

Particulars	Channel I	Channel II	Channel III
Cost concepts (Rs./ha)			
Cost A_1	38974	38407	36624
Cost A_2	41149	41582	39799
Cost B_1	39907	39385	37602
Cost B_2	43407	45807	40102
Cost C_1	46822	44036	43568
Cost C_2	53244	50458	49990
Cost of production (Rs./Q)	1016	951	869
Marketing cost (Rs./Q)	5	88	67
Yield (Q/ha)	51.40	52.10	52.50
Price per quintal (Rs.)	1702	1740	1787
By product yield (Q/ha)	111.90	110.50	113.40
By product revenue @ Rs.45/Q	5035	4974	5104
Gross income (Rs./ha)	92544	95641	98941
Farm business income (Rs./ha)	53569	57233	62317
Family labour income (Rs./ha)	52636	56255	61338
Net income (Rs./ha)	45721	51604	55372
Benefit cost ratio	1.77	1.93	2.17

such as seeds, fertilizers, pesticides and insecticides for discounted prices. Availability of cheap inputs led to decreased cost than other two channels. Marketing cost was highest for the farmers following channel II and least for the farmers following channel I. Gross income was highest for the farmers following channel III (Rs. 98941/ha) and least for the farmers following channel I (Rs. 92544/ha). Net income and B:C ratio of the

Table 4: Market efficiency of existing channels

Particulars	Channel I	Channel II	Channel III
Total market costs (Rs./Q)	468	419	525
Total market margins (Rs./Q)	693	651	520
Price spread (Rs./Q)	1197	1159	1112
Producer's share in consumer rupee	0.58	0.60	0.61
Market efficiency	1.46	1.62	1.70

farmers following channel III was highest (Rs. 55372/ha and 2.17) and least for the farmers following channel I (Rs. 45721/ha and 1.77). In channel III, more net income and B:C ratio can be attributed to both decreased cost of production and increased prices of sale to farmers. Total marketing costs were highest in channel III (Rs. 525/Q) followed by channel I (Rs. 468/Q) and least in channel II (Rs. 419/Q).

Total marketing margins was highest in channel I (Rs. 693/Q) followed by channel III (Rs. 520/Q). Price spread was recorded highest in channel I (Rs. 1197/Q) and was found least in channel III (Rs. 1112/Q). Producer's share in consumer rupee was least in channel I (0.58) and was highest in channel III (0.61). Market efficiency was highest in channel III (1.7) and least in channel I (1.46) as shown in Table 4.

FPO-led marketing showed net income of 6307 Rs./ha more than the farmers who followed traditional market channels. Advantages of both cost reduction and higher price were captured in net income.

CONCLUSION

India has shown increase in area under maize from the year 2002 and increase in production after 2006. Marketing of maize played an important role in the study area. Though maize is used for various purposes, most of it is used for poultry feed. Three major channels for poultry feed were identified and farmers following those channels were surveyed. Material costs and total costs are lesser for the farmers who were following FPO-led marketing (Channel III), reduction in cost is mainly due to availability of inputs at lower prices. Farmers following FPO-led marketing received net income of 6307 Rs./ha more than the farmers who followed traditional market channels.

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Research Article

An Analysis of Adoption and Satisfaction Level of Farmers Towards Artificial Insemination in Jharkhand State

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ABSTRACT

Artificial insemination being the most imperative technique to bring genetic improvement in the animals yet its potential is not entirely adopted by many farmers. The contemporary study was conducted in three districts of Jharkhand to know the present status of artificial insemination. The data was collected from 204 respondents (180 farmers and 24 service professionals) with the help of pre structured interview schedule. The findings of the study revealed that overall, 67.42 per cent of the respondents continued the adoption of artificial insemination whereas 20.36 per cent of the respondents occasionally adopted the artificial insemination and only 12.22 per cent of the respondents discontinued the adoption. On measuring overall satisfactions levels based on five parameters viz. timeliness, variety of semen provided, quality of service, success rate and costliness, the respondents were mostly satisfied by the NGO (BAIF), followed by Government Veterinarians and were least satisfied with the services of Lay Inseminators.

Keywords: Adoption, Artificial insemination, Dairy, Satisfaction

INTRODUCTION

Dairying is an efficient instrument to develop rural societies, to generate employment and persistent income and it provides assurance against various odds (Prasad, 2011). Indian subcontinent has restructured its position from a milk shortage country to leading the world in milk production, with production more than 210 million tonnes in 2021-2022 (Press Information Bureau, 2022). Value of output from Livestock sector is 11,59,636 crores where 7,72,705 crores is contributed from milk group in the year 2018-19 (Basic Animal Husbandry Statistics, Department of Animal Husbandry, Dairying and Fisheries, Government of India, 2019). India, despite having the largest bovine population of 303.76 million (Livestock Census, Government of India, 2019), the milk productivity is not at par with other countries. Potential of Indian milch animals is very low when comparison is made with other developed countries of world. Thus, for Indian livestock and dairying industry, poor productivity along with the quality of production and products remains a reason of worry (Chander *et al.,* 2010). In India's dairy industry, critical portion of it is comprised by millions of small and marginal farmers who has two to three animals with production of few litres of milk on an average. Artificial Insemination has been perhaps the most important among all the animal husbandry technologies to bring about genetic improvement of animals, in order to escalate the milk yield of Indian cattle owned by resource deprived livestock owners. Singh (1979) stated that majority (93%) of the dairy farmers adopted artificial insemination in cattle to improve the breed. Rathod *et al.* (2017) concluded that 62.5 per cent of the farmers partially adopted artificial insemination, while 24.45 per cent farmers fully adopted artificial insemination in their farm. Only 8 percent dairy farmers in the study area

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never followed artificial insemination. The socio-economic demographics among the dairy farmers played significant role in the adoption of the A.I. technique. Bhanja and Kumar (1978) reported that there was a progressive trend in adoption of artificial insemination with increase of land holding. Similarly, Singh *et al.* (1979) found that education, herd size, size of land holding mass media exposure, knowledge of artificial insemination, extension contacts and socio-economic status of cattle owners were related with adoption of artificial insemination in cows. However, the diffusion of the A.I. at the grassroots levels largely depends on the timely services rendered by lay inseminators or para-veterinarians. Karthikeyan (2018) revealed dairy co-operatives, private integrators, public departments, private veterinarians and para-veterinarians as major artificial insemination service providers to the dairy farmers. Further, Shruti (2016) highlighted that lay inseminators provided timely and effectively A.I services to the dairy farmers.

However, most of these researches and innovations regarding livestock and dairy sector have not reached to the end users due to numerous causes. From the pool of immense dairy innovations produced and disseminated, artificial insemination is deliberated as an evolving dairy innovation of immense socio-economic significance to Indian dairy industry (Rathod and Chander, 2014), but the adoption of these technologies is not at par at the field conditions (Rathod *et al.* 2014). Gandhi *et al.* (1998) testified that only a miserable (10%) percentage of bovine population in India was covered through artificial insemination in spite of enormous infrastructure and financial provisions over the years. Artificial insemination coverage of bovines in the country is about 30 per cent ranging from 71 per cent to even less than 1 percent for different states. Around 65 per cent animals are still bred through natural service because either the services are not available at farmers' doorstep or they are not swayed with the efficacy of the prevailing services. Also, this is attributed to lack of knowledge about proper timing of insemination and lack of knowledge about benefits of artificial insemination were the constraints in the adoption of artificial insemination. Keeping this theoretical background as reference, the present research was focused to study the level of adoption artificial insemination (A.I) technology among the dairy farmers and vis-à-vis evaluate their satisfaction levels in the state.

MATERIALS AND METHODS

Jharkhand state was purposively selected for the study. Further, based on the coverage of artificial insemination three districts *viz.* Ranchi, Saraikela-Kharsawan and Ramgarh were purposively selected. From each purposively selected districts, 2 blocks were selected randomly and from each block, 2 villages were selected randomly for study. Fifteen farmers and two artificial insemination service professionals were randomly selected from each village for data collection. Therefore, the total number of respondents selected for the study was 204 (180 farmer respondents and 24 Service Professionals). The criteria for selection of the respondents were that each dairy farmer should be rearing at least one milch animal either cow or buffalo and at least once have tried artificial insemination. According to Rogers and Shoemaker (1971), adoption is a decision to make full use of new ideas as the best course of action available. The standard operating procedures (SOP) adopted by dairy farmers were depicted by taking responses in 3 continuum viz. 'Always', 'Sometimes' and 'Never'. Similarly, to measure the level of adoption structured interview schedule was developed. The respondents were asked to put their responses as occasionally adopted, adoption continued and adoption discontinued and were analysed using frequency and percentages. Finally, satisfaction level of respondents in relation to A.I services provided by different service providers was assessed based on five parameters viz. timeliness, variety of semen provided, quality of service, success rate and costliness. The response for satisfaction level were categorised as 'Good', 'Average' and 'Poor', and accordingly their overall satisfaction level was evaluated by considering their total weighted mean score.

RESULTS AND DISCUSSION

The result of the study indicated different practices adopted by the respondents' farmers with regard to Artificial Insemination at the field level as presented in Table 1.

According to Table 1, the pooled value showed that 87.97 per cent of the respondents always watched their animals in heat. Proper heat identification is prerequisite for effective artificial insemination. When animals were in heat, 85.44 per cent of the respondents never separate their animals from other animals. Small

Table 1: SOP's followed by farmer respondents for artificial insemination

Practices	Ranchi (n=55)			Saraikela-Kharsawan (n=52)			Ramgarh (n=51)			Pooled (n=158)		
	A	S	N	A	S	N	A	S	N	A	S	N
Watching animals for the signs of estrus	100.00	00.00	00.00	84.62	15.38	00.00	78.43	21.57	00.00	87.97	12.03	00.00
Separating the animal in heat from others	00.00	23.64	76.36	00.00	13.46	86.54	00.00	05.88	94.12	00.00	14.56	85.44
Following right time of A. I	67.27	32.73	00.00	69.23	30.77	00.00	68.63	31.37	00.00	68.35	31.65	00.00
Knowledge of semen/breed	00.00	85.45	14.55	00.00	65.38	34.62	00.00	17.65	82.35	00.00	56.96	43.04
Helping inseminators during A. I	87.27	12.73	00.00	90.38	09.62	00.00	96.08	03.92	00.00	91.14	08.86	00.00
Helping in thawing process providing lukewarm water	92.73	07.27	00.00	92.31	07.69	00.00	92.16	07.84	00.00	92.41	07.59	00.00

Where, A= Always, S= Sometimes, N= Never

herd size might be the reason for not separating the animals in addition with less space available for keeping the animals separately. Most of the respondents (68.35%) always followed the right time of insemination i.e., they inseminate their animals after 12-16 hours of estrous detection. Majority of the respondents (56.96%) only sometimes knew about the breed of semen used in the insemination followed by 43.04 per cent of the respondents who never knew about the breed of the semen. The reason might be the lack knowledge about various breed of bulls. About 92 per cent of the respondents always helped the inseminators during by providing lukewarm water for thawing of the straw.

Majority of the respondents (80% from Ranchi, 63.34% from Saraikela-Kharsawan and 58.33% from Ramgarh) as depicted in Table 2 continued the adoption of artificial insemination. From Ranchi 8.33 per cent, Saraikela-Kharsawan 13.33 per cent and Ramgarh 15 per cent of the respondents discontinued the adoption. Overall 67.42 percent of the respondents continued the adoption of artificial insemination whereas 20.36 per cent of the respondents occasionally adopted the artificial insemination. Only 12.22 per cent of the respondents discontinued the adoption. The reasons for discontinued adoption might be the high price of the insemination, poor conception rate and repeat breeding problems. Whereas, majority of the respondents adopted artificial insemination because it helped in breed improvement and was perceived as time saving, economical and convenient as compared to natural breeding. Other reasons for adoption were low possibilities of infection as compared to natural service. When A.I services are not available or respondents were unable to avail the A.I services as their cattle got served during grazing or inability to detect heat on proper time or some other reasons, they switch to natural method of breeding.

The Pearson's correlation was calculated using SPSS to find out the relationship between socio-personal, socio-economic and communication variables and adoption. The obtained results are depicted in the Table 3. It showed that adoption of artificial insemination of all the respondents was significant and positively correlated with age, education level, family education status, annual income, land holding, milk production, and experience in crop farming, extension contacts and mass media exposure at 5% level of significance. With

Table 2: Distribution of respondents according to the adoption status of A.I

Adoption status	Ranchi (n=60) Percentage	Saraikela-Kharsawan (n=60) Percentage	Ramgarh (n=60) Percentage	Pooled (n=180) Percentage
Occasionally adopted*	11.67	23.33	26.67	20.36
Adoption continued	80.00	63.34	58.33	67.42
Adoption discontinued	08.33	13.33	15.00	12.22

*Here occasionally adopted category of respondents can be described as those respondents who availed the artificial insemination services as well as natural insemination as per availability of the services.

Table 3: Relationship between socio-personal and socio-economic variables and adoption of Artificial Insemination

Socio-personal and socio-economic variables	Ranchi (n=60) (r value)	Saraikela-Kharsawan (n=60) (r value)	Ramgarh (n=60) (r value)	Pooled (n=180) (r value)
Age	0.163	0.242	0.089	0.163*
Gender	-0.076	-0.152	0.174	0.007
Cast	0.062	0.000	-0.123	0.004
Education Level	0.328*	0.311*	0.295*	0.267*
Family Education Status	0.379*	0.225	0.293*	0.274*
Annual Income	0.247	0.220	0.186	0.231*
Land Holding	0.140	0.176	0.174	0.167*
Family type	-0.216	-0.006	0.050	-0.046
Family size	-0.093	-0.135	0.008	-0.085
Herd size	0.116	0.243	0.073	0.160
Milk Production	0.115	0.285*	0.310*	0.179*
Experience in crop farming	0.302*	0.095	0.131	0.168*
Experience in dairy farming	0.084	0.116	0.176	0.143
Social Participation	0.373*	-0.016	0.387*	0.142
Extension Contacts	0.311*	0.286*	0.212	0.289*
Mass Media Exposure	0.067	0.103	0.314*	0.173*

the increase in age, education and family education status the exposure of farmers towards the innovation increases significantly which ultimately motivates the farmers to adopt the technology. With high annual income, the risk bearing ability of farmer increases to try something new. Increase in milk yield due to artificial insemination significantly contributes to adoption of artificial insemination, as increase in production is clearly visible to the farmers. Frequent contacts with extension agents and high level of mass media exposure also contributes significantly in adoption. Whereas gender, cast, herd size, experience in dairy farming and social participation was non-significant and not correlated with adoption of artificial insemination. The above findings are supported from the earlier studies of Bashir *et al.* (2013) who reported similar correlation among some mentioned variables and adoption of artificial insemination.

It was found from the study that there were three major service providers in the study area who were providing artificial insemination service and the results of the study are compared in the Table 4. In terms of timeliness, with maximum weighted score, respondents were mostly satisfied with NGO (BAIF) (275.68) followed by Lay Inseminators (263.93). Respondents were least satisfied with the services of Government Veterinarians (173.53). Due to engagement of veterinarians in other works can be the reason of

Table 4: Satisfaction level of respondents in relation to A.I services provided by different Service Providers

Service Providers	Aggregate weighted score of different Service Providers														Total weighted score
	Timeliness			Variety of Semen			Quality of Service			Success Rate			Costliness			
	D1	D2	D3	D1	D2	D3	D1	D2	D3	D1	D2	D3	D1	D2	D3	
Govt. Vets	178.57	176.92	157.14	214.29	207.69	214.29	264.29	269.23	271.43	242.86	253.85	285.71	263.10	200.00	200.00	3399.37
L.I	267.50	256.41	267.44	227.50	192.31	197.67	167.50	174.36	186.05	135.00	133.33	165.12	254.64	256.41	265.12	3146.36
NGO (BAIF)	214.29	282.86	271.79	269.44	277.14	265.00	205.56	222.86	195.00	166.67	177.14	210.00	263.89	260.00	287.50	3569.14

Where, D1 = Ranchi; D2 = Saraikela-Kharsawan; D3 = Ramgarh

unavailability for insemination. For providing variety of semen, respondents were mostly satisfied by NGO (270.27) followed by Government Veterinarians (211.76) and respondents were least satisfied by Lay Inseminators with weighted score of 205.74. In terms of quality of service, respondents were most satisfied with Government Veterinarians among the various service providers with the maximum weighted score of 267.65 followed by NGO (BAIF) with the weighted score of 207.21. The respondents were least satisfied with the services of Lay inseminators (176.23). For success, rate respondents were mostly satisfied with Government Veterinarians with the highest weighted score (255.88) followed by NGO (BAIF) with the weighted score of 185.59. Respondents gave least score to Lay Inseminators (145.08). In terms of cost effectiveness of the service provided, respondents were mostly satisfied by the NGO (BAIF) with the maximum weighted score (271.17) followed by the Lay Inseminators (259.02) and Government Veterinarians (211.76). Uniting all the parameters for measuring satisfaction level i.e., timeliness, variety of semen provided, quality of service, success rate and costliness overall, the respondents were mostly satisfied by the NGO (BAIF) with maximum average weighted score of 3569.14 followed by Government Veterinarians (3399.37) and least satisfied with the services of Lay Inseminators with average weighted score of 3146.36.

CONCLUSION

Artificial Insemination technique has proved to be the better alternative than natural service and thus play a pivotal role in breeding dairy animals. Especially, in Jharkhand State where majority comprises of small and marginal dairy farm holders. The majority of dairy farmers adopted A.I. as it was economical, time saving, and convenient as compared to natural service and had higher conception rate and low possibility of infection among the dairy animals. The A.I. services rendered by grassroots level workers like lay inseminators, veterinarians etc. play vital role, as they timely cater to the needs of local dairy farmers. The major determinant factor for better adoption of A.I. largely depended on farmers' socio-economic condition, timely access and availability of A.I. services by the A.I. service providers. However, the farmers increasing satisfaction level was mainly attributed to

timeliness; variety of quality semen available from superior cattle breeds; quality of A.I services performed; success rate and cost effectives in performing A.I. Therefore, creating awareness among the dairy farmers through campaign, training and method demonstrations along with favourable breeding policies implemented by government; the rate of adoption of A.I. among dairy farmers could be enhanced manifolds in the Jharkhand State.

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Research Article

Beetroot Juice Potential in Enhancing Nutritional Value and Palatability of Juice Blends and Whey-Based Beverages

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ABSTRACT

Beetroot is a super food rich in antioxidants which have the ability to prevent oxidation in our cells. Despite the numerous health benefits beetroot remains underutilised. Keeping this in view, Beetroot juice was added for the preparation of juice blend and whey drink. The developed juice blend and whey drink were further subjected to physico-chemical and bioactive composition analysis. Results of physico-chemical properties revealed that TSS (9.01 and 7.12 °Brix) and pH (4.64 and 5.28) of juice blend and whey drink decreased in comparison to the beetroot juice (10.72°Brix and 6.40) whereas the acidity increased (0.67 and 0.45%) as that of the beetroot juice (0.06). Phenols decreased from 88.75 mg GAE/100g in beetroot juice to 77.90 and 55.05 GAE mg/100 g in juice blend and whey drink, respectively. Flavonoids content in beetroot juice was found to be 47. 87 mg QE/100 g which decreased to 23.33 mg/100 in juice blend and to 19.16 mg/100 g in whey drink. Anthocyanin content in beetroot juice, juice blend and whey drink was observed to be 7.71, 3.82 and 2.32 mg/100 g, respectively. Antioxidant activity of beetroot juice (50.10 %) significantly ($p<0.01$) increased when compared to antioxidant potential of juice blend (27.15%) and whey drink (26.49%). All the bioactive compounds of juice blend and whey drink decreased as compared to the beetroot juice as there was replacement of beetroot juice with other juices which contained comparatively lesser phenols, flavonoids, anthocyanins and antioxidant activity. Carotenoids being an exception which increased in the juice blend (0.36 mg/100g) as compared to beetroot juice (0.12 mg/100g). Betalains which were present only in beetroot juice significantly reduced in juice blend and whey drink as a result of the replacement with other juices. Betalains content decreased by 2.5 times in juice blend and 4.9 times decline was observed in the betalains content of whey drink as compared to the beetroot juice.

Keywords: Beetroot, Juice blend, Whey drink, Antioxidants, Betalains

INTRODUCTION

In the modern era of personalised well-being, consumers are increasingly seeking functional beverages that deliver not just refreshment, but a boost to their health. As such, natural ingredients with abundance of nutritional and bioactive properties are taking center stage. Beetroot contains compounds such as potassium, magnesium, folic acid, iron, zinc, calcium, phosphate, sodium, niacin, biotin, the B6 vitamin, and soluble fiber. Furthermore, beet juice is a rich source of polyphenolic compounds, which are biologically available antioxidants (Wootton-Beard *et al.,* 2011). The vibrant colour of the beet is because of the presence of nitrogenous hydrosoluble pigments called betalains, which are further categorized into betacyanins and betaxanthins (Wruss *et al.,* 2015). Attributed to these nutrients, beetroot (*Beta vulgaris* L.) emerges as a potent contender, captivating not only with its vibrant colour but also with its diverse health benefits. The utilisation of beetroot juice in crafting diverse beverages, particularly in juice blends and whey-based drinks, stands as a burgeoning area of interest within the realm of functional beverages. However, integrating beetroot into blends comes with its own set of challenges. Its

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earthy flavor, potential astringency, and colour intensity require careful consideration to ensure palatability and consumer acceptance. On the other hand, fruit juice beverages are high in natural sugars and can have implications for conditions such as hyperglycaemia. Vegetable and juice blends can help overcome this issue (Wootton-Beard and Ryan, 2011). Despite its underutilisation in the beverage industry, the incorporation of beetroot juice presents an avenue for fortification, infusing these concoctions with a spectrum of health-enhancing compounds. The rationale behind integrating beetroot juice into juice blends and whey drinks lies in its multifaceted health benefits attributed to its antioxidant-rich composition. The innate ability of beetroot's antioxidants to combat oxidative stress within cellular structures underscores its potential as a functional ingredient in beverages. This inclusion not only augments the nutritional content but also enhances the sensory experience, imparting unique flavors and vibrant hues to the final products.

Exploring the transformation of beetroot juice into a pivotal component of blended beverages holds promise for innovating within the beverage industry. Understanding the physicochemical alterations, bioactive composition, and sensory attributes resulting from the integration of beetroot juice into these formulations is paramount. Such insights could pave the way for the development of novel, health-conscious beverages catering to evolving consumer preferences for both taste and wellness. Therefore, this research paper will embark on a comprehensive exploration of beetroot's potential in juice blends and whey drinks.

MATERIALS AND METHODS

Beetroot is abundantly available throughout the year. Medium size, fresh beetroot, free from bruises was purchased from the local market of Ludhiana. Beetroot was processed into juice for which washed and peeled beetroot were sliced manually to a thickness of 3 mm. Extraction of juice was done with Philips Grinder HL 1631/00 (Voltage - 230V~50 Hz). Extracted juice was strained with a stainless steel strainer to attain clear juice.

Preparation of juice blend: Beetroot juice and orange juice were blended using 10 and 90 ml in J1, 20 and 80 ml in J2, 30 and 70 ml in J3, 40 and 60 ml of beetroot juice and orange juice in J4, respectively.

Preparation of whey drink: Whey drink was developed using whey water, beetroot juice, orange juice, ginger juice, mint juice and variation in the level of beetroot juice. The quantity of whey water, beetroot juice, orange juice, ginger juice and mint juice used were, 80, 5, 13, 1, 1ml in W1; 75, 10, 13, 1, 1 ml in W2; 70, 15, 13, 1, 1ml in W3 and 65, 20, 13, 1, 1ml in W4, respectively.

The products developed were evaluated organoleptically by a panel of 10 judges from the Department of Food and Nutrition, Punjab Agricultural University, Ludhiana. In order to avoid any kind of biasness, samples were coded. The panelists were requested to record the score of the products for colour, appearance, mouthfeel, flavor, taste and overall acceptability by using a score card (Ranganna, 1986) based on the nine point hedonic scale. Pure Beetroot juice and sample with highest overall acceptability score was further subjected to analysis.

Physicochemical and nutritional evaluation of raw beetroot, beetroot juice and developed products Beetroot was analysed for TSS (°Brix), acidity, pH and juice content, Total soluble solids (TSS °Brix) Total soluble solids content of fresh beetroot juice as well as the product was determined by using a hand refractometer with scale ranging from zero to 32° Brix. The observations were expressed as °Brix at 20° C.

Acidity was evaluated using method given by Ranganna 2007. The acidity was expressed was expressed as citric acid (equivalent weight-64) percent.

The pH of the juices was evaluated using a digital pH meter at 27°C.

Juice content: A sample of 1 kg beetroot was washed and cleansed thoroughly. Juice was extracted using a mechanical juice extractor (Philips HL1632 500-Watt 3 Jar Juicer Mixer Grinder) and measured in a measuring cylinder. Results were expressed as ml/kg.

Bioactive analysis

Determination of ascorbic acid: Ascorbic acid was extracted from the sample with 0.4 per cent oxalic acid and determined by titrimetric method using 2,6-dichlorophenol indophenol dye solution (0.04%) which was standardised against standard L- ascorbic acid (0.1 mg/ml of 0.4% oxalic acid). Five grams of sample

was mixed with 0.4 per cent oxalic acid solution and volume was made up to 100 ml. It was filtered through Whatman filter paper no. 4. Ten ml aliquot was titrated with standardised dye. The end-point was recorded as pink colour, which persisted for at least 15 seconds. The results were expressed as ascorbic acid mg percent of sample (Ranganna, 2007).

$$\text{Ascorbic content mg per 100 g} = \frac{\text{Titre value} \times \text{dye factor} \times \text{volume made up}}{\text{Aliquot of extract taken} \times \text{weight of sample}} \times 100$$

Extraction preparation- Total phenols, flavonoids and antioxidant activity: The fresh and powdered sample (1.0 g) was taken in a conical flask and extracted with 80% (w/v) methanol using an orbital shaker at room temperature for 3 hours and residue was then further extracted for one hour. After filtration of the extract through Whatman no. 1 filter paper, volume was made to 100 ml with 80% methanol and stored in a volumetric flask at -20ºC for determination of phenols and flavonoids.

Determination of total phenols: The total phenolic content in the samples was determined using colourimetric method described by Singleton et al. (1999). Sample extract (0.5 ml) was taken into a test tube containing 0.5 ml 80% methanol and 5 ml (1:10 v/v diluted with distilled water) Folin-Ciocalteau reagent was added to it. After 5 minutes, 4 ml of 7.5% sodium carbonate was added and were agitated. After incubating for 2 hours at 37 ºC, absorbance of the developed colour was measured at 765 nm using a UV-spectrophotometer against a blank. A standard curve was plotted by taking known amount of Gallic acid as reference standard.

Determination of total flavonoids: The total flavonoid content in the samples was determined using the Aluminium chloride colourimetric method of Zhishen *et al.* (1999). Two ml of the sample extract was mixed with 100 µl of 10% $AlCl_3$, 100 µl of 1 mol per litre potassium acetate and 2.8 ml water and allowed to incubate at room temperature for 30 minutes at 37º C. The absorbance of resulting colour complex was read at 415 nm using UV- spectrophotometer against a blank. The quercetin content was estimated using standard curve.

Determination of antioxidant activity: Total antioxidant activity was determined using DPPH assay as described by Brand-William *et al.* (1995). The DPPH solution was prepared by dissolving 15.77 mg of DPPH in 200 mL of methanol and stored at -20°C until use. Sample extracts each of 0.1 mL were mixed with 2.9 mL of DPPH solution and vortexed for 30 seconds followed by incubation at 37 ºC for 30 minutes, after which the absorbance at 517 nm was recorded. For control, there was no sample extract added to the DPPH solution. Scavenging activity was calculated as follows:

$$\text{DPPH radical–scavenging activity \%} = \frac{A_{\text{contro}} - A_{\text{sample}}}{A_{\text{control}}} \times 100$$

Where, *A* is the absorbance at 517 nm

Quantification of betalains: Betalain content was estimated by method described by Bucur et. al (2016). Five grams of the sample was weighed in a beaker and stirred for 10 minutes in 15 ml of distilled water followed by filteration into a 50 ml volumetric flask. This extraction was repeated 3 times and stock solution was made upto 50 ml volume. Absorption was read at 25ºC ± 1 using solutions prepared from stock solution by dilution (1:2) with distilled water. Betalain content was calculated using the following equation.

$$\text{Betacyanins/ Betaxanthins (mg/g)} = \frac{A \times DF \times M_W \times V_d}{\varepsilon \times L \times W}$$

Where, *A*= Absorption value
D= Dilution factor
V_d= Sample solution volume (ml)
L= Pathlength (1cm) of the cuvette
W= weight of the sample (g)
Betacyanins (MW=550 g/mol, ε = 60000L/ (mol*cm)
Betaxanthins (MW=308/mol, ε = 48000L/ (Mol*cm)

Colour analysis: The colour values of the samples were determined by measuring L*, a* and b* values with Colour Flex meter (using 45°/0° geometry) and standard illuminant C (Hunter Lab Colour Flex 150 Hunter Associates Inc., USA).

Statistical analysis: For the analysis of data, SPSS software (version 23.0) was used. Mean values and standard error for different parameters were calculated. The significant difference between sensory evaluation scores of products was evaluated using *Kruskal-Wallis* H Test for comparison among three or more products. All chemical analyses are expressed on fresh wt. basis.

RESULTS AND DISCUSSION

The data pertaining to the sensory evaluation of whey drink showed that with increased amount of beetroot juice in whey drink, there was increase in the scores of sensory parameters. Satpute *et al.* (2018) carried out a similar study using four different combinations and found that T1 with 80 per cent whey and 20 per cent beetroot extract had scores of 8.10, 8.10, 7.90 and 8.0 for colour, flavor, taste and consistency. Product developers seeking out functional and nutritional attributes of whey to tap the tremendous growth opportunities in the beverage industry can move forward for the development of such herbal whey beverages with beetroot to enhance nutritional, therapeutic as well as medicinal properties of products.

Consuming beetroot with other fruit juices has already been in practice so in this experiment we tried different formulations of beetroot juice and orange juice so as to find the most acceptable combination. The sample containing highest concentration of beetroot juice scored highest for all the parameters with mean values of 8.20 each for appearance, colour, mouth feel and flavor, 8.10 for taste and 8.18 for overall acceptability. When mixed with orange juice, betalains gave a bright reddish purple colour which improved the colour and appearance of the juice blend. Beetroot juice has a sweet taste which contributes towards the high scores in the sample with more amount of beetroot juice.

TSS and pH of beetroot juice was 10.72 °Brix and 6.40 which were higher than the values of 9.01 Brix and 4.64 observed in juice blend (J4). Whereas acidity of juice blend (0.67%) was higher in comparison to beetroot juice (0.06%). Porto *et al.* (2017) developed five formulations of juice i.e. pasteurised beetroot juice, non-pasteurised beetroot juice, pasteurised orange juice, beet and orange juices mixed in the ratio 1:1 and 1:2 and reported acidity values of 0.41 and 0.59 per cent in beetroot and orange juice mixed in the ratio 1:1 and 1:2, respectively. The presence of higher quantities of orange juice (60%) in the juice blend resulted in more acidic product with a decrease in the pH values and an increase in the titratable acidity. The significant increase in the acidity and decrease in the pH was observed when beetroot juice was mixed with orange juice which has higher acidity and lower pH content. Akusu *et al.* (2016) developed juice blends using orange juice and pineapple juice where pH and acidity of orange juice was found to be 3.5 and 1.27 per cent, respectively. Organic acids contribute to the flavor and palatability of fruit juices. The greater acidity of the juice blend when compared to the beetroot juice could prevent the growth of food spoilage micro-organisms thus increasing the shelf life. However, excess acidity can also decrease the acceptability of the product. These results reinforced the viability of the development of juices by mixing beetroot and orange.

Whey drink developed with 65 per cent whey water and 20 per cent beetroot juice (W4) had TSS of 7.12°Brix and pH value of 5.28. Whereas acidity of whey drink was observed to be 0.45 percent. Porto *et al.* (2018) presented titrable acidity of 0.60 percent and pH of 4 in probiotic beetroot and orange juice mixed in the ratio 1:2. Kaur *et al.* (2015) reported TSS, pH and acidity of 14.7 °Brix, 5.49 and 0.53 per cent in whey drink developed by using carrot juice, beetroot juice, ginger and mint juice. Kumar *et al.* (2017)

Table 1: Sensory scores of juice blend developed using beetroot juice

Juice blend	Appearance	Colour	Mouth feel	Flavour	Taste	Overall acceptability
J1	$7.30^{a}\pm0.26$	$7.30^{a}\pm0.26$	$7.30^{a}\pm0.26$	$7.40^{a}\pm0.22$	$7.40^{a}\pm0.22$	$7.30^{a}\pm0.24$
J2	$7.70^{ab}\pm0.15$	$7.70^{ab}\pm0.15$	$7.77^{ab}\pm0.15$	$7.70^{ab}\pm0.15$	$7.60^{a}\pm0.16$	$7.68^{ab}\pm0.14$
J3	$8.10^{ab}\pm0.27$	$8.10^{ab\pm}0.27$	$8.10^{ab}\pm0.27$	$7.60^{ab}\pm0.16$	$7.60^{a\pm}0.16$	$7.90^{ab}\pm0.22$
J4	$8.20^{b}\pm0.24$	$8.20^{b}\pm0.24$	$8.20^{b}\pm0.24$	$8.20^{b}\pm0.24$	$8.10^{a}\pm0.31$	$8.18^{b}\pm0.26$
χ^2 value	6.70^{NS}	6.70^{NS}	6.49^{NS}	6.29^{NS}	5.15^{NS}	6.15^{NS}

** Significant at 1% level of significance ($p<0.01$); * Significant at 5% level of significance ($p<0.05$); NS -Non-Significant
J1-90% orange juice and 10% beetroot juice; J2- 80% orange juice and 20% beetroot juice; J3- 70% orange juice and 30% beetroot juice; J4- 60% orange juice and 40% beetroot juice
Means with different notations (a, b and c) indicate significant differences at 5% level of significance

Table 2: Sensory scores of whey drink developed using beetroot juice

Whey drink	Appearance	Colour	Mouth feel	Flavor	Taste	Overall acceptability
W1	$7.20^{a}\pm0.13$	$7.40^{a}\pm0.26$	$7.60^{a}\pm0.22$	$7.50^{a}\pm0.26$	$7.40^{a}\pm0.26$	$7.42^{a}\pm0.21$
W2	$7.50^{ab}\pm0.16$	$7.50^{a}\pm0.16$	$7.50^{a}\pm0.16$	$7.30^{a}\pm0.15$	$7.30^{a}\pm0.15$	$7.42^{a}\pm0.12$
W3	$7.80^{b}\pm0.13$	$7.80^{a}\pm0.13$	$7.70^{a}\pm0.15$	$7.50^{a}\pm0.16$	$7.50^{a}\pm0.16$	$7.66^{a\pm}0.14$
W4	$7.80^{b}\pm0.13$	$7.80^{a}\pm0.13$	$7.70^{a}\pm0.15$	$7.50^{a}\pm0.16$	$7.50^{a}\pm0.16$	$7.66^{a}\pm0.28$
χ^2 value	9.87*	5.68^{NS}	1.13^{NS}	1.01^{NS}	1.63^{NS}	3.96^{NS}

** Significant at 1% level of significance ($p<0.01$); * Significant at 5% level of significance ($p<0.05$); NS -Non-Significant,

W1- 80 % whey, 5% beetroot juice; W2- 75% whey, 10% beetroot juice; W3- 70% whey, 15% beetroot juice; W4 - 65% whey, 20 % beetroot juice

Means with different notations (a and b) indicate significant differences at 5% level of significance

observed that whey based pineapple mint beverage had TSS of 15.2° Brix, pH of 5.7 and titrable acidity of 0.54 per cent. After storage of beverage formulation, acidity, pH and TSS values did not change appreciably and no sensory changes were found during the first 15 days of storage but after some time changes in samples appeared.

Juice blend was developed with 60 per cent orange juice and 40 per cent beetroot juice, whereas in whey drink 65 per cent of whey water was mixed with 20 per cent beetroot juice. The bioactive composition and antioxidant activity of functional beverages developed by using beetroot juice is presented in Figure 1 and 2. The bioactive compounds in the developed juice blend were compared with the bioactive compounds present in beetroot juice. Total phenolic content of raw beetroot juice was observed to be 88.75 GAE mg/ 100 ml however, 13.93 per cent lower phenolic content (77.90 mg GAE/100 ml) was found in the juice blend. This decrease might be due to the proportion of beetroot juice and orange juice as orange juice contains lower phenols as compared to beetroot. Although orange juice is also a good source of phenols but beetroot has high antioxidant activity and is also a rich source of total phenols. Porto *et al.* (2017) revealed that there was found to be 7 per cent reduction in the total phenolic compounds in orange and beetroot mixed juice as compared to beetroot juice. Similarly, comparison of flavonoids content showed that beetroot juice had 47.87 mg QE/100 ml whereas the juice blend contained 23.33 mg QE/100 ml. Raw beetroot juice showed 2 fold higher flavonoids content. Panghal *et al.* (2017) reported antioxidant activity, total phenols and flavonoid content of beetroot juice increased from 75.8 to 78.1 percent, 22.12 to 24.32 per cent and 3.61 to 3.85 per cent, respectively when processed into a probiotic beetroot drink. The increase could be due to the microbial hydrolysis reaction which may have resulted in an increase of phenolic and flavonoids compounds. Ascorbic acid content increased from 3.28 to 4.08 mg/100g in juice blend as compared to the raw beetroot juice. Dambalkar *et al.* (2015) developed RTS in which beetroot juice, orange juice and ginger were blended in the ratio of 3:5:2, respectively and reported to have 30 mg/100 ml of ascorbic acid. The higher values of ascorbic acid might be due to the higher values reported in orange juice i.e. 124 mg/100 ml. Juice blend developed by incorporating beetroot juice resulted in significant change in the pigment content as compared to raw beetroot juice. Results revealed that anthocyanins significantly decreased when comparison of beetroot juice and juice blend was done.

Anthocyanins in juice blend were found to be 3.82 mg/100 ml as opposed to 7.71 mg/100 ml of anthocyanins found in raw beetroot juice. Anthocyanin content decreased to more than 2 times in juice blend as compared to raw beetroot juice. On the other hand, there was a non-significant increase in the carotenoid content of the juice blend. The slight increase could be observed as orange juice was added. Carotenoids content in juice blend increased from 0.12 to 0.36 mg/ 100 ml. Betalains composition of raw beetroot juice was compared with the juice blend as well the whey drink prepared by using 40 and 20 per cent of the beetroot juice, respectively. Beetroot juice contained significantly ($p<0.01$) higher betalains content (466.40 mg/100 ml) as compared to juice blend (185.9 mg/

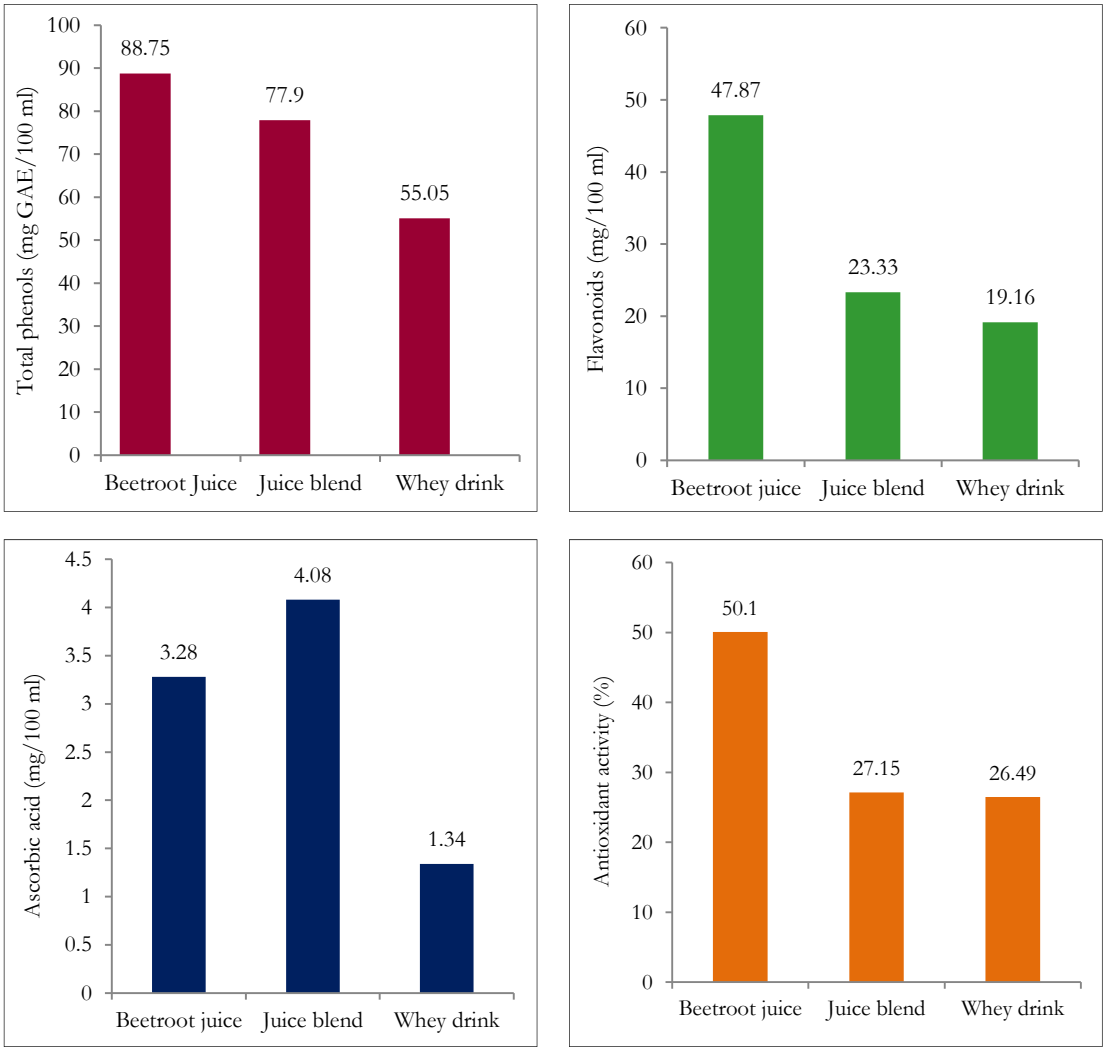

Figure 1: Total phenols, Flavonoids, Ascorbic acid and Antioxidant activity of functional beverages developed using beetroot juice

100 ml). The betalains content in juice blend decreased by 2.5 fold than that of the raw beetroot juice. Porto *et al.* (2017) mixed beet juice and orange juice in 2 proportions i.e. 1:1 and 1:2 v/v and reported 3-fold decrease in the betacyanins, betaxanthins and betalains content of mixed juice of beetroot and orange (1:2). Betacyanins and betaxanthins in beetroot juice (279.64 and 186.76 mg/100 ml) and juice blend (112.40 and 73.53 mg/100 ml) followed the same sequel where betacyanins and betaxanthins in juice blend were found to be decreased by approximately 2.5 times. These results were expected, due to the dilution of the beetroot juice with the orange juice, proportional to juice blend formulation. Antioxidant activity of beetroot juice decreased from 50.10 to 27.15 when developed into juice blend.

Whey drink was found to have 55.05 mg GAE/ 100 ml total phenols, 19.16 mg QE/100ml flavonoids and 1.34 mg/100 ml ascorbic acid. Anthocyanins content in whey drink (2.32 mg/100 ml) significantly ($p<0.01$) decreased in comparison to the raw beetroot juice (7.71). This reduction was expected as the dilution of beetroot juice in presence of whey water and orange juice. With respect to carotenoids content, significantly higher values were recorded for whey drink (0.24 mg/100 ml) as opposed to beetroot juice (0.12 mg/100 ml), this might be due to the contribution of orange juice added in the whey drink. Adadi *et al.* (2018) reported orange juice contained 1.98 mg/100 ml carotenoids. Whey drink contained 95.36 mg/100 g betalains as compared to 466.40 mg/100 ml betalains in raw beetroot juice. Betacyanins and betaxanthins in

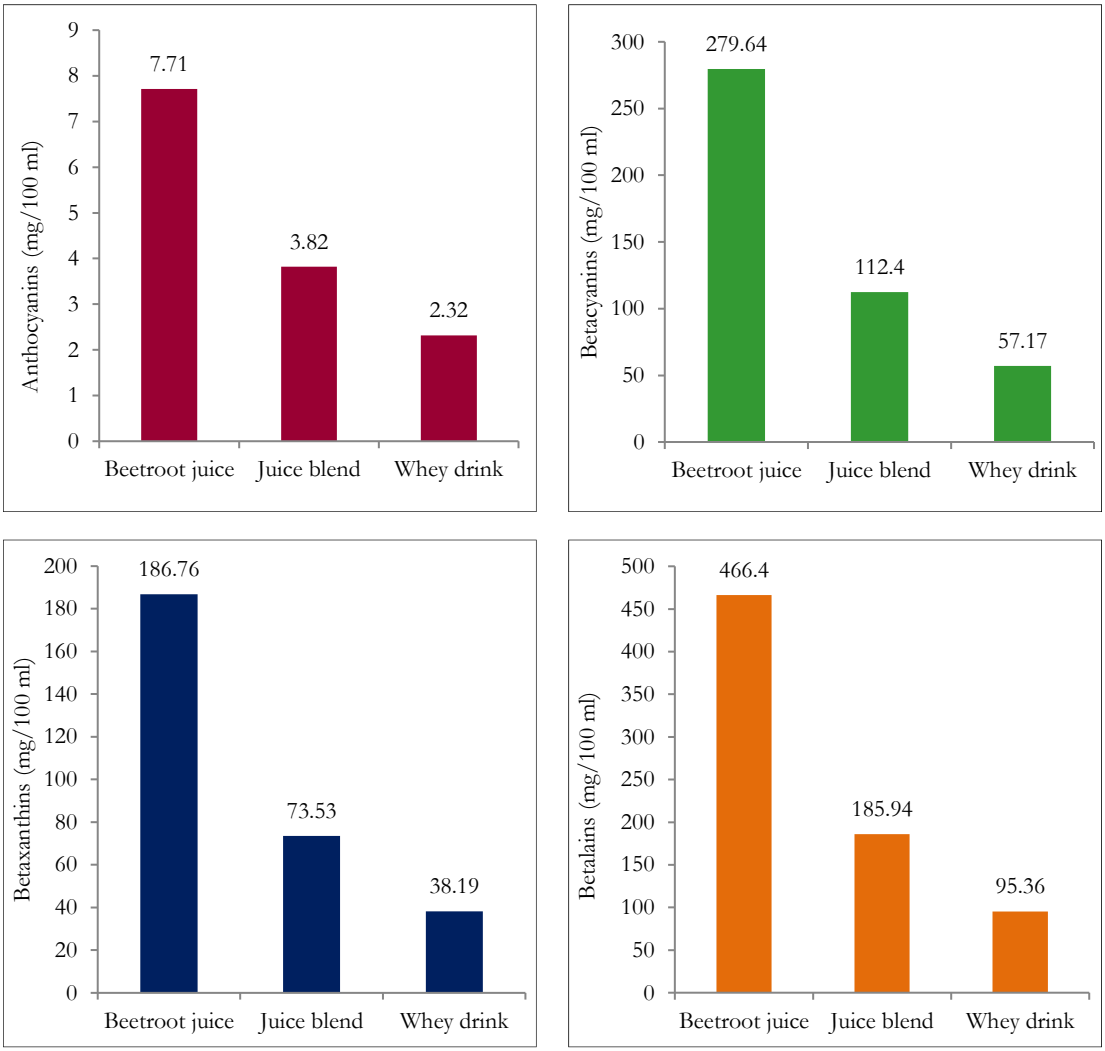

Figure 2: Anthocyanins, Betacyanins, Betaxanthins and Betalains of functional beverages developed using beetroot juice

beetroot juice (279.64 and 186.76 mg/100 ml) was found to be significantly ($p<0.01$) higher than the whey drink (57.17 and 38.19 mg/100 ml). Nearly 5-fold reduction was observed in the betalains, betacyanins and betaxanthins content of juice blend as opposed to the raw beetroot juice. Antioxidant activity of beetroot juice decreased from 50.10 to 26.49 percent in developed whey drink.

Colour is one of the most distinguishable characteristics of a food product that drives consumer perception of quality, rawness, safety and ultimately, its marketability (Sigurdson *et al.,* 2017). Juice blend and whey drink represented L*, a*, b coordinates as 22.14, 12.68, -11.86 and 20.83, 12.48, -11.29. Porto *et al.* (2017) reported L* value of beetroot and orange juice mixed in 1:1 ratio as 23.21. The mixed juices presented colour characteristics of both juices (beet and orange) (L* = 23-24; a* = 4.59-8.76; and b* = 2.19-2.75). Results indicated that the juices with more content of beetroot juice had a slightly red-purple colour, probably originating from the presence of betacyanin.

CONCLUSION

Juice blend and Whey drink were successfully produced and analysed for physicochemical, nutritional and sensory properties. Both the beverages showed good amount of antioxidant activity as they still had phenol content of 77.90 and 55.05 GAE mg/100 ml in juice blend and whey drink, flavonoid content of 23.33 mg/100 ml in juice blend and 19.16 mg/100 ml in whey drink. Addition of beetroot juice in both the beverages

were fairly acceptable to the respondents as the consumption of these products would avail a chance of incorporating beetroot into their diets which otherwise is not feasible.

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Research Article

Landscaping of Indian Start-ups Ecosystem with a Special Focus on Agriculture

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ABSTRACT

The Indian start-up ecosystem has evolved significantly, marked by a rapid increase in the number of unicorns and a substantial rise in funding. Indian start-ups are projected to generate 3.25 million jobs by 2025, with an estimated investment of $150-200 billion during 2021-2025. The number of unicorns is forecasted to increase from 108 in 2022 to 250 by 2025, highlighting the sector's robust growth. At the same time, the Indian start-up ecosystem has expanded with over more than one lakh DPIIT recognized start-ups, including 102 Soonicorns valued at $34 billion in 2023. India, with its agrarian roots and burgeoning start-up ecosystem, is witnessing a remarkable surge in agribusiness start-ups, positioning itself as a global player in the sector. This study delves into the dynamic landscape of Indian start-ups, focusing specifically on the agribusiness domain. Drawing data from various sources, including the Start-up India platform, Inc42 reports, and industry reports, the research covers the period up to May 2023. Agribusiness start-ups, in particular, are thriving, with the sector poised to unlock a market opportunity exceeding $20 billion by 2025. This growth is fueled by innovations in market linkages, precision agriculture, farm management, and financial solutions. Funding for agribusiness start-ups has experienced an impressive Compound Annual Growth Rate (CAGR) of 49% from 2014 to 2021, outpacing the global rate. This research identifies key trends, sectors, and funding patterns in the agribusiness start-up landscape, offering insights into the mechanisms supporting these ventures while providing a policy directive to fuel agribusiness startup ecosystem with more effective agents.

Keyword: Indian start-up, Start-ups ecosystem, Agri-start-ups, landscaping study

INTRODUCTION

India is the agrarian economy with the third largest start-up ecosystem in the world in the number of unicorns (Start-up Company with a value of over $1 billion) according to Startup India, May 2022. In India, there are 5068 funded start-ups and 108 start-ups in the unicorn club with a combined valuation of $345 Bn (Inc42's State of Indian Startup Ecosystem Report, 2023). Funding for these start-ups experienced a Compound Annual Growth Rate (CAGR) of 49% from 2014 to 2021, surpassing the global rate. These start-ups are expected to generate 3.25 million jobs by 2025 and are projected to invest $150-200 billion during the period of 2021-2025. The number of unicorns is also estimated to increase from 108 in 2022 to 250 by 2025 (IBEF, Nasscom, and Industry Reports, 2023). But, none of the agri based company has achieved the Unicorn status so far in India.

More than 650 million people live in extreme poverty in emerging countries. Agriculture and allied activities are the main sources of income and livelihood in developing and underdeveloped countries. The

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development of new agricultural businesses and entrepreneurship is essential and an important policy goal to reduce poverty, induce higher economic development, address environmental concerns, and achieve food security (Stefanovic *et al.*, 2010). Innovation is one of the solutions that can both help the growth and development of the agricultural sector and significantly reduce environmental crises (Saridakis *et al.*, 2023). New business-like start-ups creation promote economic growth, spur innovation, and generate competition in developed and emerging economies. Startups help traditional sectors develop, adding value to innovation and knowledge, and are recognized as engines of sustainable economic growth (Blank *et al.*, 2018). In the case of agribusiness start-ups in developing countries, they may assure food security, poverty alleviation, and nutrition if managed well (Adobor, 2020). Start-ups are any organization that creates a new product or service in the condition of high uncertainty and search for a business model that, once tested, can promote economic growth (Konsek-Ciechoñska, 2019a). According to the world economic forum (2018), startups are emerging and intrinsically innovative technological companies. Promotion of any new technological area and development of the policy framework demands in-depth understanding of start-ups and their respective ecosystem. According to Agrawal *et al.* (2018), "An ecosystem is a network of interconnected businesses, organizations, and individuals that form to achieve some sort of mutually agreed-upon outcome" comprised of numerous individuals collaborating to effect entrepreneurial/startup performance. In this study we attempted to draw a landscape of Indian start-up ecosystem especially focused on agribusiness start-ups.

Through this study we sought to analyze the temporal, spatial and operational landscape of all startups vis-à-vis agricultural startups in India. We also analyzed the incubators' scenario in both of the contexts to make a clear picture of the existing support elements in the ecosystem. In the subsequent sections, we discussed the sectoral categorization of agri startups along with their stages in the startup life cycle. We also analyzed and compared the funding scenario the total startups vis-à-vis agricultural startups which makes this paper a comprehensive documentation of Indian startup landscape as on date.

MATERIALS AND METHODS

In this study we attempted to analyze the most comprehensive and authentic database on Indian start-ups ecosystem formulated by Department of Promotion of Indian Industry and Trade (DPIIT), Government of India. This provides information on startups' distribution, categorization and sector wise information along with a comprehensive information about the ecosystem agents. We collected the total startups' and agri startups' data up-to May 2023 from start-up India website (having more than two and half lakh registered start-ups and more than one lakh DPIIT recognized start-ups). We have taken the data based upon the registration of startups on the startup India portal and recognition by the government. Any startup can register on the portal by going through some process checks but recognition is awarded only after their verification. For analyzing the funding scenario, we sought information from different publicly available reports like Inc42 report, IBFE and NAASCOM.

RESULTS

The Startup India initiative is a government program aimed at fostering entrepreneurship and innovation, while the Department for Promotion of Industry and Internal Trade (DPIIT) oversees the implementation of this program. Start-ups that are "registered" with Startup India have undergone a formal registration process, indicating their intent to benefit from the program's incentives and support. On the other hand, startups that are "recognized" by DPIIT have met specific eligibility criteria and have been granted official recognition under the Startup India program. This recognition opens the door to a range of benefits, including tax exemptions, fast-tracked patent examination, access to government funding, and support mechanisms designed to foster growth and innovation within the Indian start-ups landscape.

India is the home of more than 281176 start-ups and 29233 agri. and allied sector start-ups registered at start-up India portal, which was launched on 16 January 2016. The Startup India Initiative has rolled out several programs with the objective of supporting entrepreneurs, building a robust startup ecosystem and transforming India into a country of job creators instead of job seekers. A dedicated Startup India team

oversees these programs, which is accountable to the Department for Promotion of Industry and Internal Trade. Therefore, new firms or business organizations can register on the Startup India portal to avail the benefits of various schemes outlined on the portal. However, only those startups that meet the DPIIT's specified startup definition are eligible to receive benefits under the Startup India schemes after the approval of a board.

A total of 101931 startups was recognized by DPIIT, out of which 11036 startups were from agriculture and allied areas as on May 23, 2023. From the last decade, India steadily grew its startup ecosystem, while the government and private sector are working together to create a welcoming climate for entrepreneurs. As a result, India has emerged as one of the world's most dynamic startup hotspots, with an increasing number of start-up businesses incorporating in a wide range of industries. India has the world's third largest startup ecosystem. Sustained government efforts in this direction have resulted in an increase in the number of DPIIT-recognized start-ups from 452 in 2016 to 101931 as of May 23, 2023 (Figure 1). A total of 17919 start-up firms were born between December 31, 2022 to May 23, 2023. The startup trend, as acknowledged by DPIIT, is illustrated in the Figure 1, depicting a year-on-year growth trend.

Agribusiness start-ups have shown a consistent growth in term of number of DPIIT recognized start-ups from 54 start-ups in 2016 to 11036 start-ups in May 2023 (Figure 2), with an average growth rate of more than 49% CAGR (Compound Annual Growth rate).

In India, the current growth of recognized start-ups is showing an exponential trend and increasing at an accelerating rate in absolute number. In the overall scenario, the start-ups' trend regarding registration shows that the highest number of startups registered

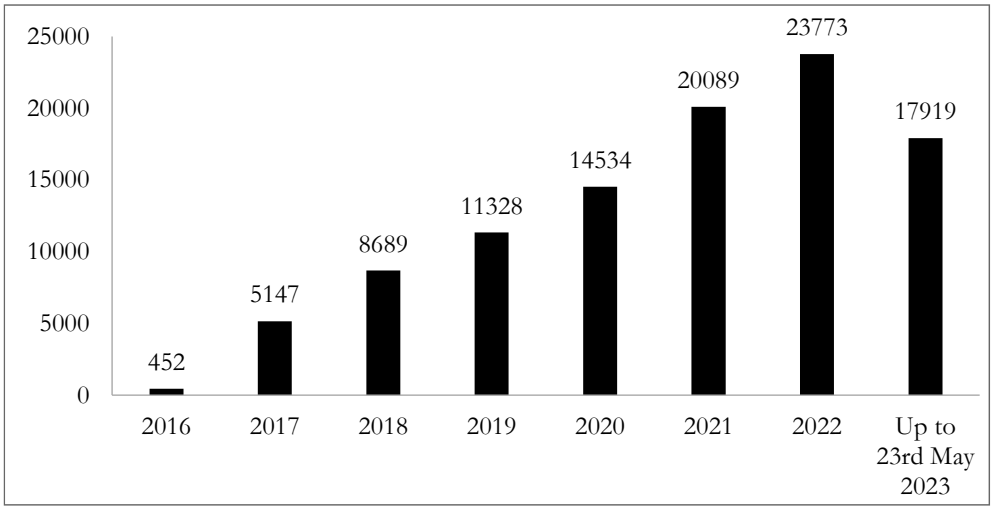


Figure 1: Year wise incorporation status of DPIIT recognized start-ups (Overall)

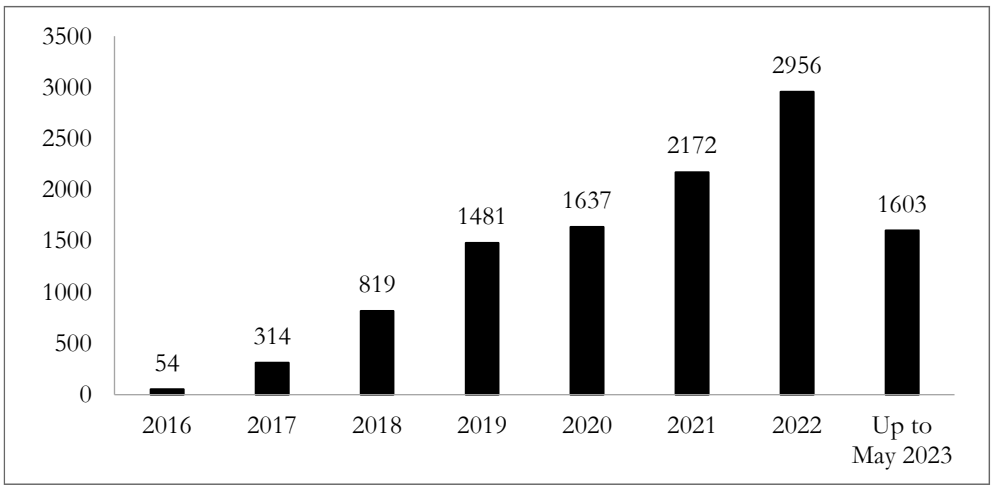


Figure 2: Year wise incorporation status of DPIIT recognized agri-start-ups

in Maharashtra (46160 start-ups), followed by Delhi (30198 start-ups), Uttar Pradesh (27291 start-ups), and Karnataka (25876 start-ups), while Lakshadweep (seven start-ups) and Ladakh (58 start-ups) have the least. Regarding recognition, it was observed that Maharashtra had the highest number of startups recognized by DPIIT (18622 start-ups), followed by Delhi (11166 startups), Karnataka (11409 start-ups), and Uttar Pradesh (9451 start-ups), while the least number of startups recognize in Lakshadweep (two start-ups) and Ladakh (eight start-ups) as shown in Figure 3.

By analyzing the agricultural startups data, we observed that Maharashtra is the home of highest number of start-ups (5205 start-ups registered and 2052 recognized), followed by Uttar Pradesh (2674 registered and 867 recognized), Karnataka (2601 registered and 1065 recognized) and Delhi (2065 registered and 800 recognized) as depicted in Figure 4. The highest numbers of startups were recorded in Maharashtra, followed by Uttar Pradesh. The state wise agri-start-ups incorporation trend is different from overall start-ups incorporation scenario because of variances in demographic factors, policy support mechanism of government and other stakeholder perception towards opportunity recognition in new business area. The technology-based farming and support from experienced industrialist, funding partners, and capital inflow may be one of most dominant reasons behind the dominance of Maharashtra in agri-start-ups scenario.

Examining the registration and growth trends of startups can provide valuable insights into the startup ecosystem and the policy challenges that entrepreneurs encounter. The growth trends of startups indicate that Maharashtra state has the highest number of startups in terms of absolute numbers, followed by Karnataka. The technology-based farming and support from experienced industrialist, funding partners, and capital inflow is one of most dominant reason behind the dominating of Maharashtra in agri-start-ups. In this industry, Maharashtra has 459 of the most formally recognized startups (Data as of 17 April 2023) as depicted in Figure 5. The Projections were made for the startup recognition rate to increase at a compound annual growth rate (CAGR) of 25% between 2022 and 2027 (Sneha *et al.*, 2023).

A start-up ecosystem may be defined as individuals' dynamic, institutionally integrated interplay with

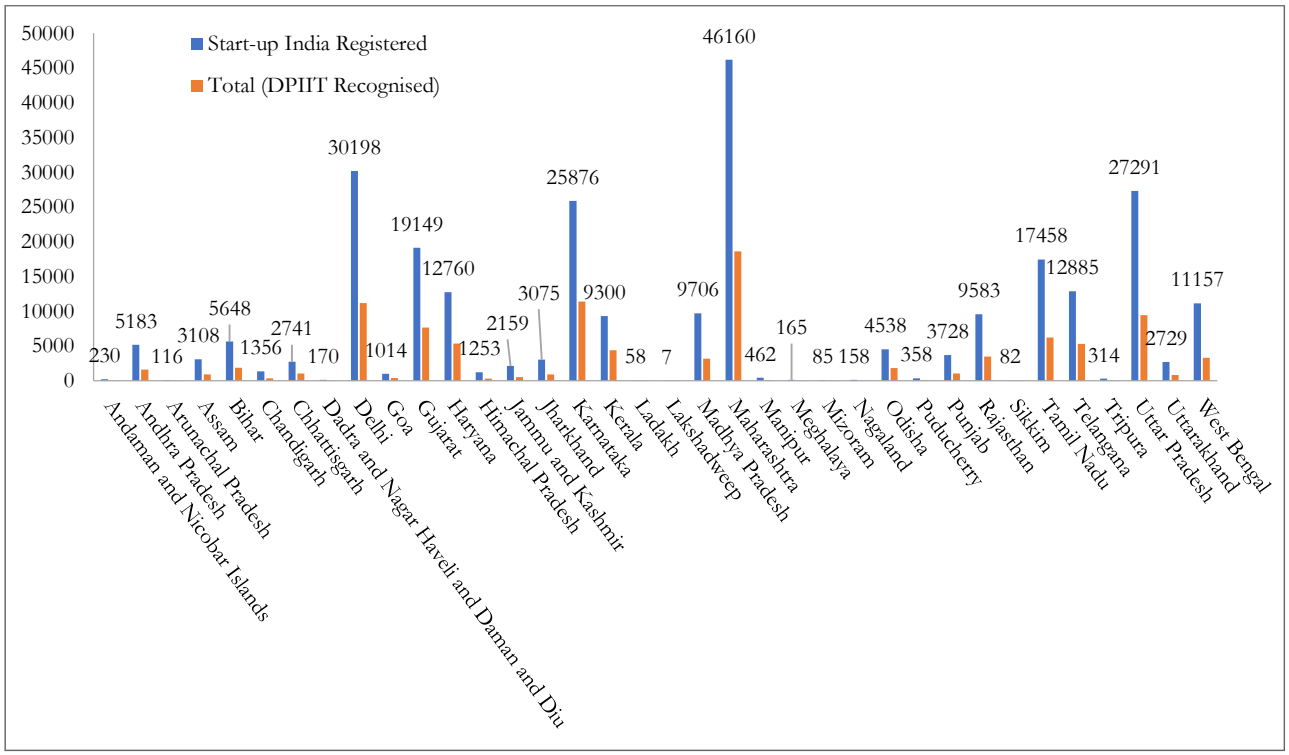


Figure 3: State-wise distribution of total start-ups

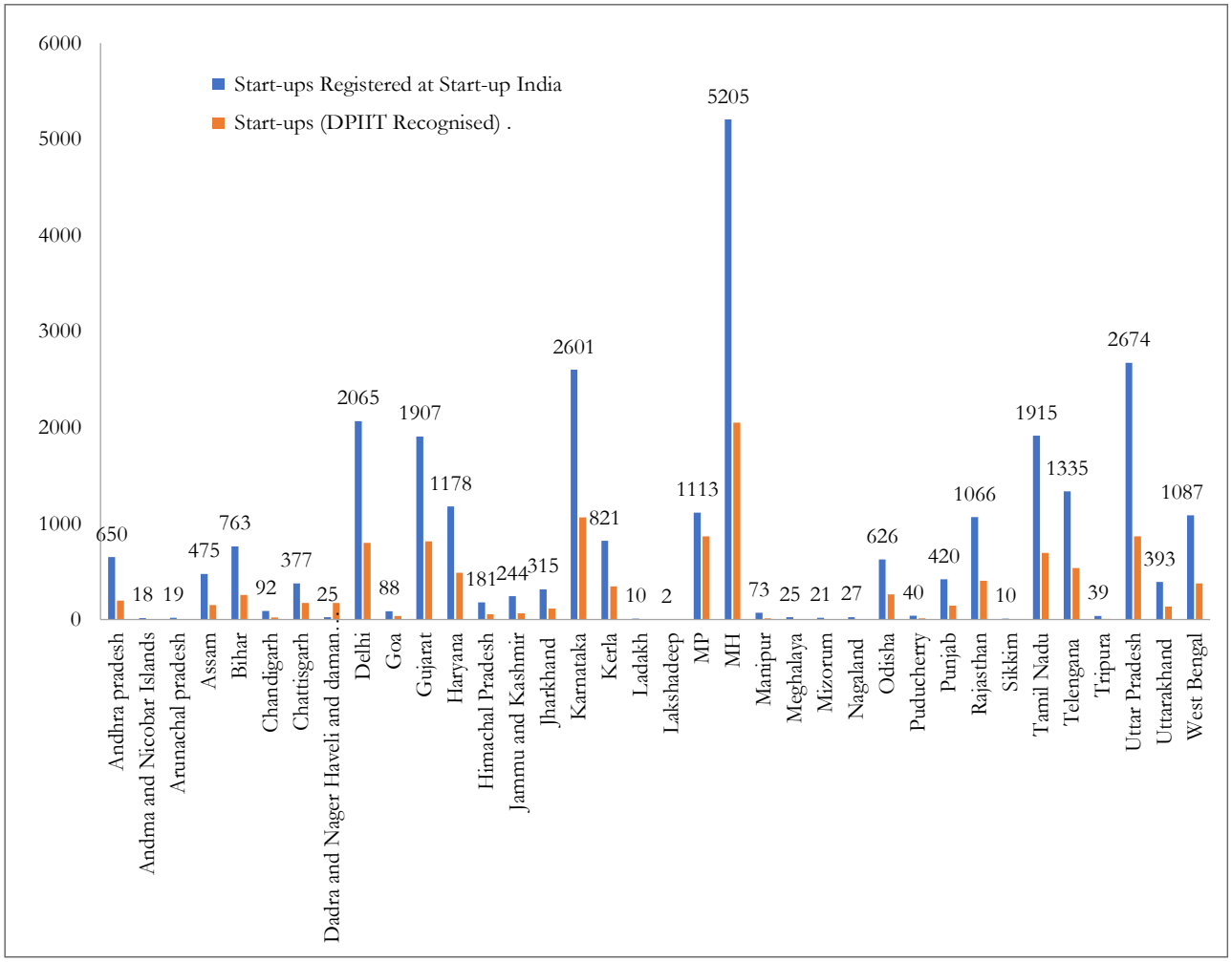


Figure 4: State-wise distribution of agri-start-ups

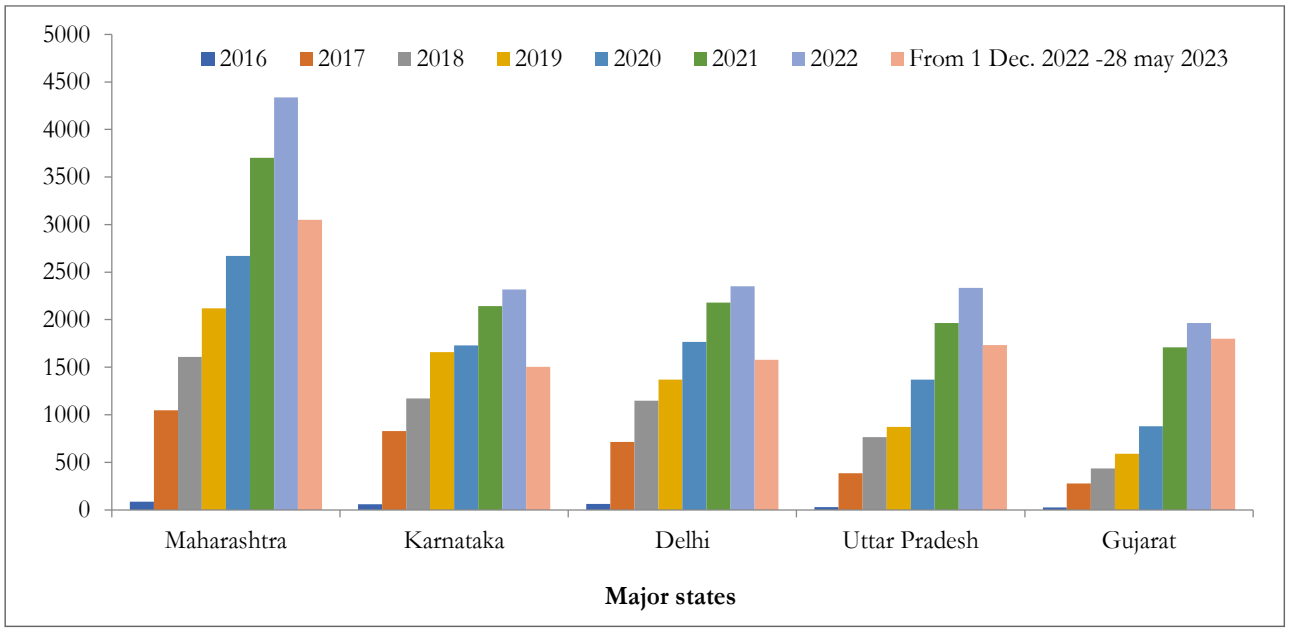


Figure 5: Year-wise growth trend of start-ups (overall)

entrepreneurial attitudes, abilities, and aspirations that drive resource allocation through the formation and operation of new companies (Sussan and Acs, 2017). A startup ecosystem is formed when individuals, startups at different developmental stages, and various types of organizations in a particular area collaborate as a system to establish new startup enterprises. The startup ecosystem is fluid ecosystem vary over time in terms of people, organizations, and environments (Arruda *et al.*, 2015) and situated in similar conditions but in different regions across the world may end up operating differently due to the presence of diverse entrepreneurial cultures and resource pools. Internal factors somehow influenced by the external start-up ecosystem and performance varied with these external ecosystem factors (Arruda *et al.*, 2015; Liedtke *et al.*, 2021; Mason and Brown, 2014; Sussan and Acs, 2017). The start-up ecosystem is composed of many integrated elements or stakeholders like innovative ideas, inventions, researchers, Start-ups at various stages, Entrepreneurs, Start-up team members, Angel investors, Startup mentors, Start-up advisors, Other entrepreneurial-minded people, venture capitalists, angel investors, public policy and external support services to start-ups, economy size, and direction. The start- up's performance is affected by all these factors depending on the start-up's working area and interaction among ecosystem elements with the start-up, which are mentioned in Figure 6.

Incubators are playing a pivotal role in the development of startups in the country. They are acting as a major change agent in the whole ecosystem by binding all the actors to the startups in a cohesive and efficient manner. They connect them with the startups according to their needs. Government departments are funding these incubators heavily ultimately propelling the growth of the startups. The incubators funded by different institutions and other sources depicted that the highest amount of funding to incubators was provided by the Department of Science and Technology (DST), followed by Ministry of Small and Medium Enterprises (MSME), Atal Innovation Mission (9%), Ministry of Electronics and Information technology (9%) and state government bodies (9%),

Figure 6: Startup Ecosystem Agents

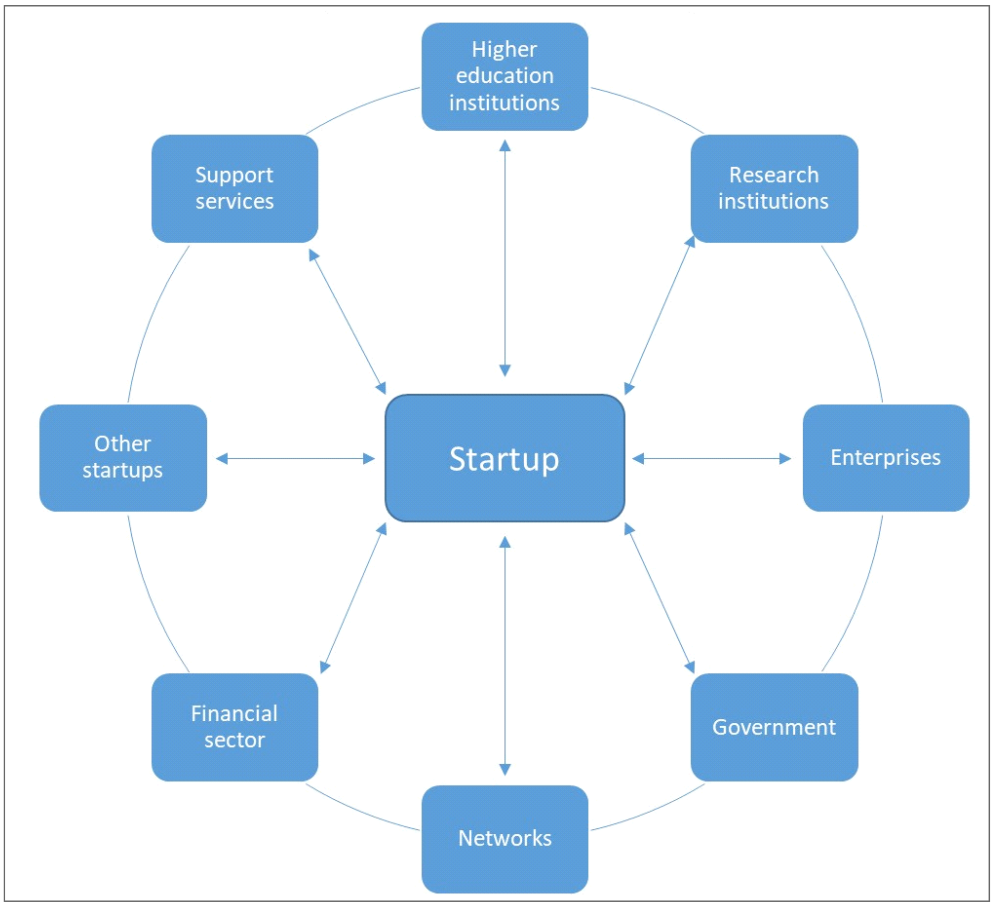
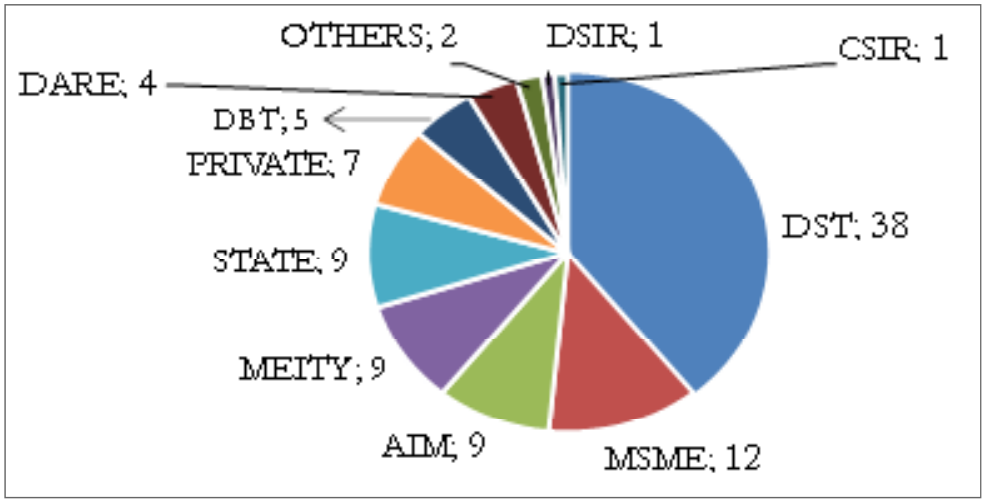


Figure 7: Incubators under different bodies or organizations



private organizations (7%), Department of Biotechnology (DBT- 5%) (Figure 7).

The ecosystem for agri-startups began experiencing noteworthy activities after 2015-16, primarily when Agribusiness Incubator centers (ABIs) were established in various regions of the country. These ABIs commenced the process of nurturing inventive solutions aimed at addressing farm-level challenges, with a strong potential for growth through value addition and connecting with farm producers. Agribusiness incubators identify and assemble small groups of emerging entrepreneurs and support their development through a combination of services, including shared facilities and equipment, business development, technology, finance, mentoring, and networking. At the end of the incubation phase, which could take anywhere between six and thirty-six months, incubators are expected to validate their business models and begin producing notable increases in revenues, clients, and staff. Similarly, the buzzword created by incubators and other actors in the ecosystem made people think about entrepreneurship as an attractive career avenue.

The total market opportunity in different areas of agriculture and allied sector is estimated to be $84 billion by 2025, while the market opportunity for agri-tech is estimated to touch $24.1 billion in 2025. Among the 24.1 billion, the market linkage is the highest contributor, given the fact that this is the gateway segment for agri-tech penetration in India, which currently stands at approximately 1%. In India, there are more than 100 incubators with an agricultural concentration, most of which are located in academic and research institutions, notably at ICAR institutes and agricultural universities. These incubators were supported by Startup India, Atal Innovation Mission, DST, RKVY-RAFTAAR and ICAR. In India, 36 agriculture-based incubation facilities were supported and promoted by the Department of Science and Technology's (DST)-NIDHI scheme. Only seven TBIs are located in National Agricultural Research, Education and Extension System (NAREES) as depicted in Table 1.

With an annual budget of Rs 10 crores (Rs 20 lakhs per ABI), ICAR had established 50 Agribusiness Incubators (ABIs) in various research institutes. Similarly, 29 ABIs were established in various State Agricultural Universities (SAUs) under the Ministry of Agriculture & Farmers' Welfare's RKVY-RAFTAAR (Rashtriya Krishi Vikas Yojana- Remunerative Approaches for Agriculture and Allied Sectors Rejuvenation) scheme,

Table 1: Institutes of NAREES supported by DST's NIDHI Scheme

ICAR-Indian Agricultural Research Institute	New Delhi
ICAR-Indian Institute of Horticultural Research	Bengaluru
Tamil Nadu Agricultural University	Coimbatore
ICAR-National Academy for Agricultural Research Management	Hyderabad
International Crops Research Institute for Semi-Arid Tropics	Patancheru
ICAR-Indian Institute of Millets Research	Hyderabad
ICAR-National Dairy Research Institute	Karnal

Table 2: List of knowledge partners under RKVY-RAFTAAR Scheme

Knowledge Partners	Geographical location
MANAGE	Hyderabad
NIAM	Jaipur
PUSA KRISHI (IARI)	New Delhi
UAS DHAWAD	Bengaluru
Assam Agriculture University	Assam

with each R-ABI receiving a grant of INR 2- 3 crores (NAARM policy paper 108).

Startups are funded by a diversity of sources including Angel Investors, Venture Capitalists, Private Equity etc. to reach out to their target markets, launch their products and expand in terms of product and relevant geographies. The total funding gained by different sector's start-ups in 2016 was 5 billion $ which was increased to 25 billion $ in 2022 (Figure 8).

The combined valuation of Indian unicorns was estimated at $345 billion, while the combined valuation of Indian soonicorns was estimated at $34 billion (Inc42 Report Quarter 1, 2023). The total funding raised by Indian start-ups (in 2022) was $25 billion with 14000 funded deal counts and an $18 million average ticket size. The Venture capital inflow in Indian startups is growing at a CAGR (2019 to 2022) of 24% while overall funding including Private Equity CAGR (2019 to 2022) was estimated to grow at 27% (Inc42 Report Quarter1, 2023). The highest funding raised by e-commerce start-ups was $4.8 billion followed by fintech ($4.5 billion) and enterprise tech ($3.9 billion). The total funding received by overall start-ups (sector agnostics) from 2016 to 2022 was 122 billion $, while total funding received by agri-start-ups from 2016 to 2022 was 2539 million $ (Figure 9).

The total funding to agri-start-ups received in from 2020-21 to 2021-22 increased by four time from US$387 million to US$1604 million in 2021-22. The highest funding received at late stage which includes validation, early traction and scaling stage while early stage (which includes ideation stage) received 28% funding. The Digital Agriculture Mission (DAM) initiative was launched in September 2021 to help agri-tech start- ups by leveraging advances in cloud computing, earth observation, remote sensing, data, and AI/ML models. This assisted the industry in unlocking new opportunities and addressing the current issues in agriculture, which can significantly increase food production and profitability for all participants while lowering operating costs.

Table 3: List of RKVY-RAFTAAR Incubators (R-ABIs)

S.No.	Name of the Institution
1	Chaudhary Charan Singh University, Hisar, Haryana
2	CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh
3	IIT-BHU, Varanasi, Uttar Pradesh
4	Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh
5	ICAR-Indian veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh
6	Punjab Agricultural University, Ludhiana, Punjab
7	Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
8	Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Jammu &Kashmir
9	IIIM, Kashipur, Uttarakhand
10	Kerala Agricultural University, Thrissur, Kerala
11	Icar- Indian institute of millets research Hyderabad
12	TNAU, Coimbatore, Tamil Nadu
13	Agri-innovation and entrepreneurship cell, ANGRAU, Andhra Pradesh
14	National-Rice Research Institute, Cuttack, Odisha
15	S K N Agriculture University, Jobner, Rajasthan
16	Indian Institute of Technology Kharagpur, West Bengal
17	Bihar Agricultural University, Bhagalpur, Bihar
18	Anand Agricultural University, Anand, Gujarat
19	ICAR-Central Institute for Research on Cotton Technology, Mumbai,
20	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra
21	National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI),Bengaluru, Karnataka
22	College of Fisheries, Lembucherra, Tripura
23	Department of Veterinary Medicine College of Veterinary Sciences and Animal Husbandry, Aizawl, Mizoram
24	of Collage of Horticulture & Forestry, Pasighat, Arunachal Pradesh

The agriculture industry in India contributes significantly to the country's economy, accounting for

Figure 8: Total funding to Indian Start-ups from 2016-2022 (Kalaari capital 2022 report)

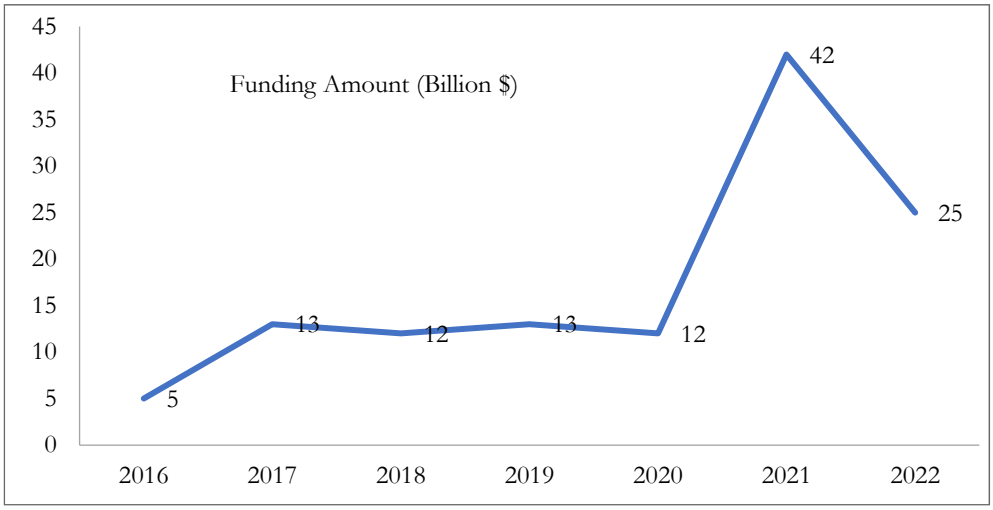
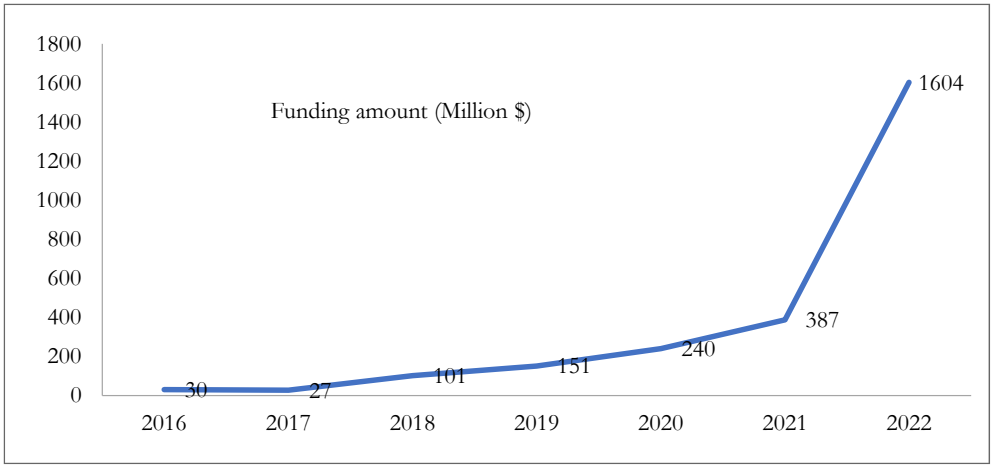


Figure 9: Total funding to agri-Start-ups from 2016-2022 (Kalaari capital 2022 report)



approximately 18.3 percent of the GDP and employing 45 percent of the national workforce (Economic Survey, 2022). The market opportunity for agri-tech is estimated to touch $24.1 billion in 2025. Among the 24.1 billion, the market linkage is the highest contributor, given the fact that this is the gateway segment for agri-tech penetration in India, which currently stands at approximately 1%. The estimated market opportunity in the market linkage is valued$12 billion followed by precision agriculture ($3.4 billion), farm management input ($1.7 billion), and agriculture finance ($4.1 billion) (Inc42 Report 2022).

Startup-friendly policies in India may not necessarily entail significant financial incentives. The regulatory framework and startup prerequisites can vary based on the technology sector and the stage of the startup. Nevertheless, startups at all stages of development, including business strategy, community building, and connecting with expert business mentors, require support from successful founders and strategic angel investors. Given India's large and diverse population, with numerous talented individuals seeking opportunities, it becomes crucial to enhance state ecosystems by establishing a startup policy framework in each state to gain a competitive edge over the current scenario.

Sector and stage-wise distribution of agri-start-ups recognized by DPIIT

The agri-business and allied sector start-ups were showing record growth over the past few years regarding incorporation. The highest number of startups registered at startups India website were in food technology (11347 start-ups, while DPIIT recognized 3842 start-ups) industry followed by agri-tech (5105 startups, while DPIIT recognized 2513 start-ups), organic agriculture (2332 start-ups, while DPIIT recognized 824 start-ups), restaurants (2219 startups, while DPIIT recognized 673 start-ups), and dairy

farming (510 start-ups, while DPIIT recognized start-ups 183). The same trend was followed by start-ups recognized by DPIIT (Figure 10).

According to stage wise classification of start-ups (Figure 11) the highest number of start-up (overall) recognized by DPIIT were found at ideation stage followed by validation, early traction and scaling stage while, in case of agri-startups the greatest number of startups recognized at the validation stage. At this stage (validation stage) start-ups have a prototype ready and need to validate the same for potential demand of the startup's product/service, followed by the ideation stage where startup co-founders work with ideas to bring them to life. The third largest stage of Indian agri. and allied sector start-up was early traction, which holds the utmost importance. This stage comes when the startup has launched its products or services in the market. Key performance indicators such as customer base, and revenue, are the most important performance determinants at this stage, and 4th and last stage was the scaling stage, which is typically the most significant stage of growth generating high revenue (Figure 11). The figure shows the highest number of agri-start-ups recognized at validation followed by ideation phase and early traction phase, while in overall scenario the highest number of start-ups found at ideation stage followed by validation stage.

As per a NASSCOM study, Indian farmers confront post-harvest losses amounting to INR 93,000 crore. Agri-tech startups in this region play a pivotal role in reducing waste and enhancing agricultural practices efficiency, ultimately benefiting farmers. These agri-tech solutions aim to enhance agricultural productivity and profitability by reducing crop loss and wastage. With the world's population projected to surpass 8.5 billion by 2030, agri-tech companies are diligently working to attain agricultural scalability to meet the inevitable food demand.

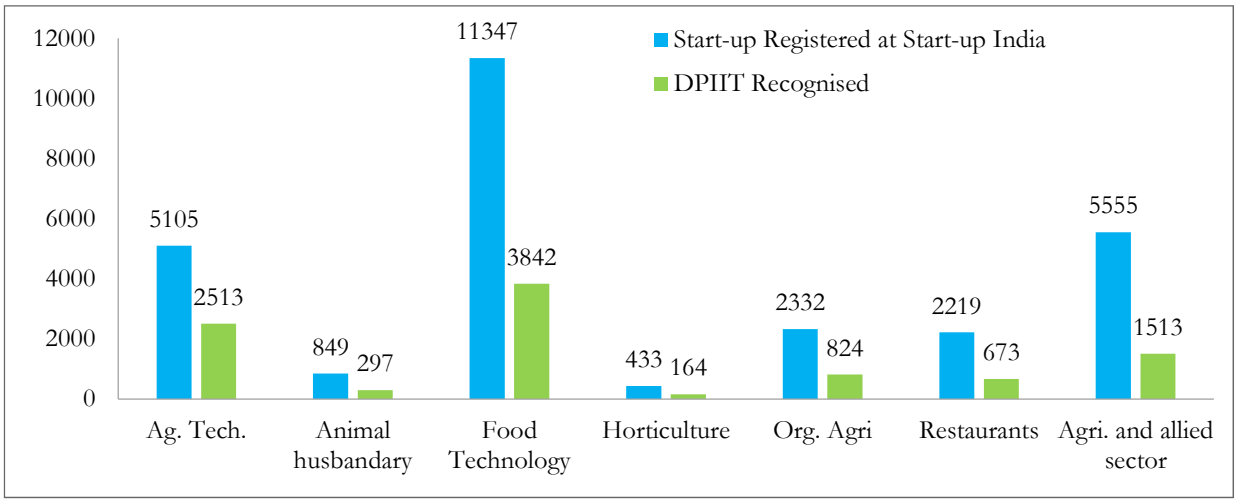


Figure 10: Sector wise agri-startups distribution

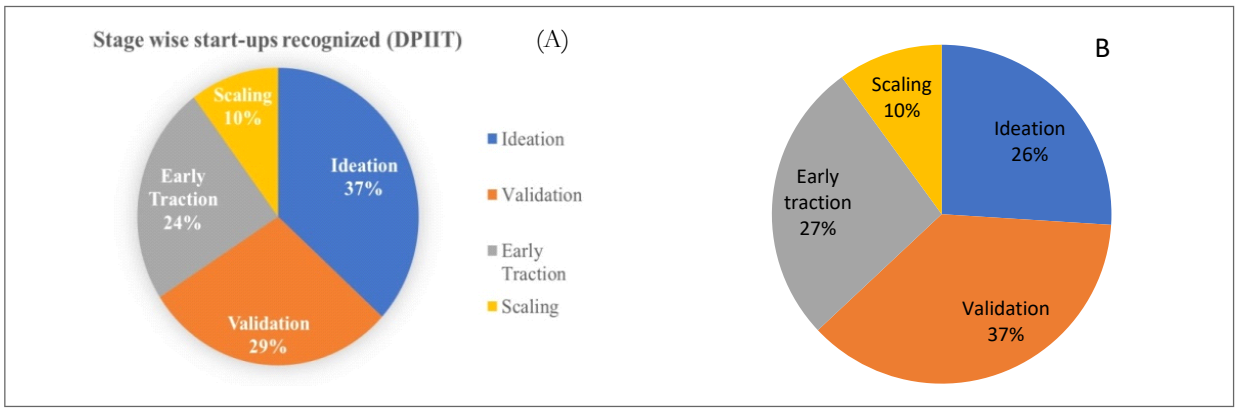


Figure 11: Stage wise start-ups scenario overall (A) and agri-start-ups (B)

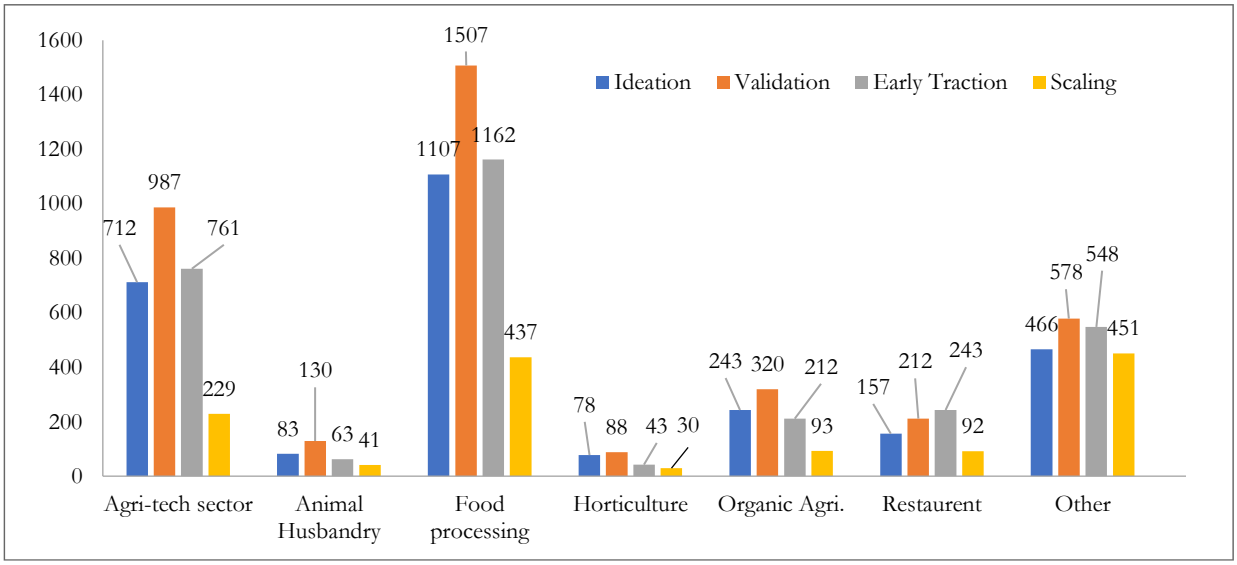


Figure 12: Sector and stage wise agri-start-ups Scenario

In India, almost 86.2 percent of total farmers are small and marginal farmers who continue to rely on traditional, unscientific farming methods. The agri-tech firms in this space not only opened new capital channels, but also improved yield through data, real-time crop monitoring, analytics, digitization, crop and soil health, and weather forecasts for better strategies, resulting in more revenues and less waste (DCMSME Report, 2022) (Figure 12). In the Indian scenario the highest number agri-start-ups found in the food processing industry (9750 start- ups), out of which 3388 start-ups were found in the ideation stage, 2702 start-ups were at the validation stage, 2574 start-ups were in early traction, and 1086 start-ups were in the scaling stage. Other sector having the highest number of start-ups was agri. tech sector (5105 start-ups). The agricultural technology industry had the most start-ups at the scaling stage, whereas the food processing sector had the most start-ups in the ideation stage. The greatest number of startups identified in the agriculture and allied sector was food technology followed by agri. tech., restaurant, animal husbandry, horticulture, and other agri-start-ups were recognized by DPIIT. In this context, the category "others" encompasses fisheries, agrochemicals, and various other segments within the agribusiness industry that were not assigned specific industry names.

CONCLUSION

The Indian startup ecosystem was not limited to a specific sector but spanned across a wide range of industries. The Indian agri-startup ecosystem was one of them experiencing significant growth and transformation. However, the landscape is dynamic and subjected to changes. India had witnessed a surge in startup funding, with both domestic and international investors showing interest in Indian startups especially agri-startups were leveraging technology such as information technology, artificial intelligence, machine learning, and data analytics to improve various aspects of agriculture including creating efficient marketplaces connecting farmers directly with consumers or businesses. The current support and policy program promoted the Indian agri-startups which not only contributing to employment and generating revenue but also bought new ray of hope among the farming community addressing social and environment issue. There is a strong need to invite more and more funding at the initial stages either from government grants or private funds so that the valley of death could be passed. Along with this better validation opportunities need to be generated by making the R&D workforce cohesively working for the startups. Then only, strong and impactful solutions for agricultural problems will be generated from the agri startup industry to revolutionized agri-sector with innovation in this agriculture 4.0 era.

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Research Article

To Study the Knowledge of Rural Women Regarding Pratapdhan Poultry Production Technology Promoted by KVK Bhilwara

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ABSTRACT

The study was conducted in Bhilwara district of Rajasthan. Bhilwara was selected purposively for the study as the researcher is well known to the area and Pratapdhan Poultry Production Technology has been widely promoted through KVK Bhilwara. The random sample of 20 rural women was selected from each village to form a total sample of 100 respondents from five selected villages. Personal interview method was used for data collection. Frequency, percentage, and mean percent score were used for analysis of the data.

Keywords: Pratapdhan, Poultry production, Knowledge, Rural women

INTRODUCTION

In India, poultry farming occupies a pivotal position in bringing about the rapid economic growth. India has one of the world's largest and fastest growing poultry industry, ranking 3rd in egg production with annual production of 88.14 billion and 5th rank in poultry meat production. (Anonymous, 2017-2018).

Indian poultry industry as it exists today is a mixture of traditional backyard system of poultry keeping and modern space age technology. Livestock and poultry sector are upcoming as one of the rapid growing sectors in Indian agriculture adding considerable proportion to National GDP (Singh *et al.,* 2018; Adbhai *et al.,* 2019; Thakur *et al.,* 2020). Poultry farming is an age-old traditional practice in rural hilly areas in India since time immemorial. It plays an indispensable role in poverty alleviation through income generation by the sale of eggs or chicken (Hussain *et al.,* 2017; Roy *et al.,* 2017; Thakur *et al.,* 2020b), maintains family food security (FAO, 1997; Gondwe, 2004; Abdelqader *et al.,* 2007; Nagar *et al.,* 2020) and also provides quality protein for growing and malnourished children. Even with proliferation of the industrial poultry on a large scale, backyard poultry constitutes a significant proportion of the total poultry population at the national level and the demand of eggs and meat of rural areas is fulfilled by rearing of backyard poultry (Nath *et al.,* 2012). In spite of low productivity of local birds, the contribution of backyard poultry towards Indian egg production is about 21 per cent (DADF, 2018). Hence backyard poultry has a tremendous contribution in the upliftment of rural families with reference to socio-cultural and nutritional needs, thus boosting poultry sector of the country.

The poultry husbandry in India is a very old practice and this food industry is one of the important contributors to the economy of rural and semi-urban India. Indian Poultry Industry is 5,000 years old, since last four decades it began to witness remarkable growth from backyard to poultry industry. India ranks seventeenth in the world poultry production index. Further, India is the fifth largest producer of eggs and ninth largest producer of poultry meat amongst all the countries. The organized sector of poultry industry is contributing nearly 70 per cent of the total output and the rest 30 per cent in the unorganized sector. The broiler

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industry is well dominated in Southern states of our country with nearly 60-70 per cent of total output coning from these states. The layer industry once again is represented more in Southern states especially. Andhra Pradesh, Tamil Nadu and Maharashtra producing nearly 70 per cent of the country's egg production. India's 75 per cent of egg produce is consumed by the 25 per cent population living in urban and semi-urban areas.

India has emerged as the only country in the developing world a self-reliant, technology driven industry, with capability to produce every essential input for successful poultry farming including indigenous genetic resources and breeding, world class poultry vaccines and medicines specific pathogen free eggs (SPF), farms and hatchery automation system, pelleted feed, egg processing, poultry processing, nationwide network of disease diagnostic laboratories and facilities for entrepreneurial development and training in both private and public sectors.

In last 4 decades poultry farming in India has transformed from a mere tool of supplementary income and nutritious food for the family to the major commercial activity generating the required revenue. The growth of the industry with steady production of 1,800 million kg of poultry meat, 40 million eggs per year and employment generation of about 3 million people indicates the future prospects for the industry.

MATERIALS AND METHODS

The study was conducted in Bhilwara district of Rajasthan. The district has 12 panchayat samities. As per the information provided by Subject matter Specialist and Senior Scientist- cum Head KVK, Bhilwara, the Pratapdhan poultry production technology have been promoted in fifty villages out of which five villages were selected randomly which were namely Pondras, Akola, Salariya, Suwana and Kodu kota. Sample for the study consisted of 100 rural women, 20 from each village who were randomly selected from list provided by KVK.

Personal interview method was used to collect the data from the respondents regarding knowledge of the rural women about Pratapdhan poultry production technology. Frequency, percentage, mean percent score and adoption index were used to analyse the data.

RESULTS AND DISCUSSION

Knowledge is the most important component of behavior and play an important role in covert and overt behavior of human beings. Once knowledge is acquired, it produces changes in the thinking process of an individual. It helps to develop favorable attitude to take certain action in accepting an innovation. For making any programme to be effective, it is most important that people should be first aware and informed about it (Anshuman and Mistry, 2007).

To find out knowledge of the respondents about Pratapdhan poultry production technology five components were identified and knowledge of the respondents was judged in light of these components which are presented as under.

Table 1: Component-wise Knowledge of the respondents about Pratapdhan poultry production technology (n=100)

Components	Mean per cent Knowledge score
Breeding and rearing of Chicks	65.18
Housing management	80.85
Health Care	51.56
Feeding management	71.12
Marketing practice	43.5

Table 1 presents component-wise knowledge of the respondents about Pratapdhan poultry production technology. Critical examination of the knowledge score highlights that the respondents possessed good knowledge about housing management (80.85 MPS), feeding management (71.12 MPS), Knowledge about breeding and rearing of chicks was near about good (65.18 MPS). However, their knowledge was found to be average in health care (51.56 MPS) and marketing practice (43.5 MPS).

An in-depth enquiry into knowledge of the respondents in different components was made to find out specific deficiencies in knowledge so that necessary efforts can be made to increase the knowledge of the rural women about Pratapdhan poultry production technology.

With regard to knowledge of the respondents regarding breeding and rearing of chicks, Table 2

Table 2: Knowledge of the respondents about Breeding and rearing of chicks (n=100)

Breeding and rearing of Chicks	f/%
Immersing of egg in bowl of water/Candling to test suitability eggs for hatching.	85
12-13 eggs be kept under broody hens for hatching.	72
Chicks be kept under brooder/broody hen 4-6 week.	65
Different types of brooders.	60
Meaning of chick guard.	60
Candling equipment is used to assess the fertility of egg for hatching purpose.	61
Use of egg incubator	52

depicts that more than three fourth of the respondents 85 per cent knew that immersing of eggs in bowl of water/candling to test suitability eggs for hatching. Nearly three fourth of the respondents (72%) knew about 12-13 eggs be kept under broody hens for hatching, 65 per cent respondents knew that chicks be kept under brooder/broody hen for 4-6 weeks. However, only 60 per cent women had knowledge regarding different types of brooders. As regard to meaning of chick guard, 60 per cent women had knowledge and 61 per cent respondents answered candling equipment is used to assess the fertility of egg for hatching purpose. With respect to use of egg incubator only half of the respondents (52%) could answer correctly.

The data presented in Table 3 indicate that majority (85%) of the respondents had knowledge about providing open area for sand bathing to express natural behavior to birds in Pratapdhan poultry and almost same percentage (84%) said that backyard/deep litter system of housing is required for Pratapdhan poultry production. More than three fourth of the respondents (78%) had knowledge about the height of poultry shed to be 8-10 feet. Same number of the respondents new that litter should be replaced in viable poultry unit after 6 months. Nearly three fourth of the respondents (73%) knew about 14-16 house day light is required for layer birds, information regarding replacing wet litter with dry litter was known to 82 per cent of the respondents. Almost all respondents (98%) had knowledge about use of window curtains to maintain optimum temperature inside poultry house during summer and 90 per cent respondents knew that it there should be

Table 3: Knowledge of the respondents about Housing management (n=100)

Housing management	f/%
Backyard/Deep litter system of housing is required for Pratapdhan poultry production.	84
The height of poultry shed should be 8-10 feet	78
It is essential to provide open area for sand bathing to express natural behavior to birds in Pratapdhan poultry	85
Birds become sick when litter become wet beyond limit.	70
When litter become wet and forms hard crust it should be Racking/replacing with dry litter.	82
Litter should be replaced in viable poultry unit after 6 months.	78
1.5 sq. ft floor space per adult birds is required.	69
14-16 house day light required for layer birds.	73
Window curtains are used to maintain optimum temperature inside poultry house during summer.	98
There should be provision of nests for laying hen.	90

provision of nests for laying hens. More than two third of the respondents (69%) were aware about requirement of 1.5 sq. fit floor space per adult birds.

The data presented in Table 4 indicate that nearly half of the respondents (49%) were aware that nasal discharge/facial swelling is important symptoms of coryza disease. More than half the respondents (58%) knew that bloody diarrhea/blood spot on wall and litter is common symptoms of coccidiosis disease. More than half of the respondents (55%) knew that tick/lice/mites are the common external parasite of poultry birds. Knowledge about practicing deworming in poultry birds was known to 52 per cent of the respondents and same number of the respondents were aware about disease prevention in birds by not allowing any outside person to enter in the farm. Half of the respondents had knowledge that rodents, lice, mite transmit the disease in poultry. Nearly half of the respondents (47%) knew that vaccination is done at first day in poultry to prevent from Marek disease, and 49 per cent respondent were aware about vaccination should be done within 1-7 days to prevent poultry from ranikhet disease. More than half of the respondents (59%) had knowledge about sick birds should be separate out from healthy flocks, 54 per cent respondents were aware regarding use of lime

Table 4: Knowledge of the respondents about Health care management (n=100)

Health care Management	f/%
Nasal discharge/Facial swelling is important symptoms of coryza disease.	49
Bloody diarrhea/Blood spot on wall and litter is common symptoms of coccidiosis disease.	58
Tick/lice/mites are the common external parasite of poultry birds.	55
Rodents, lice, mite transmit the disease in poultry.	50
Deworming practice should be followed in poultry birds.	51
Vaccination is done at first day in poultry to prevent form Marek disease.	47
Vaccination should be done 1-7 day to prevent poultry from ranikhet disease.	49
Sick birds should be separate out from healthy flocks.	59
It is essential to use of lime power/foot bath in the entrance poultry house is essential.	54
Proper cleaning of sheds should be done when new lot is started.	42
For disease prevention outside persons should not be allowed to enter in the farm	51

power/foot bath at the entrance of poultry house. Less than half of the respondents (42%) knew that proper cleaning of sheds should be done when new lot is started.

The findings pertaining to feeding management are given in Table 5. Findings reveal that majority of the respondents (92%) had knowledge about feeding balance feed to poultry birds. Nearly three fourth of the respondents (73%) had knowledge that 100-110gm per day is average feed required for laying hen. More than three fourth of the respondents (76%) knew that feed should be offered in utensils and almost same number of the respondents (78%) were aware about necessity of providing free excess area to hens for scavenging. Majority of the respondents (82%) were aware that birds should be kept in foraging area for more than 5 hours and same percentage knew about keeping one drinking water unit for 25 birds and nearly three fourth of the respondents (72%) answered correctly that one feeder unit is enough for feeding 25 birds. Majority of the respondents (87%) knew that debeaking is essential in poultry birds of Pratapdhan poultry and almost same percentage (89%) were aware

Table 5 : Knowledge of the respondents about Feeding management (n=100)

Feeding Management	f/%
Poultry birds should be given balance feed.	92
An average laying hen consume 100-110gm per day.	73
Feed should be offered in utensils.	76
The frequency of feeding is day two-time per day.	89
It is necessary to provide free excess area for scavenging.	78
Herbal feed additives should be given to poultry birds.	84
Birds should be kept in foraging area for more than 5 hours.	82
One feeder is enough for 25 birds.	72
One waters unit is enough for drinking water 25 birds.	82
Debeaking is assenting in poultry birds in Pratapdhan poultry farming.	87

about feeding of birds two times per day as well as providing herbal feed additives to poultry birds was known to 84 per cent of the respondents.

Data with respect to various marketing practices followed by the respondents are presented in Table 6. Cursory of the table clearly reveal that maximum price of eggs is obtained in winter was known to majority (83%) of the respondents. Nearly two third of the respondents (63%) were aware about poultry cooperative societies/farmer produce organization. Regarding information about Pratapdhan poultry produce fetches more price and age at which adult birds can be sold out was known to approximately same number of respondents i.e. 58 and 59 per cent respectively.

To know the level of knowledge of the respondents about Pratapdhan poultry production

Table 6: Knowledge of the respondents about marketing practice (n=100)

Marketing practice	f/%
Winter season maximum price of eggs is obtained.	83
Awareness about poultry cooperative societies/ farmer produce organization.	63
Two year is average age of selling adult birds.	59
Pratapdhan poultry produce fetches more price.	58

Table 7: Distribution of the respondents by their overall knowledge about Pratapdhan poultry production technology (n=100)

Knowledge Category	f/%
Poor	0
Average	11
Good	89

technology, they were grouped into three categories of knowledge namely poor, average and good on the basis of their mean present scores.

Perusal of Table 7 highlights that the categorization of respondents clearly depicts that majority of the respondents (89%) had good knowledge about Pratapdhan poultry production technology and very few (11%) were in average category. It was very interesting to know that there was not a single respondent in poor knowledge category. This shows that KVK has given good practical knowledge to the respondents. The results of the study are also in line findings of Poonam kumari (2015) in which 37 per cent were in average category and 63 per cent of the respondents were in good category. None of the respondents had poor Knowledge. Jiji and Vijayan (2012) revealed that majority of the respondents (41.07%) had high knowledge of poultry farming. However, the number of respondents in the medium knowledge category (39.29%) were more than that of low (19.64%) regarding poultry farming practices.

CONCLUSION

The categorization of respondents clearly depicts that majority of the respondents 89 per cent had good knowledge about Pratapdhan poultry production technology and very few 11 per cent were in average category. It was very interesting to know that there was not a single respondent in poor knowledge category. This shows that KVK has given good practical knowledge to the rural women. Component wise knowledge about Pratapdhan poultry production technology indicate that the respondents possessed good knowledge about housing management (80.85 MPS), feeding management (71.12 MPS), brooding and rearing of chicks (65.18 MPS), and health care (51.56 MPS). However, their knowledge was found to be average in marketing practice (43.5 MPS) components.

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Research Article

Utilization Pattern of ICT Applications and Web Services by Students of MPUAT, Udaipur

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ABSTRACT

The study was conducted in Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan. For sample selection, all the students on roll in P.G (M.Sc/M.Tech) and Ph.D programme from all the six constituent colleges of MPUAT were selected and the responses received were taken as final sample which comprise of 155 students. An online survey was conducted to collect the information from the students. A link was generated for the developed questionnaire and was sent to all M.Sc/M.Tech and Ph.D students through Whatsapp and e-mail. Frequency, percentage and mean per cent score were used for analysing of the data. Results clearly depicts that nearly three-fourth of the respondents (74%) were found in the category of high extent of utilization and more than half of the respondents (53%) had high level of frequency of utilization. Majority of the respondents (80%) used 'Google' frequently and 'whatsapp' was the most preferred by the respondents as daily (80%), weekly (14.2%), fortnightly (3.9%) and monthly (1.9%).

Keywords: ICT applications and web services, Utilization, P.G students, Mean percent score

INTRODUCTION

ICT is a general phrase that covers any technology-based communication tool or set of software programmes that allow users to collect, access, store, and distribute or transmit information. ICT has emerged as one of the most influential factors in the current information society due to its demonstrated role as a key engine of knowledge, research, and innovation. ICT refers to a set of peripheral devices with integrated hardware and software that are designed to facilitate easy information transfer. Satellite systems, middleware, storage, a variety of services, computers, telecommunications, and business software are all examples of ICT.

Information and communication technology in education is a modern, efficient and cost-effective process and has created a need to transform how students and teachers from higher institutions learn and teaches respectively. Most universities and colleges throughout the world are now utilising ICT to facilitate and enhance educational programmes, make data administration simpler, and improve communication between students and staff as a result of the quick advancements & availability of ICT resources over time.

ICT tools and services have been considered as powerful services that enable the educational change and reform. When used properly, they help to expand access to the education, reinforce the importance of education to the increasing digital environment, increase educational quality and mainly help in making the teaching-learning process into dynamic and active process which is associated with reality. They allow quicker delivery and a more adapted content of technical assistance in a variety of sectors, ranging from long-distance education to telemedicine and the creation of new livelihoods.

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Different ICT tools when used appropriately are said to help expand access to education, raise educational quality, strengthen the relevance of education to the increasingly digital workplace, helps making teaching and learning into an engaging, active process connected to real life. However, integration of ICT into educational systems varies from the simple use of technology to assist instruction (e.g., power point presentations) to the delivery of whole courses or programs using ICT (e.g., MOOCs).

MATERIALS AND METHODS

The study was conducted in Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan. The sample was selected from all the constituent colleges of MPUAT which included CCAS, RCA, CDFT, CTAE, COF and COA, Bhilwara. Fifteen ICT applications and web services were selected for the study viz., e-mail, MOOCs, CeRA, Mendeley, Wikipedia, WhatsApp, Facebook, YouTube, online thesis repositories, google scholar, research gate, M.S. power point presentation, MS-word, MS-excel and google. List of all the students on roll in P.G (M.Sc/ M.Tech) and Ph.D. program from all the six constituent colleges of MPUAT were selected and the responses received were taken as final sample which comprise of 155 students.

An online survey was conducted to collect the information from the students. A link was generated for the developed questionnaire and was sent to the students through WhatsApp and e-mail. Questionnaire consisted of four major information sections i.e. general background information, knowledge regarding ICT applications and web services, utilization pattern and problems in use of ICT applications and web services. Data were analyzed in terms of frequency, percentage and mean percent score were used to analyse the data.

RESULTS AND DISCUSSION

For assessing the extent of utilization of ICT applications and web services by the respondents, the responses were recorded on a four point continuum as frequently, sometime, rarely & never with scores of 3, 2, 1 & 0 respectively. For frequency of use the four

Table 1: Distribution of the respondents on the basis of extent of utilization of ICT applications and web services (n=155)

S. No.	ICT applications and web services	Extent of Utilization								MPS	Rank
		Frequently (3)		Sometimes (2)		Rarely (1)		Never (0)			
		f	%	f	%	f	%	f	%		
1.	e-mail	99	63.9	41	26.4	13	8.4	2	1.3	84.30	IV
2.	MOOCs	21	13.6	49	31.6	54	34.8	31	20	46.23	XV
3.	CeRA	41	26.5	53	34.2	42	27.1	19	12.2	58.27	XIII
4.	Mendeley	30	19.4	52	33.5	50	32.3	23	14.8	52.47	XIV
5.	Wikipedia	92	59.4	48	30.9	13	8.4	2	1.3	82.79	V
6.	WhatsApp	119	76.8	21	13.5	13	8.4	2	1.3	88.60	II
7.	Facebook	77	49.7	32	20.6	32	20.6	14	9.1	70.32	XI
8.	YouTube	110	70.9	29	18.8	12	7.7	4	2.6	86.02	III
9.	Online thesis repositories	56	36.1	49	31.6	26	16.8	24	15.5	62.79	XII
10.	Google scholar	87	56.1	42	27.1	17	10.9	9	5.9	77.84	VIII
11.	Research gate	80	51.6	53	34.2	15	9.7	7	4.5	77.63	IX
12.	MS-power point presentation	82	52.9	55	35.5	11	7.1	7	4.5	78.92	VII
13.	MS- word	90	58	44	28.4	15	9.7	6	3.9	80.21	VI
14.	MS-Excel	65	41.9	61	39.4	22	14.2	7	4.5	72.90	X
15.	Google	124	80	17	10.9	8	5.2	6	3.9	89.03	I

point continuum are daily, weekly, fortnightly & monthly with scores of 4, 3, 2 & 1 respectively. On the basis of MPS ranks were given to the utilization accordingly.

Table 1 reveals that google, WhatsApp and YouTube were used frequently as reflected by MPSs (89.03), (88.60) and (86.02) respectively and also depicted by data in the table as majority of the respondents were using these sources frequently (70.9 to 80%) or sometimes (10.9 to 18.8%) or rarely (5.2 to 8.4%) and very few respondents (1.3 to 3.9%) reported for never use. Followed by this, e-mail, Wikipedia and MS-word with MPSs (84.30), (82.79) and (80.21) with rank IV, V and VI respectively. This can also be seen in the table that the respondent were using these sources frequently (58 to 63.9%) or sometimes (26.4 to 30.9%) or rarely (8.4 to 9.7%) and few respondents (1.3 to 3.8%) reported for never use. MS-power point presentation, Google scholar, Research gate, MS-Excel, Facebook and online thesis repositories were used with MPSs (78.92), (77.84), (77.63), (72.90), (70.32) and (62.79) with rank VII, VIII, IX, X, XI and XII respectively. This can also be seen in the table that good numbers of respondents were using the sources frequently, sometimes as well as rarely. The CeRA, Mendeley and MOOCs were found to be used with MPSs (58.27), (52.47) and (46.23) with rank and XIII, XIV and XV respectively also reflected by the distribution of respondents in categories of extent of use as frequently (13.6 to 26.5%), sometime (31.6 to 34.2%), rarely (27.1 to 34.8%) and never (12.2 to 20%).

Findings of Munshi and Nagar (2015) and Braimllari and Sala (2017) also revealed that majority of the respondents prefer to use 'google' search engine followed by yahoo, Alta vista, google scholar and other search engines.

Table 2 shows that nearly three-fourth of the respondents (74%) were found in the category of high extent of utilization, followed by 20 per cent of them found in the category of medium utilization and the rest 6 per cent were in category of low utilization of ICT applications and web services which depicts that P.G students of MPUAT constituent colleges were using ICT applications and web services in their education for different purpose that is information gathering/collection, browsing edutainment, information sharing, online classes, etc.

Table 2: Distribution of the respondents on the basis of overall extent of utilization of ICT applications and web services (n=155)

Categories	Frequency	Percentage
Low	10	6
Medium	31	20
High	114	74

The findings get support from the study conducted by Chandrakar *et al.* (2015) that majority of the students (70.53%) had high extent of utilization, followed by 22.63 per cent of the students had medium extent of utilization and 6.84 per cent of students had low extent of utilization of ICT tools.

Table 3 shows that WhatsApp, google and YouTube were found most preferred as reflected by MPSs (90.75), (88.81) and (86.88) respectively and also depicted by data in the table as the respondents were using these sources daily (41.9 to 80%), weekly (14.2 to 38.7%), fortnightly (3.9 to 14.2%) and monthly (1.9 to 5.2%). Followed by this, e-mail, Wikipedia, Facebook, MS-word, Google scholar, Research gate, MS-power point presentation and MS-Excel were found more preferred with MPSs (79.13), (78.06), (74.40), (72.90), (72.47), (70.10), (67.74) and (65.16) with rank IV, V, VI, VII, VIII, IX, X and XI respectively and the respondents were using the sources daily, weekly, fortnightly and few respondents reported for monthly. Online thesis repositories, CeRA, Mendeley and MOOCs were not used daily by majority of the respondents and were used by almost equal number of respondents one-fourth to one-third (25.8 to 31.6%) on monthly, fortnightly and weekly basis as presented by MPSs (58.92), (46.02), (41.29) and (36.55) with rank XII, XIII, XIV and XV respectively.

The study supported by Sarman *et al.* (2018) who revealed about frequency of use of web-based applications by respondents and majority of the respondents (93.02%) used 'WhatsApp' daily, followed by e-mail (91.87%), Facebook (82.56%), YouTube (67.44%) and twitter (52.33%).

Table 4 shows that more than half of the respondents (53%) had high level of frequency of utilization, nearly half of the respondents (43%) fell into the medium utilization and the rest 4 per cent of

Table 3: Distribution of respondents on the basis of frequency of use (n=155)

S. No.	ICT applications and web services	Frequency of use								MPS	Rank
		Daily (4)		Weekly (3)		Fortnightly (2)		Monthly (1)			
		f	%	f	%	f	%	f	%		
1.	e-mail	83	53.5	55	35.5	9	5.8	8	5.2	79.13	IV
2.	MOOCs	16	10.3	40	25.8	42	27.1	57	36.8	36.55	XV
3.	CeRA	31	20	40	25.8	41	26.5	43	27.7	46.02	XIII
4.	Mendeley	19	12.3	44	28.4	47	30.3	45	29	41.29	XIV
5.	Wikipedia	79	50.9	55	35.5	16	10.3	5	3.3	78.06	V
6.	WhatsApp	124	80	22	14.2	6	3.9	3	1.9	90.75	I
7.	Facebook	90	58.1	31	20	14	9	20	12.9	74.40	VI
8.	YouTube	112	72.2	29	18.7	10	6.5	4	2.6	86.88	III
9.	Online thesis repositories	45	29	49	31.6	41	26.5	20	12.9	58.92	XII
10.	Google scholar	65	41.9	60	38.7	22	14.2	8	5.2	72.47	VIII
11.	Research gate	61	39.4	61	39.4	21	13.5	12	7.7	70.10	IX
12.	MS-power point presentation	55	35.5	62	40	26	16.8	12	7.7	67.74	X
13.	MS-word	69	44.5	60	38.7	12	7.7	14	9.1	72.90	VII
14.	MS-Excel	49	31.6	64	41.3	28	18	14	9.1	65.16	XI
15.	Google	119	76.8	23	14.8	10	6.5	3	1.9	88.81	II

Table 4: Distribution of the respondents on the basis of frequency of use of ICT applications and web services (n=155)

Categories	Frequency	Percentage
Low	7	4
Medium	66	43
High	82	53

the respondents were in low frequency of utilization which depicts that P.G students have more chances of using ICT in their study because along with education they need help of ICT for their research work hence they used more of the ICT applications and web services to gain maximum knowledge and also review of related research.

CONCLUSION

It was observed that the major ICT applications and web services utilizing frequently by the students were google, WhatsApp and YouTube as reflected by MPSs (89.03), (88.60) and (86.02) respectively. WhatsApp, google and YouTube were found most preferred as reflected by MPSs (90.75), (88.81) and (86.88) respectively. Online thesis repositories, CeRA, Mendeley and MOOCs were not used daily majority of the respondents. The overall, nearly three-fourth of the respondents (74%) were found in the category of high extent of utilization and more than half of the respondents (53%) had high level of frequency of utilization. It was concluded that ICT in education is the mode of education to support, enhance and optimise the delivery of information. The use of ICT web services in the field of education add values to the teaching and learning by improving the effectiveness of learning. It gave a new dimension to learning that was not previously available.

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Research Article

Screen Device Usage and its Impact on Behavioral Outcomes of Preschool Children

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ABSTRACT

In this modern time, screen devices have become an integral but essential part of everyone's daily life, especially preschoolers are unavoidably getting exposed to screen devices earlier in life and for longer hours. The American Academy of Paediatrics (AAP) has recommended that children between the ages of 2-5 years should limit their screen time to a maximum of 1 hour per day under the supervision of parents. So considering the scenario, the present study was undertaken to investigate the "Behavioural outcomes of screen device usage by preschool children". The differential research design and correlational research design was adopted for the study. The sample of the study comprised of 300 children of age 2-5 years, randomly selected from the anganwadi centres and preschools of Roorkee and Bahadrabad blocks of Haridwar district, Uttarakhand. For the data collection, a general information schedule, self-structured screen related questionnaire and Child Behavioral Checklist for 1.5-5 years of children developed by Achenbach and Rescorla, 2000 were used. The data were analyzed by using frequency-percentage, Chi-square test, student t-test, one-way ANOVA, and correlation coefficient. The results revealed that all rural and urban preschoolers had an access to smartphones and televisions. Moreover, device-specific screen time and total screen time of urban children were higher as compared to rural children. Screen time was significantly associated with behavioral outcomes of children. The correlational analysis revealed significant and positive relationship of type of content of exposure (non-educational child-oriented programme and adult-oriented programme) with internalizing and externalizing among children.

Keywords: Screen time, Behavioral outcomes, Internalizing behavior, Externalizing behavior, Preschool children

INTRODUCTION

In India, most household has televisions connected with cable networks which decide the extent of television watching by children which have been increased rapidly. Young children are being exposed to television from the beginning of their life and it plays a major role in their life. They play critical roles in sociability, attitude formation and deciding behavioral patterns in the lives of children. Children's main motive behind viewing television is being entertained. Through television, they can identify with exciting and attractive people and they are provided with different kinds of experiences which the child may yarn. The prevalence of digital technology has not only changed the way children learn and absorb knowledge, but also transformed the way they communicate and interact with each other (Wartella *et al.,* 2013).

In addition, preschool age is a pivotal period in various areas of development. Previous research has indicated that the preschool and early school years are a sensitive period for the acquisition of social competencies and related abilities associated with social adjustment. Screen time through media use is likely to affect children's behaviour and capacity to pay attention

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through several mechanisms, as it may lead to sleep disturbances, which can adversely impact development.

The American Academy of Pediatrics (AAP) has recommended that children below 18 months must completely avoid the use of digital screen but suggests the gradual introduction of family-shared, high-quality content between 18 months and 2 years while limiting screen time to a maximum of 1 h/day between 2-5 years of age. It also suggested that parents and guardians restrict screen time during mealtimes and keep screen viewing devices including televisions out of children's bedrooms (Hill *et al.*, 2016).According to the American Academy of Child & Adolescent Psychiatry (AACAP, 2020), children should spend most of their time engaged in such activities as sleeping, doing schoolwork and reading for enjoyment, making social and family connections, doing physical activities and chores, etc. to ensure their proper and healthy development, rather than spending so much time engaged in on-screen pursuits.

MATERIALS AND METHODS

The present study was carried out in urban and rural areas of Haridwar district, Uttarakhand state on the sample size of 300 preschool children. From the district Haridwar, out of six blocks, two blocks were purposively selected as per the highest population of the blocks. From each block, for rural sample, four villages were approached randomly to meet the sample size. Similarly, for urban sample, two town areas from each block were selected randomly. One anganwadi was selected from each of the selected villages. Similarly two preschools from each of the city areas were selected purposively. Anganwadis and preschools were selected purposively on the basis of intake capacity of children.

The self-structured, Screen device usage questionnaire was used to assess the screen-device usage (screen time and content exposure time) of preschoolers. Child Behavioral Checklist for 1.5-5 years of children developed by Achenbach and Rescorla, 2000 was used to assess behavioral outcomes of preschool children.

Frequency and percentage were calculated to interpret the preschooler's characteristics, parental and familial characteristics, and screen device related factors of children. To study the association between screen device usage and behavioral outcomes, chi-square was computed. T-test and ANOVA were applied to know the differences between the groups of variables in terms of behavioral outcomes.

The parents of preschoolers were prior informed about the study purpose and procedures, and were made aware that there is no obligation to participate and have a right to withdraw at any time. Parents were assured that their personal identity and information will be kept confidential. Throughout the phase of data collection, researcher has taken care of all the measures for protecting the participants from potential harm.

RESULTS AND DISCUSSION

It is evident from the Table 1 that, majority (56.67% and 59.33%) of the children was in older age category in both rural and urban areas respectively. The composition of preschool children, majority of the sample were of boys in both rural (53.33%) and urban (54%) area. With regard to ordinal position, in both areas majority (47.33% and 46.67%) of the children were first born least were later born. With respect to number of siblings, most of the children in rural (70.67%) and urban (58.67%) were having only one sibling.

With regards to mother's age, majority (59.33%) of the rural preschoolers had mothers below the age of thirty years while in contrast, majority of mothers (62%) of urban preschool children were older. With regards to father's age, 62.33 per cent of the rural preschoolers had fathers of younger age group and 59.19 per cent of the preschoolers had older age fathers (Table 2).

With regard to mother's education, majority of 33.33 per cent mothers in rural areas and 42.33 per cent in urban areas were graduated. With respect to father's education, 36.30 per cent were 10^{th} pass but below graduation, while in urban areas, more than half (52.05%) of the father's were graduates and least of 6.84 per cent were having professional qualification.

In case of mother's occupations in rural area, it was found that most of them (64%) were homemakers followed by service at shops/cultivation (22.67%), however in urban locality, majority (74.67%) were homemakers, followed by service in government sector

Table 1: Percentage distribution of rural and urban preschoolers by child characteristics.

Characteristics	Category	Rural (n=150)	Urban (n=150)	Total (N=300)
Age (Months)	Younger (24-42)	65 (43.33)	61 (40.67)	126 (42.00)
	Older (42-60)	85 (56.67)	89 (59.33)	174 (58.00)
Gender	Boys	80 (53.33)	81 (54.00)	161 (54.67)
	Girls	70 (46.67)	69 (46.00)	139 (46.33)
Ordinal position	First born	71 (47.33)	70 (46.67)	141 (47.00)
	Second born	67 (44.67)	62 (41.33)	129 (43.00)
	Later born	12 (8.00)	18 (12.00)	30 (10.00)
No. of siblings	None	20 (13.33)	37 (24.67)	57 (19.00)
	One	106 (70.67)	88 (58.67)	194 (64.67)
	Two or more	24 (16.00)	25 (16.67)	49 (16.33)

Figures in parentheses indicate percentages

Table 2: Percentage distribution of rural and urban preschoolers by parental characteristics

Characteristics	Category	Rural	Urban	Total
Mother's Age	Younger (<30)	89 (59.33)	57 (38.00)	146 (48.67)
	Older (>30)	61 (40.67)	93 (62.00)	154 (51.33)
Father's Age	Younger (<35)	91 (62.33)	60 (40.81)	151 (51.53)
	Older (>35)	55 (37.67)	87 (59.19)	142 (48.46)
Mother's education	Illiterate	-	-	
	Just literate but no Schooling	-	-	
	<Primary but attended school for at least one year	05 (3.33)	-	05 (1.67)
	Primary pass but <10th	23 (15.33)	06 (4.00)	29 (9.67)
	10th class pass but < graduation	32 (21.33)	23 (15.33)	55 (18.33)
	Graduation	50 (33.33)	63 (42.33)	113 (37.67)
	Post graduation	40 (26.67)	58 (38.67)	98 (32.67)
	Professional qualification/technical degrees /diplomas	-	-	
Father's education	Illiterate	-	-	-
	Just literate but no Schooling	-		
	<Primary but attended school for at least one year	04 (2.73)	-	04 (1.36)
	Primary pass but <10th	06 (4.10)	-	06 (2.05)
	10th class pass but < graduation	53 (36.30)	25 (17.12)	78 (26.71)
	Graduation	40 (27.39)	76 (52.05)	116 (39.72)
	Post graduation	36 (24.65)	35 (23.97)	71 (24.31)
	Professional qualification/ technical degrees/diplomas	07 (4.79)	10 (6.84)	17 (5.82)
Mother's occupation	Service in central/state/public undertaken	16 (10.66)	18 (12.00)	34 (11.33)
	Service in private sector/ business	-	16 (10.67)	16 (5.33)
	Service at shops/home/cultivation	34 (22.67)	-	34 (11.33)
	Self employed with income >5000	04 (2.67)	04 (2.67)	08 (2.66)
	Self employed with income <5000	-	-	
	Homemakers	96 (64.00)	112 (74.67)	208 (69.33)
Father's Occupation	Service in central/state/public undertaken	48 (32.87)	61 (41.78)	109 (37.32)
	Service in private sector/ business	56 (38.35)	83 (56.84)	139 (47.60)
	Service at shops/home/cultivation	30 (20.54)	-	30 (10.27)
	Self employed with income >5000	12 (8.21)	02 (1.36)	14 (4.79)
	Self employed with income <5000	-	-	-
	Unemployed	-	-	-

(12%). With respect to father's occupation in rural area, it was found that most of them (38.35%) work in private sector followed by service in government sector (32.87%) while in urban areas, majority (56.84%) of father's working in private sector, followed by service in government sector (41.78%) and only 1.36 per cent of them were self-employed with income above Rs 5000/-.

With respect to type of family, it was found that 73.33 per cent children belonged to joint family in rural and 50.67 per cent were from nuclear family in urban locality (Table 3).

With respect to monthly family income, in rural area, majority (48.67%) were in low income category of below Rs 30000/- and majority of 36 per cent of children were in income category of Rs 30000-50000/-.

The Table 4 shows that in rural area, majority (93.33%) of the households had television, 89.33 per cent has smart phone and only 6.67 per cent has laptop/computer. None of the households has tablets in their home. While in Urban areas, every household has T.V, 98 per cent has smart phones, 34 percent has laptops/computers and least of the household has tablets in their house.

Regarding screen used by preschoolers, all preschoolers use television and smart phones in rural areas. While in urban areas, cent percent of preschoolers use T.V. and smart phones followed by 8 percent uses tablets and least of 7.33 percent uses laptop/computer.

When looking at the age of exposure to screen devices, 36 per cent of the rural preschoolers have started using screen devices at <1 year of age however in urban areas, 38.67 per cent of urban preschoolers started using screens at or below <1 Years of age.

From the Table 5 it can be concluded that in urban areas, due to the advancement in the field of

Table 3: Percentage distribution of rural and urban preschoolers according to familial characteristics

Characteristics	Category	Rural	Urban	Total
Type of family	Nuclear	40 (26.67)	76 (50.67)	116 (38.67)
	Joint	110 (73.33)	74 (49.33)	184 (61.33)
Family Income	< 30,000	73 (48.67)	23 (15.33)	96 (32.00)
	30,000-50,000	40 (26.67)	37 (24.66)	77 (25.67)
	50,000-80,000	26 (17.33)	54 (36.00)	80 (26.67)
	>80,000	11 (7.33)	36 (12.00)	47 (15.70)

Figures in parentheses indicate percentage

Table 4: Percentage of rural and urban children exposed to different types of screens and their age of first screen exposure

Factors	Category	Rural (n=150)	Urban(n=150)
Types of Screens at home	Television	140 (93.33)	150 (100)
	Smart phones	134 (89.33)	147 (98.00)
	Tablets	-	12 (8.00)
	Laptops/Computers	10 (6.67)	51 (34.00)
Screens used by preschoolers	Television	150 (100)	150 (100)
	Smart phones	150 (100)	150 (100)
	Tablets	-	12 (8.00)
	Laptops/Computers	-	11 (7.33)
Age at started using S.D	<1 Year	54 (36.00)	58 (38.67)
	1-2 Year	40 (26.67)	51 (34.00)
	2-3 Year	38 (25.33)	33 (22.00)
	>3 Year	18 (12.00)	8 (5.33)

Table 5: Percentage distribution of device specific screen time (per day) of rural and urban children

Screen time	Television		Smartphones		Tablets		Laptop/Computer		Total screen time	
(Minutes)	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
<30	60 (40.0)	38 (25.33)	44 (29.33)	22 (14.66)	-	03 (2.00)	-	11 (7.33)	20 (13.33)	10 (6.67)
30-90	63 (42.0)	62 (41.33)	51 (34.0)	64 (42.67)	-	09 (6.00)	-	-	59 (39.33)	55 (36.67)
>90	27 (18.0)	50 (33.33)	55 (36.67)	64 (42.67)	-	-	-	-	71 (47.33)	85 (56.66)

technology, high educational and occupational status of the parents, every household possesses traditional and modern screen devices like television, smart phones, tablets/laptops and computers as compared to rural areas.

The Table 6 indicates that, the percentage of children spending >90 minutes of screen time per day is more in urban areas (56.66%) compared to rural areas (47.33%). When the screen time was observed separately for television and smart phone, percentage of children from urban areas were found to be more than rural areas. The percentage of children spending <30 minutes screen time is more in rural areas (13.33%) compared to urban areas (6.67%). When the screen time was observed separately for television and smart phone, percentage of children from rural areas were found to be more than urban areas. The possible reason behind the high screen time of urban children as compared to rural children is that the most of the urban mothers in the present study were homemakers who seemed to utilize screen devices as their leisure activity which may influence the screen time of the preschoolers. Moreover, in urban setting due to the increasing trend of online education mode and amalgamation of technology with education has increased the availability and usage of screen devices by children. The results are in congruence with Tomaz *et al.* (2020) who reported that 67 per cent of the children had higher rates of exceeding screen time guidelines than children from rural setting (3.5%).

The Table 6 reveals that, the majority of the rural mother (68.67%) showed more than 2 hours of total screen time against 50 percent of urban mothers. Less than two hours of total screen time has been seen in 50 percent of urban mothers and 31.33 percent of rural mothers. The majority of both rural (98%) as well as urban mothers (98%) spend less than two hours in front of television screen. Only two percent showed more than two hours of exposure. More than two hours of exposure to smart phone screen has been seen in 63.33 percent of rural and 49.33 percent of urban mothers. Less than two hours of exposure was in 36.67 percent of rural and 50.67 percent of urban mothers. With respect to laptop/computer, in rural areas only 4.67 per cent had <2 hours of screen and in urban areas only 1.33 per cent mothers' had <2 hrs of screen time. The reason behind high screen time of mothers in rural areas may be that, the mothers after completing household chores utilize their leisure time by watching television or using mobile phones rather than looking after their children because they leave their kids outdoor for playing by themselves.

The Table 7 shows that, the majority of children watch educational content less than 30 minutes in rural areas and 30-90 minutes in urban areas. While looking at non-educational content, majority of rural and urban children watch it for about 30-90 minutes per day. Regarding Adult-oriented programmes, most of the children watch it for less than 30 minutes and a few for 30-90 minutes. To conclude, the urban children had high screen time regarding all three types of content exposure. The possible explanation may be that, in urban setting due to covid19 situation, children's outdoor activities has hampered. Hence, they spend

Table 6: Percentage and frequency distribution of mother's screen time per day

Screen	Television		Smartphones		Tablets		Laptop/Computer		Total screen time	
Time	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
<2 Hrs	147 (98.00)	147 (98.00)	55 (36.67)	76 (50.67)	-	-	07 (4.67)	02 (1.33)	47 (31.33)	75 (50.00)
>2 Hrs	03 (2.00)	03 (2.00)	95 (63.33)	74 (49.33)	-		-		103 (68.67)	75 (50.00)

Table 7: Percentage and frequency distribution of screen time of content exposure of rural and urban children

Locality	Content exposure time	Educational child oriented programmes	Non-educational child oriented programmes	Adult oriented programmes
Rural	<30 Min.	102 (68.00)	22 (14.66)	36 (24.0)
	30-90	48 (32.0)	90 (60.0)	37 (24.66)
	>90	-	38 (25.33)	01 (00.67)
Urban	<30 Min.	42 (28.0)	13 (8.66)	65 (43.33)
	30-90	91 (60.67)	70 (46.67)	27 (18.0)
	>90	17 (11.33)	67 (44.67)	04 (02.67)

their time watching fun and entertainment games and videos on screens. Primarily because games and entertaining videos comprised of animations and characters that best suits their likings, attracts their attention due to which children's screen time for such contents increases. According to the study of Shirley and Kumar (2019), majority of the screen time (67.6%) was based on children's entertainment (children's entertainment programs and playing games) followed by educational contents (21%) and adult based entertainment programs (11.4%). This pattern was observed in all the age groups studied.

Table 8 indicates that, in rural area, majority of mothers' (66.67%) provide screen to their children to keep them engaged, 48.67 per cent to calm down their children, 29.33 per cent for entertainment purpose, and 28 per cent of the parents provide for teaching purpose. In urban areas, 75.33 per cent provides screen for engaging their children followed by 49.33 per cent provides it for educational purpose, 36.67 per cent to calm their children, 25.33 per cent for entertainment purpose. In overall, the majority of the mothers irrespective of their locality, deliberately provide screens to their naughty, explorative, curious preschool children to keep them engaged to avoid interruption during their household and other important works. Moreover, children of this age is very attention seeker, and if they don't get the attention they starts throwing tantrums and whines so parents provides screens to calm them down. Moreover, parents believe that the children can learn a lot through watching videos, games, so to facilitate learning parents allow their children to use screens. According to the results of Kabali *et al.* (2015), parents reported that they gave children devices when doing house chores (70%), to keep them calm (65%), and at bedtime (29%).

The above Table 9 shows that higher percentage of preschoolers from both rural and urban areas fell under normal level (73% and 65.30% respectively) followed by clinical (rural 17.30% and urban, 21.30%) level. Accordingly, 9.30 per cent of the rural and 13.30 per cent of the urban preschoolers fell under borderline level of behavioral outcomes. In urban setting, while comparing with rural setting, have different familial characteristics like majority of being nuclear families, having small family size, dual-earner parents and parenting practices which may somewhere contribute to more behavior problems among children.

Table 8: Percentage and frequency distribution of parent's reason of providing screens to preschoolers

Parent's Reasons	Rural	Urban	Total
To engage child	100 (66.67)	113 (75.33)	213 (70.00)
To calm child	73 (48.67)	55 (36.67)	128 (42.67)
To get child sleep	02 (1.33)	01 (0.67)	03 (1.00)
To teach child	42 (28.00)	74 (49.33)	116 (38.67)
For fine motor development	03 (2.00)	07 (4.67)	10 (3.33)
To keep in touch with relatives	04 (2.67)	02 (1.33)	06 (2.00)
To get child have food	19 (12.67)	34 (22.67)	53 (17.67)
For entertainment purpose	44 (29.33)	38 (25.33)	82 (27.33)

Table 9: Percentage distribution of preschooler's behavioural outcomes in rural and urban areas

Levels of behavior	Rural Frequency (%)	Urban Frequency (%)	Total Frequency (%)
Normal	110 (73.30)	98 (65.30)	208 (69.33)
Borderline	14 (9.30)	20 (13.30)	34 (11.33)
Clinical	26 (17.30)	32 (21.30)	58 (19.33)

Figures in parenthesis indicates percentages

Table 10: Categories of children under different behavioral dimensions in rural and urban areas

Dimensions of behavior	Levels of behavior	Rural Frequency (%)	Urban Frequency (%)	Total Frequency (%)
Internalizing problems	Normal	109 (72.70)	95 (63.30)	204 (68.00)
	Borderline	15 (10.00)	21 (14.00)	36 (12.00)
	Clinical	26 (17.30)	34 (22.70)	60 (20.00)
Externalizing problems	Normal	84 (56.00)	84 (56.00)	168 (56.00)
	Borderline	19 (12.70)	25 (16.70)	44 (14.66)
	Clinical	47 (31.30)	41 (27.30)	88 (29.33)

Figure in parenthesis indicates percentages

These total samples were again analyzed as per externalizing and as per internalizing problems and shown in Table 10. The results of Table 10 shows that, regarding internalizing problems, majority of the rural (72.70%) and urban (63.30%) children fell under normal level. While in externalizing problems, it was found that in both rural and urban area majority of (56%) preschoolers fell under normal level equally, followed by clinical level (rural, 31.30% and urban, 27.30%). For borderline level, 12.70 per cent of rural and 16.70 per cent of urban preschoolers were found. But when looking meticulously at behavior of rural and urban children, urban children were more in clinical range of internalizing problems and rural children were more in clinical range of externalizing problems as compared to their counterparts. The possible reason may be that the children in preschool age are socially and emotionally dependent on the family especially on mothers but due to nuclear family system and maternal employment status in urban settings may cause emotional instability because parents are not able to provide quality time to their children. However rural children exhibit more externalizing behavior as compared to urban children due to the fact that in rural areas, children may get more exposure to their immediate environment, they have more number of siblings and neighborhood children with whom they play without parents supervision.

The above Table 11 revealed significant association between screen time of children and their externalizing (χ^2=14.390) and total behavioral problems (χ^2=16.525) in rural areas. Moreover, in urban settings, significant association found between screen time of children and their internalizing (χ^2=27.080), externalizing (χ^2=33.740), and total behavioral problems (χ^2= 31.472). In Table 12, when mean scores were compared it is evident that, behavioral problems of children with high screen time are significantly higher than those children with low and medium screen time in rural and urban children. The results of studies conducted by Mistry *et al.* (2007) and Poulain *et al.* (2018) indicated that the "use of mobile phones and other screens at baseline was associated with higher conduct problems and hyperactivity/inattention problems at follow-up. It also reported that the assignment of children to the risk group of behavior difficulties, the use of mobile phones was associated with an increased likelihood to be assigned to the total difficulties risk group and the hyperactivity/inattention risk group". Moreover, Hosokawa and Katsura (2018) also reported that users spending 60 minutes or more a day had significantly more problems/symptoms such as conduct problems, hyperactivity/inattention, and emotional symptoms. The possible explanation behind this is that, the excessive screen time or screen device usage causes lack of social interaction among family members which

Table 11: Association between preschooler's screens time and their levels of behavior.

Locality	Preschooler's screen time	Levels of behavior				Modified
		Normal	Borderline	Clinical	Total	χ^2
Rural				**Internalizing problems**		
	<30 Min.	18 (12.00)	02 (1.30)	0 (0.00)	20 (13.30)	5.093^{NS}
	30-90 Min.	42 (28.00)	06 (4.00)	11 (7.30)	59 (39.30)	(.278)
	>90 Min.	49 (32.70)	07 (4.70)	15 (10.00)	71 (47.30)	
	Total	109 (72.70)	15 (10.00)	26 (17.30)	150 (100)	
				Externalizing problems		
	<30 Min.	17 (11.30)	01 (0.70)	02 (1.30)	20 (13.30)	14.390**
	30-90 Min.	37 (24.70)	08 (5.30)	14 (9.30)	59 (39.30)	(.006)
	>90 Min.	30 (20.00)	10 (12.70)	31 (20.70)	71 (47.30)	
	Total	84 (56.00)	19 (12.70)	47 (31.30)	150 (100)	
				Total behavior problems		
	<30 Min.	20 (13.30)	0 (0.00)	0 (0.00)	20 (13.30)	16.525**
	30-90 Min.	48 (32.00)	04 (2.70)	07 (4.70)	59 (39.30)	(.002)
	>90 Min.	42 (28.00)	10 (6.70)	19 (12.70)	71 (47.30)	
	Total	110 (73.30)	14 (9.30)	26 (17.30)	150 (100)	
Urban				**Internalizing problems**		
	<30 Min.	10 (6.70)	0 (0.00)	0 (0.00)	10 (6.70)	27.080**
	30-90 Min.	45 (30.00)	07 (4.70)	03 (2.00)	55 (36.70)	(.000)
	>90 Min.	40 (26.70)	14 (9.30)	31 (20.70)	85 (56.70)	
	Total	95 (63.30)	21 (14.00)	34 (22.70)	150 (100)	
				Externalizing problems		
	<30 Min.	10 (6.70)	0 (0.00)	0 (0.00)	10 (6.70)	33.740**
	30-90 Min.	43 (28.70)	07 (4.70)	05 (3.30)	55 (36.70)	(.000)
	>90 Min.	31 (20.70)	18 (12.00)	36 (24.00)	85 (56.70)	
	Total	84 (56.00)	25 (16.70)	41 (27.30)	150 (100)	
				Total behavior problems		
	<30 Min.	10 (6.70)	0 (0.00)	0 (0.00)	10 (6.70)	31.472**
	30-90 Min.	48 (32.00)	05 (3.30)	02 (1.30)	55 (36.70)	(.000)
	>90 Min.	40 (26.70)	15 (10.0)	30 (20.00)	85 (56.70)	
	Total	98 (65.30)	20 (13.30)	32 (21.30)	150 (100)	

Table 12: Comparison of mean scores of preschooler's behavior by their screen time

Dimensions of behaviour	Screen time	Rural		Urban	
		Mean ± SD	F-test	Mean ± SD	F-test
Internalizing problems	<30 Min.	51.35 ± 6.54	4.659**	53.20 ± 5.47	11.587**
	30-90 Min.	54.11 ± 8.33	(.001)	52.25 ± 7.74	(.000)
	>90 Min.	56.94 ± 7.83		58.96 ± 8.87	
Externalizing problems	<30 Min.	52.25 ± 7.48	8.410**	56.20 ± 1.98	9.723**
	30-90 Min.	55.94 ± 9.75	(.000)	53.32 ± 7.55	(.000)
	>90 Min.	60.70 ± 9.13		60.31 ± 10.55	
Total behavior problems	<30 Min.	51.75 ± 4.37	6.639**	52.60 ± 3.20	17.508**
	30-90 Min.	54.35 ± 7.94	(.002)	51.58 ± 7.15	(.000)
	>90 Min.	57.74 ± 7.45		59.92 ± 9.48	

leads emotional issues. Due to excessive indulgence with screen devices, children not able to give time to other soothing and beneficial activities like indoor-outdoor play, art and craft which might helps in reducing stress, anxiety, frustration and such other issues. Excessive screen usage may lead sleep disturbances among children which also lead to moodiness and irritability among children.

It is also proven from the Table 13 that there was a positive significant correlation between screen time and behavior problems among rural (r = .266) and urban (r=.508) preschool children, indicating that children with higher screen time exhibited higher behavioral problems. The correlation analysis was found to be significant at 1 per cent level.

Table 14 reveals that, in rural areas, correlation analysis revealed a significant and positive correlation between preschooler's screen time of content of non-educational programmes and all three dimensions of behavioral outcomes. It means higher the time of watching non-education content, higher the externalizing, internalizing and total behaviors problems exhibited by preschoolers. In urban areas, significant and positive correlation found between non-education content and all three dimensions of behavioral outcomes and also between adult oriented programmes and all three dimensions of behavioral problems. It means that the more preschoolers expose to non-educational content and adult oriented content, the more behavioral problems preschoolers exhibits. The reasons may be that the content of non-educational programme and adult oriented programmes present more foul language, aggression and violent content which children see and imitate and easily influenced by them. Study by Guerrero *et al.* (2019) stated that screen time is associated with problem behaviors: watching television was associated with a 5.9 per cent increase in rule-breaking behavior, 5 per cent increase in social problems, 4 per cent increase in aggressive behavior, and 3.7 per cent increase in thought problems. Greater time spent playing mature-rated video games was associated with greater somatic complaints, aggressive behavior.

Table 13: Correlation between preschooler's screen time and behavioural outcomes

Locality	Variable	Screen time	Behavior problems
Rural	Screen time	1	.266**
	Behavioral outcomes	.266**	1
Urban	Screen time	1	.508**
	Behavioral outcomes	.508**	1

**Significant at 1 per cent level

CONCLUSION

In conclusion the overall results suggested that all of the children had access to smartphones and television. Irrespective of the locality, the majority of the children had started using screens at or below the age of 1 year. Moreover, the percentage of spending >90 minutes of screen time per day is more among urban children (56.66%). When device-specific screen time was observed, the percentages of urban children using smartphones and television for a longer time were higher. Moreover, the children using screens for a longer time exhibited significantly higher internalizing, externalizing and total behavioral problems among rural and urban children. Results also indicated a significant correlation between the type of content exposure and behavioral outcomes of preschool children. It showed that the children exposed to the non-educational child-

Table 14: Inter-correlation between content exposure and dimensions of behavioral problems

Locality	Content exposure/behavior problems	Internalising behavior	Externalising behavior	Total behavior
Rural	Child-oriented educational programme	.159	.134	.144
	Child-oriented non-educational programmes	.180*	.263**	.220**
	Adult-oriented programmes	.142	.156	.159
Urban	Child-oriented educational programme	.029	.040	.058
	Child-oriented non-educational programmes	.339**	.269**	.393**
	Adult-oriented programmes	.325**	.430**	.433**

**Significant at 1 per cent level

oriented programme and adult-oriented programme exhibited significantly higher internalizing, externalizing and total behavioral problems.

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Research Article

In vitro Assessment of Fungicides and Plant Extracts against Common Bean Anthracnose Incitant

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ABSTRACT

Common bean Anthracnose is a destructive and devastating disease, which leads to decline in quality as well as well quantity in the crop yield across the globe. It is hard to manage because of its seed and soil borne nature. In order to delineate the efficient strategy for the management of common bean anthracnose an *in vitro* study for evaluating the efficacy of various non-systemic, systemic, combo fungicidal formulations and plant extracts was carried out. Evaluation of these fungicides and plant extracts against the target pathogen was done as per the guidelines of poisoned food technique. From different non-systemic fungicides mancozeb 75 WP was found best in inhibiting the mycelial growth of *Colletotrichum lindemuthianum* (75.63% mean inhibition), among systemic fungicides carbendazim 50 WP was found best (85.13% mean inhibition), among combo fungicides mancozeb (63%) + carbendazim (12%) gave maximum values for mycelial growth inhibition of *Colletotrichum lindemuthianum* (89.05% mean inhibition) and among plant extracts clove extract of garlic was found best (65.33% mean inhibition).

Keywords: Anthracnose, Beans, Fungicides, *In vitro*, Plant extract

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is called by different names like French and kidney bean. Based upon its form of consumption it is called snap bean (green form) or pulse (dried form). It belongs to family Fabaceae (Romero-Arena *et al*., 2013). It holds third position (after soyabean and arecanut) among all legume crops in terms of importance, but in terms of direct consumption it holds top position (Broughton *et al.,* 2003). It is a short-duration crop with shallow roots that is day-neutral. The optimal temperature range for its cultivation is 10–27°C; below that, the flowers, branches, and developing pods are harmed, and beyond 30°C, there is a significant risk of flower drop. In India, 221 thousand hectares were cultivated for beans in 2019–2020, yielding 2226 thousand MT of production (Anonymous, 2021). This devastating disease limits the common bean production globally (Kelly and Vallejo, 2004). Because farmers primarily rely on farm-saved seed and seed exchange is common, anthracnose is a disease that spreads quickly through seed (Lopes and Berger, 2001). For *C. lindemuthianum,* the ideal growing temperature range is 22°C to 23°C, while the maximum growth range is 30°C to 31°C. Although the fungus can tolerate temperatures as low as -15°C to -20°C, it is sensitive to high temperature. The optimum temperature for sporulation was 15°C, with minimum and maximum temperatures of 4°C and 38°C, respectively. The critical temperature ranges between 32°C and 35°C, respectively. Spore germination occurs rapidly at temperatures higher than the optimal temperature for growth, although normally not exceed 27.5°C (Ravi *et al.,* 2000). More than 121 plant genera from 45 distinct families,

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including angiosperms, gymnosperms, ornamentals, vegetables, fruits plants, field crops, and even grasses, are known to be susceptible to the anthracnose disease caused by *Colletotrichum* species (Farr *et al.,* 2016).

MATERIALS AND METHODS

Following the collection of infected samples from the field, the tissue bit transfer method was used to isolate the pathogen (Sicard *et al*., 1997). Infected samples of leaf and pod were cut in to minute pieces followed by surface sterilization with 0.1% mercuric chloride for a time period of 30 seconds (Jhonston and Booth, 1983). After surface sterilization, tissue bits were washed three times in the sterile distilled water serially. To remove the moisture, tissue bits were placed on sterilized filter paper under laminar-air-flow cabinet. Dry sterilized tissue bits were transferred in Petri plates and test tubes containing solidified cold potato dextrose agar under aseptic conditions i.e., under laminar-air-flow cabinet. Inoculated plates and slants were kept in incubator to maintain temperature at around 25ºC for the promotion of test fungus growth. Purification of fungal culture was done by employing single spore method (Jhonston and Booth, 1983). The pure culture of test fungus was maintained for subsequent use by sub-culturing at 30 days interval. Storage of culture was done in PDA slants stored at 4-5ºC.

Using poisoned food technique, fungicides were evaluated against *C. lindemuthianum* at three different concentrations in vitro (Nene and Thapliyal, 1979). At 500, 1000, and 1500 ppm, the non-systemic fungicides (Mancozeb 63% + Carbendazim 12%) were evaluated. At 50, 150, and 250 ppm, systemic and their combination formulations were evaluated. After estimating the required quantity of fungicides, 100 ml of sterilized PDA media were added individually to a conical flask (250 ml). A 90 mm sterilized Petri plate was filled with 20 ml of the poisoned media, whereas plain PDA media was used as the untreated control. For every treatment, three replications were maintained. One week old culture, seeded at a depth of 5 mm, was incubated at 27±1°C per day in each Petri plate. When the control plate made contact with the periphery, observations were made and recorded. Using the Vincent formula (1927), the colony diameter and the percentage of the fungus's mycelial inhibition were determined:

$$I = \frac{C-T}{C} \times 100$$

Where, C: Growth of the test fungus in control plate. T: Growth of test fungus in treated plate.

Aqueous extracts of leaves, green hull, and clove of test plants like artimesia, datura, nettle, walnut and garlic respectively were made by taking 100 grams of the desired plant part. The plant part taken was washed twice or thrice with running tap water followed by washing with sterilized distilled water (3 times). Now the said plant parts were air dried and then macerated in the grinder in 100 ml distilled water (w/v). The crushed plant parts were subjected to pass through two layers of muslin cloth. The juice extracted was filtered through Whartman No. 1 filter paper. The juice obtained was collected in conical flasks of volume 50 ml. The juice was subjected to centrifugation at 15,000 rpm for 10 minutes. The solid matter accumulated at the bottom of the centrifuge tube was culled and the supernatant was passed through bacteria proof membrane syringe filter (0.22 μ) under laminar air flow

Table 1: List of non-systemic and combo fungicide used

Fungicide	Concentrations (ppm)		
	C1	C2	C3
Mancozeb 75 WP	500	1000	1500
Copper oxychloride 50 WP	500	1000	1500
Captan 50 WP	500	1000	1500
Chlorothalonil 50 WP	500	1000	1500
Carbendazim 12% + Mancozeb 63%	500	1000	1500
Control	DW	DW	DW

DW= distilled water

Table 2: List of Systemic Fungicides used

Fungicide	Concentrations (ppm)		
	C1	C2	C3
Carbendazim 50 WP	50	150	250
Hexaconazole 5 EC	50	150	250
Propiconazole 25 EC	50	150	250
Azoxystrobin 25% + Difenconazole 12.5%	50	150	250
Propiconazole 13.9% + Difenconazole 13.9%	50	150	250
Control	DW	DW	DW

DW= distilled water

cabinet. Now the plant extracts obtained having concentration of 100 per cent called standard plant extracts were kept in refrigerator for ensuring storage temperature of 4ºC. As the required concentration for testing the bio efficacy of different botanicals was 10 per cent, so to make 10 per cent concentration of concerned plant extracts 10 ml of each standard plant extract was mixed with 90 ml of sterilized PDA media in conical flasks under laminar air flow cabinet (Poisoned food technique- Nene and Thapliyal, 1979). Now 20-25 ml of PDA mixed with said concentration of plant extracts was poured into Petri plates of 90 mm diameter under laminar air flow cabinet. The poured plates were allowed to cool down for solidification. Inoculation of said plates was done by transferring 5 mm disc of concerned fungus (from 10 day old culture) in the center of said culture plates. Test fungus was also inoculated into control plates that included PDA but no plant extracts. These plates were maintained side by side to compare the mycelial growth of the test fungus in the control and treatment plates. At 25 ±1 ºC, the inoculation plates were incubated. After 12 days, the mycelium's radial growth was taken for comparison. This study used a completely randomized experimental design with three replications for each treatment. In order to assess the mycelial growth inhibition, Vincent's (1927) formula was applied as follows:

$$I = \frac{C-T}{C} \times 100$$

Where I: per cent inhibition; C: colony diameter in control plate; T: colony diameter in treated.

Statistical analysis: The data collected during the present study was analyzed by using OPSTAT software Gomez and Gomez (1984).

RESULTS AND DISCUSSION

At all three concentrations compared to the control, the non-systemic fungicides evaluated in vitro against *Colletotrichum lindemuthianum* showed a discernible response in inhibiting the test fungus's mycelial growth (Table 4 and Plate 1). Carbendazim (12%) + mancozeb (63%) proved to be the best among combo fungicides. The mycelial growth inhibition percentage over control observed was 89.05, 75.63, 70.08, 67.92 and 61.44 for carbendazim (12%) + mancozeb (63%), mancozeb 75 WP, captan 50 WP, copper oxychloride 50 WP and chlorothalil 50 WP, respectively. The percentage of mycelial growth inhibition increased as the concentrations of all the fungicides increased. The mycelial growth inhibition was seen to shoot up from 68.51 per cent to 77.87 per cent when the concentration was increased from 500 ppm to 1500 ppm in non-systemic fungicides. Carbendazim (12%) + Mancozeb (63%) was found statistically superior to rest of the non-systemic and combo fungicides at all the respective test concentrations with most promising result at 1500 ppm and least effective fungicides recorded was chlorothalil 50 WP at all the three concentrations.

All five systemic fungicides tested *in vitro* against *Colletotrichum lindemuthianum* executed their role well of inhibiting the mycelial growth of test pathogen. Significant mycelial growth inhibition of test fungus by systemic fungicides tested *in vitro* over control is well presented in the Table 5 and Plate 2. The recorded mycelial growth inhibition over control with carbendazim 50 WP, difenconazole (13.9 %) + propiconazole (13.9 %), propiconazole 25 EC, azoxystrobin (25 %) + difenconazole (12.5 %) and hexaconazole 5 EC was 85.13, 82.78, 82.01, 78.29 and 74.50 per cent, respectively. The results of the poisoned food technique revealed that carbendazim 50 WP was the most effective systemic fungicide against *Colletotrichum lindemuthianum.* It inhibited the mycelial growth of the test fungus by 85.13 per cent at all three concentrations. Conversely, hexaconazole 5 EC was the least effective systemic fungicide screened, with a

Table 3: List of Botanicals used

Common name	Local name	Scientific name	Part used	Concentration
Artimesia	Tethwan	*Artimesia annula*	Leaf	10%
Walnut	Doon	*Juglans regia*	Green hull	10%
Datura	Datur	*Datura stramonium*	Leaf	10%
Garlic	Ruhun	*Allium sativa*	Clove	10%
Nettle	Soi	*Utrica dioca*	Leaf	10%

Table 4: *In vitro* evaluation of non-systemic fungicides and a combo fungide on *C. lindemuthianum*

Fungicides	Mycelial growth inhibition (%)			
	Concentrations (ppm)			
	500 ppm	1000 ppm	1500 ppm	Mean
Mancozeb 75 WP	72.49(8.57)	75.29(8.73)	79.10(8.95)	75.63(8.75)
Mancozeb 63% + carbendazim 12% (Combo product)	84.70(9.26)	87.53(9.41)	94.92(9.80)	89.05(9.49)
Copper oxychloride 50 WP	63.14(8.00)	67.91(8.30)	72.7(8.58)	67.92(8.29)
Chlorothalonil 75 WP	54.8(7.46)	61.74(7.91)	67.77(8.29)	61.44(7.89)
Captan 50 WP	67.4(8.26)	70.12(8.43)	74.88(8.70)	70.8(8.47)
Mean	68.51(8.31)	72.52(8.56)	77.87(8.86)	
C.D. ($p \leq 0.05$)	Fungicides (F) = 0.25	Concentrations (C) = 0.19	Fungicide × Concentrations (F×C) = 0.43	

* The values in parenthesis are square root transformed values

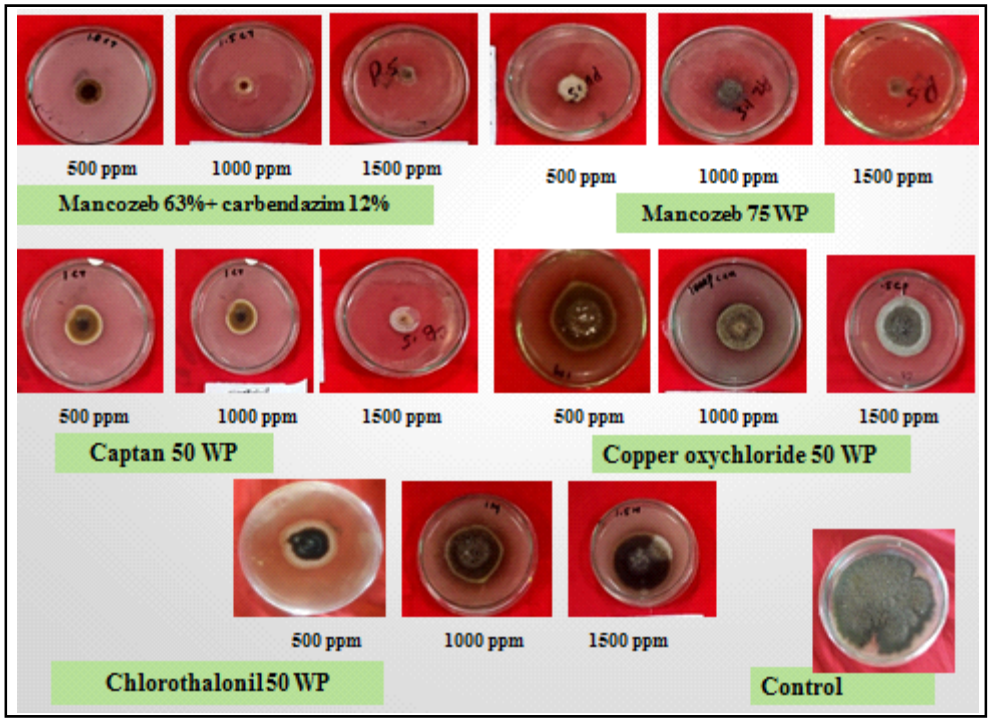

Plate 1: *In vitro* evaluation of Non-systemic fungicides and a combo fungicide on *C. lindemuthianum*

mycelial growth inhibition of 74.50 per cent over control.

Extracts of garlic, datura, walnut, nettle and artemesia were evaluated against the test fungus @ 10 per cent through poisoned food technique under *in vitro* conditions. The recorded mycelial growth inhibition of test fungus by the extracts of garlic, artemesia, walnut, datura and nettle over control in terms of percentage was 65.33, 57.12, 51.78, 47.96 and 42.12 respectively. Statistically superior results were recorded with the clove extract of garlic and least significant mycelial growth inhibition was recorded with leaf extract of nettle plant. Table 6 and Plate 3 give representation of above findings.

All of the fungicides used in the current study significantly reduced the test fungus's ability to develop mycelially, although carbendazim (12%) + mancozeb (63%) worked best. The mycelial growth inhibition percentage over control observed was 89.05, 75.63, 70.08, 67.92 and 61.44 for carbendazim (12%) +

Table 5: *In vitro* evaluation of systemic fungicides on *C. lindemuthianum*

Fungicides	Concentrations			
	50 ppm	150 ppm	250 ppm	Mean
Carbendazim 50 WP	81.33(9.07)	84.93(9.27)	89.13(9.49)	85.13(9.28)
Difenconazole13.5% +propiconazole 13.5%	80.18(9.01)	83.61(9.20)	84.56(9.25)	82.78(9.15)
Propiconazole 25 EC	79.30(8.96)	82.86(9.16)	83.86 (9.21)	82.01(9.11)
Azoxystrobin 25% + Difenconazole 12.5%	75.02(8.72)	77.29(8.85)	82.55(9.14)	78.29(8.90)
Hexaconazole 5 EC	71.4(8.50)	73.9(8.65)	78.2(8.88)	74.5(8.68)
Mean	77.45(8.85)	80.52(9.02)	83.66(9.20)	
C.D. ($p \leq 0.05$)	Fungicides (F) = 0.20	Concentrations (C) = 0.16	Fungicide × Concentrations (F×C) = 0.33	

* The values in parenthesis are square root transformed values

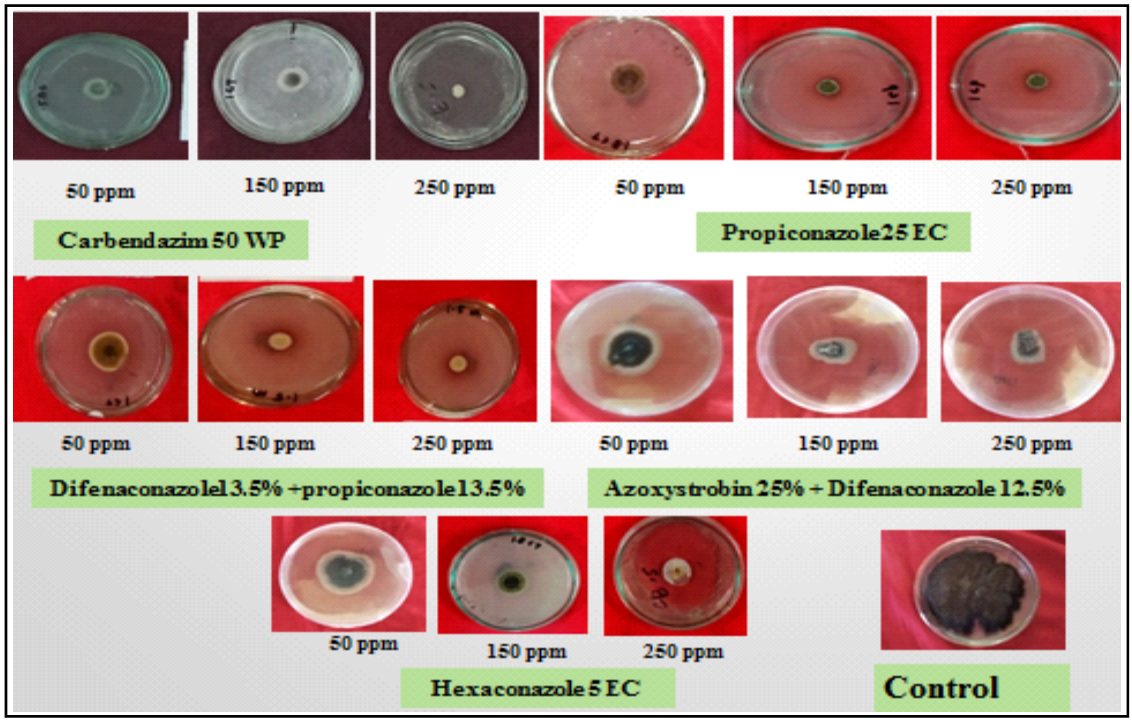

Plate 2: *In vitro* evaluation of Systemic fungicides on *C. lindemuthianum*

mancozeb (63%), mancozeb 75 WP, captan 50 WP, copper oxychloride 50 WP and chlorothalil 50 WP, respectively. The percentage of mycelial growth inhibition increased as the concentrations of all the fungicides increased. Mycelial growth was maximally inhibited at 1500 ppm by carbendazim (12%) + mancozeb (63%). The mycelial growth inhibitions recorded for different systemic fungicides against the incitant of anthracnose of common bean over control were appreciable and the inhibition of mycelial growth increased with the increase in concentration of the fungicides. The recorded mycelial growth inhibition over control with carbendazim 50 WP, difenconazole (12.5%) and propiconazole (13.9%), propiconazole 25 EC, azoxystrobin (25%) + difenoconazole (13.9%) and Hexacoanzole 5 EC was 85.13, 82.78, 82.01, 78.29 and 74.50 per cent, respectively. The best systemic fungicide against *C. lindemuthianum* found under in vitro conditions through poisoned food technique was carbendazim 50 WP at all the three concentrations which inhibited mycelial growth of test fungus by 85.13 per cent. The results of in vitro study by Rajesha *et al.* (2010) evaluating various systemic and non-systemic fungicides against *C. lindemuthianum* are consistent with the scientific findings regarding in vitro fungicide evaluation. They inferred that the mycelial growth

Table 6: *In vitro* evaluation of Plant extracts on *C. lindemuthianum*

Plant species	Common name	Plant part used	Concentration (%)	Mycelial growth inhibition (%)
Artemesia annula	Artemesia	Leaves	10%	57.12
Juglans regia	walnut	Green hull	10%	51.78
Allium sativum	Garlic	Clove	10%	65.33
Utrica dioca	Nettle	Leaves	10%	42.12
Datura stramonium	Datura	Leaves	10%	47.96

C.D. ($p \leq 0.05$) 7.04

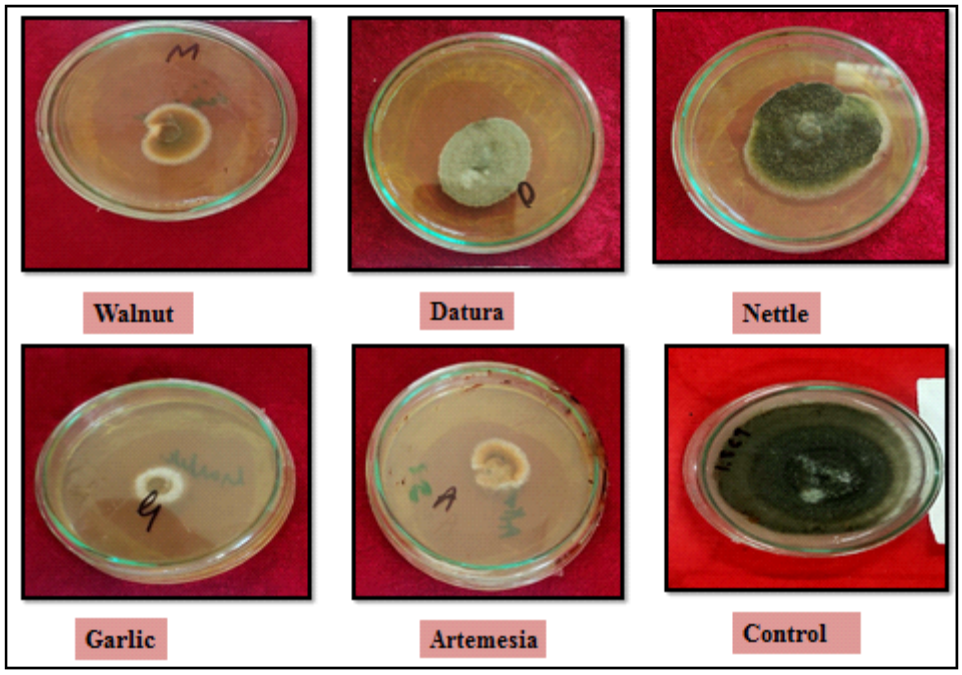

Plate 3: *In vitro* evaluation of plant extracts on *C. lindemuthianum*

inhibition of test fungus treated with non-systemic fungicides, namely mancozeb, propineb, and chlorothalonil, was 100 per cent, 48.12 per cent and 37.39 per cent, respectively, at the concentration of 800 ppm. They also inferred that among different systemic fungicides tested *in vitro* against the test fungus carbendazim and propiconazole inhibited mycelial growth by 100 per cent followed by difenoconazole for which recorded mycelial growth inhibition was 84.87 per cent at the concentration of 400 ppm. Fitsum *et al.* (2014) evaluated three fungicides under *in vitro* conditions namely mancozeb, folpan and mancolaxyl at the concentrations of 100 ppm, 250 ppm, 500 ppm and 1000 ppm against *C. lindemuthianum* and inferred that among the selected fungicides Mancozeb proved to be the best with 2.4, 2.23, 0 and 0 centimeters recorded mycelial growth at the four said concentrations respectively.

The recorded mycelial growth inhibition of test fungus by extracts of garlic, artemesia, walnut, datura and nettle over control in terms of percentage was 65.33, 57.12, 51.78, 47.96 and 42.12, respectively. The aforementioned results are in consonance with those of Lokhande *et al.* (2019), who employed the poisoned food technique to evaluate the bioefficacy of various plant extracts against *C. capsici* under in vitro conditions. They found that extracts from datura leaves and garlic bulbs inhibited the above-mentioned fungus's mycelial growth by 55.12 per cent and 51.22 per cent, respectively. Furthermore, Masangwa *et al.* (2012) reported that *Allium sativum* extract was effective against *Colletotrichum* spp.

CONCLUSION

Among all the fungicides tested, carbendazim (12%) + mancozeb (63%) showed the highest mean inhibition

of mycelial growth, accounting for 89.05 per cent. Mancozeb 75 WP proved to be the most effective non-systemic fungicide, as evidenced by its maximum mean mycelial growth suppression percentage of 75.63 per cent relative to the control. The above results are consistent with those of Lokhande *et al.* (2019), who used the poisoned food technique to assess the bioefficacy of many plant extracts against C. capsici in vitro. They found that extracts from datura leaves and garlic bulbs suppressed the above-mentioned fungus's mycelial growth by 55.12 per cent and 51.22 per cent, respectively. Moreover, Masangwa *et al.* (2012) observed that Allium sativum extract had efficacy against *Colletotrichum spp.* When garlic clove extract was evaluated in vitro, it showed the highest mean mycelial growth inhibition of 65.33 per cent among all plant extracts.

Conflict of interest: The authors declare that they have no conflicts of interest relevant to this research.

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Research Article

Indigenous Technical Knowledge (ITKs) in Dairy Farming

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ABSTRACT

Indigenous Technical Knowledge evolved from the experiences of farmers found to possess practical utility in solving some of the farmer's problems under their own conditions. A study undertaken in Gwalior division of Madhya Pradesh helped to document various Indigenous Technical Knowledge (ITKs) in dairying. The validation of Indigenous Technical Knowledge with 80 scientists showed varied level of validity scores.

Keywords: Indigenous technical knowledge, Dairy farming

INTRODUCTION

This it has led the scientific world to appreciate the role of indigenous technical knowledge (ITKs), also referred to as traditional knowledge. It is evolved by members of the farm community and passed on from, generation to generation, or developed on the basis of recent experimentation by farmers. Indigenous technical knowledge is unique to a given culture and society, - but it has value also for the scientists and planners that are involved in development projects. This paper provides a comparison of ITKs with modern practices; it discusses possibilities to use ITKs and problems associated with ITKs. Its study is important because attempts to impress researchers with the need to study traditional animal husbandry practices were already made in the late sixties (Verma and Singh, 1969). The study and appreciation of indigenous technical knowledge is important because indigenous technical knowledge may have scientific basis and its technologies could be transferred to other similar farming situations; documentation and screening of indigenous technical knowledge is necessary before the valuable information is lost forever; indigenous technical knowledge may be an alternative, a substitute or a complement to modern technology; ITKs may generate ideas for future research; it is often easier to secure adoption of indigenous technical knowledge than modern technology. A study was undertaken to identify, document and validate the indigenous technical knowledge (ITKs) practiced by the farmers in the Gwalior division of Madhya Pradesh.

MATERIALS AND METHODS

The study was carried out in Gwalior division of Madhya Pradesh. A multistage random sampling was applied to draw the samples for the study. Among the three selected districts of Gwalior division their and eight, four and five blocks in Shivpuri, Gwalior and Guna, respectively. A separate list of blocks of each selected districts were prepared and with the help of officials of respective districts, three blocks (two blocks having highest dairy farmer and one block having lowest dairy farmer) was identify for the selection of blocks and in the last stage of sampling process the block wise list of dairy farmers was prepared for each selected block. Overall 300 dairy farmers were selected as respondents with the help of simple random sampling without replacement under proportional scheme. Validity refers to the degree to which the data are realistic. The validation of ITK was done with a group of researchers for their relevance in scientific

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scenario. The selected technologies, which the farmers concern mostly, were sent for scrutiny. These were circulated to 80 scientists for their responses on 5-point validity continuum and the responses were scored 5, 4, 3, 2 and 1 for strongly agree, Agree, neither, Disagree, strongly disagree, respectively1. Thus, one ITK could get a maximum score of 400 and a minimum of 80. And thereafter ranking was done on the basis of frequency or percentages.

RESULTS AND DISCUSSION

They were documented by asking the dairy farmers about the indigenous treatment of animals that are coming from their ancestors and Questionnaires were sent to the researchers working in the following institutions like veterinary hospitals, veterinary dispensaries, veterinary department, agriculture office, Dairy farm officers and KVKs etc., were validated. The important indigenous technical knowledge with their validity score were show (Table 1). It was observed that even veterinary scientists/ Doctors have a varied level of perception on different indigenous technical knowledge practices. A total of healthcare formulations have been presented with the validity scores.

They were documented by asking the dairy farmers about the indigenous treatment of animals that are coming from their ancestors and Questionnaires were sent to the researchers working in the following institutions: veterinary hospitals, veterinary dispensaries, veterinary department, agriculture office, Dairy farm officers and KVKs etc. were validated, which are shown in Table 1.

After documentation and validation, it has been found out what are the reasons why the farmer is using indigenous medicines in the treatment of animals. To know these reasons, the help of farmers, scientists, veterinarians, etc., are mentioned in Table 2.

Table 1: Documentation of the validation of ITKs (N=80)

Documentation	Validation						
	SA	A	N	DA	SDA	TVS	MS
Health care							
1. General debilitation, indigestion and lack of appetite							
Liquid extracts of Ajwain (150g), black cumin (50g), black pepper (30g), sesame seeds (50g), and cardamom (30g) are given to cure digestive problems.	30	27	12	7	4	312	3.9
Aloe-vera was fed to animal if animal stopped taking food, while its fleshy leaves were fed to animals in case of indigestion.	10	16	20	19	15	227	2.837
2. To improve digestibility							
In the case of gastric problems in animals, 10g of hinged (hepatida) + 500g of edible oil is dissolved and its given carminative and smoothing action.	14	12	16	19	19	223	2.787
3. Indigestion							
Betel leaf + pepper crushed and mixed in coconut oil. This is believed that it induces appetite and reduces indigestion.	12	15	22	25	6	242	3.025
The problem of flatulence in animals is common during monsoon days as excessive grazing is done by animals due to excess of green fodder during monsoon. Therefore, for the treatment of this disease, whey, onion and custard apple leaf should be mixed and fed.	5	11	29	22	13	213	2.662
***4.* Diarrhoea**							
Dhatura Stramonium Seed (Jimsonweed) – 3g, arecanut – 20 g and white clay – 500g mixed with rice gruel and given two times per day.	27	31	12	8	2	313	3.912
Flowers of tobacco (*Nicotina tabacum*) were mixed in wheat flour and feed the animals once in 24 hours.	10	11	18	20	21	209	2.61
Fruits of bael (*Aegle marmelos*) were fed to animals having diarrhea.	5	7	21	24	23	185	2.312
250g sheera solution (Sugar) in half litre water or 250g khamir solution (yeast) in half litre of water is given to animals two times a day till recovery.	20	28	15	10	7	284	3.55

Table 1 contd....

Documentation	Validation						
	SA	**A**	**N**	**DA**	**SDA**	**TVS**	**MS**
5. Constipation							
Silk cotton (*Ceiba petandra*) fibers is soaked in castor oil and given to animals.	19	26	15	13	7	277	3.462
Castor seeds (200g) is ground and mixed with 250 ml of water and given to animals.	8	15	22	12	23	213	2.662
50g Ajwain (*Trachyspemuma mmi*) seed + 50g salt + 50g mustard seeds (*Brassica compestris*) + 100g Jaggery. In addition to this, animals should be fed two times a day.	15	23	20	16	6	265	3.312
Kadha made from 50g Brahmijiri (*Tagetus minuta*), 50g Ajwain (*Trachyspemum ammi*) and 100g Jaggery boiled in one litre water for 10 to 15 minutes. This is given two times a day till recovery.	9	25	20	15	11	246	3.075
Constipation is cured by giving castor oil orally to animals with extracts of neem leaf or bark.	8	19	23	16	14	231	2.887
6. Jaundice							
Turmeric is ground and made into arecanut size and given to animal.	16	32	15	12	5	282	3.525
Feeding the animals by cutting small pieces of sugarcane gives they comfort in the jaundice for few days.	5	7	29	25	14	204	2.55
7. Urinary problems							
Datura stramonium is dried leaves powder mixed with honey and given to animal.	13	16	19	21	11	239	2.987
10 g Coriander and 10 g of pepper is powdered and mixed with 100 ml of sesame oil.	15	20	28	10	7	266	3.325
8. Intestinal worms							
Leaves, flowers and bark of neem are ground and given to cattle. This destroys intestinal worms.	10	20	20	14	16	234	2.925
Grind neem leaves and make tablets with jaggery and feed them.	2	3	17	31	27	162	2.025
Boiled betel nut in water and drink it.	-	4	20	25	31	157	1.962
Worms are also killed by mixing ground rye in the whey.	1	6	18	26	29	164	2.05
9. Foot and mouth disease							
For mouth: Paste of roasted brinjal and pure ghee is scrubbed on the tongue to clean as well as treat the lesions.	10	12	18	25	15	217	2.712
Animals were allowed to walk into mud, so that a thick layer of mud was formed and covered the wounds of feet.	12	25	20	17	6	260	3.25
2 pieces of camphor + 10 ml coconut oil, mixed and applied on wounds in the feet of cattle.	8	19	27	17	9	240	3.00
To treat FMD affected animals, the hooves and mouth are washed with warm salt solution, and the mixture of leather ash and sesame oil or groundnut oil is applied to septic area.	15	20	17	12	16	246	3.075
The mixture of turpentine oil and camphor provides relief on washing the infected feet or part of mouth with lukewarm water and after drying it properly.	17	19	16	18	10	255	3.187
Neem leaves were boiled in water, after cooling the green water was used to rinse the infected hooves.	10	25	15	12	18	237	2.962
10. Fever and other diseases							
50g Gur (Jaggary) + 50g clove (*Syzygium aromaticum*) + 50g Ajwain (*Trachyspemum ammi*) + 50g ginger (*Zingiber officinale*) + 10 pieces of black pepper (*Piper nigrum*) + 50g methi (*Trigonella foenum-graecum*) mixed in 1 liter water and fed to animals once a day till recovery.	20	23	19	15	4	283	3.537

Table 1 contd....

Documentation	Validation						
	SA	**A**	**N**	**DA**	**SDA**	**TVS**	**MS**
11. Milk fever							
Leaves of indigo (*Indigofera tinctoria*) is made as tablets and given to animals. This is believed that it prevents milk fever.	5	7	24	23	21	192	2.4
12. Breathing diseases							
Cough-: Caflon powder should be used as a sauce (chutney) with 30 to 60g jaggery or molasses and animals should be kept in hot and airy environment and avoid cold air and congestion.	18	19	20	12	11	261	3.262
1 egg and 100g desi ghee are given to animal once in a day.	3	5	26	21	25	180	2.25
Massaging of animal body with paste of Jaiphal (*Myristica fragrans*) and mustard oil (*Brassica compestris*) once in a day.	6	11	28	16	19	209	2.612

Table 2: Rationale behind the use of ITKs

Practices	Rationale
Health care	
1. General debilitation, indigestion and lack of appetite	
Liquid extracts of Ajwain (150g), black cumin (50g), black pepper (30g), sesame seeds (50g), and cardamom (30g) are given to cure digestive problems.	Ajwain contains searoptin, thymine, thymol which has antihelminthic, antiseptic, carminative and antispasmodic properties, black cumin used as usual medicine due to being there of antimicrobial, antioxidant and other pharmacological properties. Black pepper has the occurrence of a large number of indispensable nutrients. Which is supportive for good digestion, if eaten raw, hydrochloric acid is released from the stomach which reliefs in breaking down the protein. Black cumin, celery, cardamom and black pepper are ironic in medicinal properties, which are a panacea for improving digestion.
Aloe-Vera was fed to animal if animal stopped taking food, while its fleshy leaves were fed to animals in case of indigestion.	Aloe Vera is found in high amounts of amino acids like calcium, folate, iron, magnesium, chromium, phosphorus, selenium, beta carotene, potassium and zinc, besides vitamins A, C and E are also available. So internally processed juice is given to animals, it can help in prevention or treatment of indigestion.
2. To improve digestibility	
The first abdominal rumen should be massaged. The pedu should be pressed up and down repeatedly. Mustard and Linseed oil and consumed later should be 250g of magasulf. Only water should be fed in small amounts Mixing Timpol 40g and Magasulf 150-400g per cow or buffalo in water is beneficial.	Dairy Farmers say that massaging with mustard and Linseed oil provides relief to the animals because this oil produces heat in the body and mixing megsulf and timpol with water gives quick relief and it gives comfort so it is used more by farmers. Timpol and magasulf is Ayurvedic Veterinary Medicine.
In the case of gastric problems in animals, 10g of hinged (hepatida) + 500g of edible oil is dissolved and its given carminative and smoothing action.	Asafetida is heated. It is a gum-like substance of light yellow or dusky white color, which has a pungent smell and bitter taste. It is used in the condition of stomach ache, phlegm, or gas, and asafetida contains ferulic acid, alpha pionin, lutein, azulin etc. Apart from this, many vitamins and minerals are found in asafetida, all these elements together make asafetida an effective Make medicine.
3. Indigestion	
Betel leaf + pepper crushed and mixed in coconut oil. This is believed that it induces appetite and reduces indigestion.	Betel leaves are rich source of vitamin C, niacin, thiamine, carotene and riboflavin and also a great source of calcium. Therefore it is used as a stimulant and antiseptic.

Table 2 contd...

Practices	Rationale
The problem of flatulence in animals is common during monsoon days as excessive grazing is done by animals due to excess of green fodder during monsoon. Therefore, for the treatment of this disease, whey, onion and custard apple leaf should be mixed and fed.	Custard apples are rich sources in antioxidants, rich in minerals such as calcium and potassium. Hence fiber is easily digested so it does not cause sudden spikes in blood sugar levels and helps the digestive system to function optimally.
4. Diarrhoea	
Dhatura Stramonium Seed (Jimsonweed) – 3g arecanut – 20g and white clay – 500 gm. mixed with rice gruel and given two times per day.	Datura metel seed contains rich phosphorous (690.2 mg/100g) and calcium (174.0 mg/100g). Datura oil contains high percent of linoleic acid (55.11%). This is told that it immediately stops diarrhea.
Flowers of tobacco (*Nicotina tabacum*) were mixed in wheat flour and feed the animals once in 24 hours.	Leaves of tobacco (*Nicotiana tabacum* L.) are thermogenic, sedative, anodyne, anti-inflammatory, antihelminthic, carminative, laxative, mental stimulant and toxic.
Fruits of bael (*Aegle marmelos*) were fed to animals having diarrhea.	Bael fruit might have antidiarrhoea ingredients such as alkaloids, tannins flavonoids, saponins and triterpenes which may be responsible for ameliorative potential of bael. The green or half-ripe fruit is considered astringent, intestinal and stomach helps to confiscate constipation, which makes it difficult to heal ulcerated surfaces of the intestines.
250g sheera solution (Sugar) in half litre water or 250g. khamir solution (yeast) in half litre of water is given to animals two times a day till recovery.	Farmers say that sugar and water solution removes water shortage and it easily available into homes.
5. Constipation	
Silk cotton (*Ceiba petandra*) fibers is soaked in castor oil and given to animals.	Farmers told that silk cotton possesses laxative substances and Castor oil is said to be a mild laxative. It works by increasing the movement of the intestine, helping the constipation.
Castor seeds (200g) is ground and mixed with 250 ml of water and given to animals.	Castor oil is said to be a mild laxative that increases the movement of the intestine, further helping relieve constipation. Farmers indicated that it was an easy method and the contents of castor were found effective against ulcer.
50g Ajwain (*Trachyspemum ammi*) seed + 50g salt + 50g mustard seeds (*Brassica compestris*) + 100g Jaggery. In addition to this, animals should be fed two times a day.	Mustard seed contains a unique dense, thin, high fiber-rich mucilage salt substance which is extremely important in relieving constipation. Mustard seeds have the main property of producing more saliva which helps in improving digestion. Ajwain is a virtuous home remedy for constipation due to its laxative properties.
Kadha made from 50g brahmijiri (*Tagetus minuta*), 50g Ajwain (*Trachyspemum ammi*) and 100 g Jaggery boiled in one litre water for 10 to 15 minutes. This is given two times a day till recovery.	Dairy farmers say by giving a decoction of Brahmijiri, ajwain and jaggery, the animal gets relief. And brahmijiri, ajwain and jaggery are easily available in locality and hence very cost effective.
Constipation is cured by giving castor oil orally to animals with extracts of neem leaf or bark.	Castor oil is used to treat constipation. It may also be used to clean out the intestines before a bowel examination/surgery. Castor oil is known as a stimulant laxative. It works by increasing the movement of the intestines, helping the stool to come out.
6. Jaundice	
Turmeric is ground and made into arecanut size and given to animal.	Curcumin is the main active constituent in turmeric. It has effective anti-inflammatory effects and antioxidants and is therefore very beneficial for jaundice.
Feeding the animals by cutting small pieces of sugarcane gives they comfort in the jaundice for few days.	Sugarcane (*Saccharum officinarum*) when chewed mixed with saliva is considered a nourishing tonic. It is diuretic. It is used as disinfectant of urinary tract.

Table 2 contd...

Practices	Rationale
7. Urinary problems	
Datura stramonium is dried leaves powder mixed with honey and given to animal.	Farmers told that it cures stomach pain and urinary problems and it is easy to apply.
10g Coriander and 10g of pepper is powdered and mixed with 100 ml of sesame oil.	Coriander seeds are rich in linalool antiseptic, antibacterial, antiviral, antifungal and spasmolytic and alpha-pinene antimicrobial compounds and sesame oil antioxidants. It is helpful in relieving the signs of urinary tract infection.
8. Intestinal worms	
Boiled betel nut in water and drink it.	Betel nuts contain the alkaloid arecoline a mild stimulant that produces a feeling of well-being in some parts of the orient, betel nut are used to destroy intestinal worms.
Worms are also killed by mixing ground rye in the whey.	Whey is a by-product obtained during the course of production of chhana. Chhana contains whey-water 93.6%, fat 0.5%, protein 0.4%, lactose 5.1%, ash 0.1%, lactic acid 0.2%, and milk solid 6-7%. It is good source of vitamin A & D. It is diuretic and having antibacterial property.
	Mustard seed is a fiber rich diet in which omega 3 fatty acids, calcium, manganese, iron, zinc and protein are found in abundance.

CONCLUSION

Many dairy farmers who have traditional knowledge of dealing with various practices and techniques are hardly able to document their experience but can solve their own problems without resorting to the advice of technical consultants. The indigenous technical farming documented on dairy farming could help the scientific community and farmers to use them to the best advantage of themselves.

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Research Article

Optimization of Nutritional Composition and Antioxidant Potential in Corn Silk using Different Drying Techniques

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ABSTRACT

Corn silk, generally discarded as agricultural waste derived from maize crop, is significantly dense in essential nutrients along with good antioxidant potential. Corn silk is also an excellent source of phenols and flavonoids. However, there are limited studies on suitable techniques for drying corn silk. The aim of the present study was to identify the effect of different drying techniques on nutritional composition and antioxidant potential of corn silk for the optimization of suitable drying technique. Fresh corn silk was dried by four different techniques viz. Shade drying, Sun drying, Tray drying and Microwave drying. Significantly higher content of protein, fat, fibre, calcium, magnesium, potassium, sodium, total phenols and flavonoids were observed in microwave dried corn silk. Antioxidant activity was also observed maximum in microwave dried corn silk (84.95%) followed by shade (83.69%), tray (82.81%) and sun (81.68%) dried corn silk. Thus, microwave drying is the optimum technique for drying of corn silk in comparison to shade, sun and tray drying.

Keyword: Corn silk, Nutritional composition, Antioxidant potential, Drying techniques, Microwave drying

INTRODUCTION

Corn silk (*Maydis stigma*), by-product of maize cultivation, is highly ignored as agro-waste. It serves as stigmas of female flower, whereby each strand of the silk is attached to the kernel (Dermastia *et al.,* 2009). Corn silk contains nutrients that are indispensable for human fitness like carbohydrates, protein, fibre, lipids, flavonoids, vitamins and minerals such as magnesium, calcium and potassium (Guo *et al.,* 2017). Despite of its good nutritional and antioxidant potential, it is underutilized but available in loads. Since ancient times, corn silk is utilized as a diuretic agent to relieve the passage of stones from urinary bladder and kidney (Makismovic *et al.,* 2003). It is also used in treating hypertension, hyperglycaemia and prostatitis in many regions of the world (Hu *et al.,* 2011). It also has anti-obesity and anti-oxidant effects (Lee *et al.,* 2016). Corn silk has also been determined to be non-toxic and safe for human consumption (Ha *et al.,* 2018).

Fresh corn silk contains high amount of moisture (Wan Rosli and Nurhanan, 2015a) which aids in quick deterioration and leads to reduced shelf life if it is stored fresh. It is very crucial to process fresh corn silk to dried corn silk in order to extend its shelf life. Dehydration is one of the best methods to store the food products for longer time period as dehydration lowers microbial activity by decreasing the moisture content.

Drying, as an essential processing operation for the safe storage of agricultural products and food, plays a critical role in improving global food security. By removing moisture to a safe level, drying aids in preventing microbial proliferation, ameliorate moisture-mediated deteriorative biochemical reactions, and

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reduce the costs of packaging, transportation, storage and processing, thereby reducing postharvest losses, extending shelf life, and increasing added value (Mujumdar, 2014).

Dried corn silk powder has been successfully incorporated into food products like chicken patties, beef patties, bread, biscuits to enhance the nutritional value and physiological properties (Wan Rosli *et al.,* 2011; Wan Rosli and Nurhanan, 2015b).

There are limited comparative studies on suitable techniques for drying corn silk. The effect of different drying techniques on nutritional as well as antioxidant potential of corn silk still remains relatively unexpected domain. The current study aims to evaluate the effect of different drying techniques on nutritional composition and antioxidant properties of corn silk.

MATERIALS AND METHODS

Sample collection: Corn silk of PMH-11 (single cross hybrid) corn variety was procured at the dough stage (25 days after anthesis) from the maize farm section, Department of Plant Breeding and Genetics, PAU, Ludhiana, Punjab (30º 54' N, 75º 48' E, 247 MASL). The corn was grown in a Completely Randomized Design (CRD) with three replications at the maize farm section in the rainy season during May to July, 2021.

Drying of corn silk: The harvested fresh corn silk (PMH 11) was processed by different drying methods (Shade drying, Sun drying, Tray drying and Microwave drying) to optimize the best drying technique for corn silk.

Shade drying: The fresh corn silk was chopped and spread into a thin layer over the butter paper in a tray. The tray containing sample was placed under the fan at room temperature for 5 days consecutively till constant weight.

Sun drying: The chopped fresh corn silk sample was spread over the butter paper into a thin layer and placed over a tray. The tray was kept under the sunlight and sample was dried for 9 hours till the constant weight achieved.

Tray drying: The chopped fresh corn silk sample was spread over the butter paper into a thin layer and placed over a tray. The tray was kept in an oven at 50°C for 8 hours and dried the sample to a constant weight.

Microwave drying: The chopped fresh corn silk (50g) was placed on a glass tray in microwave oven. The sample was dried to a constant weight in microwaves for 6 minutes at 900 watts.

All the dried sample were ground into a fine powder with the help of grinder and packed in airtight high-density polythene (HDPE) pouches and stored at a temperature of -20°C for further use.

Nutritional and antioxidant potential of corn silk

Proximate composition: Corn silk was analysed for proximate composition viz. moisture, crude protein, crude fat, total ash, crude fibre, total carbohydrate and energy using AOAC (2000) recommended methods in triplicates.

Mineral content: For minerals, the samples were wet digested in hot plate using nitric acid and perchloric acid mixture in 5:1 ratio (v/v) and used for the determination of total amount of calcium, magnesium and potassium by atomic absorption spectrophotometry (AOAC, 2002).

Antioxidant properties

Extraction: 1 g dried corn silk was extracted with 80 per cent methanol by shaking for three hours consecutively in an orbital shaker. The prepared methanolic extract was analysed for total phenols, flavonoids and antioxidant activity in triplicates.

Total phenolic content: Total phenolic content was estimated by Folin-Ciocalteau method (Limmatvapirat *et al.,* 2020). 0.5 ml of prepared methanolic extract was taken in a test tube. Then 3 ml Folin-Ciocalteu reagent was added and kept for 5 minutes followed by the addition of 2.5 ml of saturated sodium carbonate solution. The test tubes were shaken properly to mix the solution and incubated for 60 minutes in dark at 25°C. Along with sample, a standard was also run similarly to sample with the concentration ranging between 20–100 µg/ml. A blank was also prepared with using reagents and instead of 0.5 ml sample, methanol (80%) was used. After incubation of 60 mins, spectronic-20 spectro-photometer was used for measuring absorbance of the developed blue color which was read at 765 nm. Sample concentration was calculated with the help of standard curve. The total phenols in the sample were expressed as mg GAE (Gallic Acid Equivalent)/100g.

Flavonoid content: Flavonoid content was estimated by colorimetric method using quercetin as a standard (Pavun *et al.,* 2018). 2 ml methanolic extract of the sample was taken in the test tube followed by 0.1 ml of 10 per cent aluminium chloride and 0.1 ml of 1M potassium acetate. Then 2.8 ml distilled water was added, mixed well and kept for 30 minutes at room temperature. Similarly, standard was also run with the concentration ranging from between 20–100 µg/ml. A blank was also prepared by substituting sample with distilled water. Absorbance of the sample and standard was measured at 415 nm. Sample concentration was calculated from standard curve and expressed as mg QE (Quercetin Equivalent)/100 g.

Antioxidant activity (DPPH assay): Antioxidant activity was estimated by using DPPH (2,2-diphenyl-1-picrylhydrazyl) assay (Liang Yu, 2008). An aliquot 0.1 ml of methanolic extract was taken in test tubes and 2.9 ml of 0.1 mM DPPH solution was added. The mixture was vortexed for 1 minute and then incubated in dark for 30 minutes at room temperature. When DPPH reacts with an antioxidant compound, which can donate hydrogen, it is reduced. Discolouration (change in colour from deep violet to light yellow) of DPPH was measured against blank at 517 nm. Control was also prepared using the same procedure except sample extract, only methanol (80%) was used. The DPPH scavenging effect (Antioxidant activity) was measured using the following formula:

$$\text{Antioxidant activity \% (DPPH inhibition)} = \frac{\text{Aa} - A_b}{A_a} \times 100$$

Where, Aa = Absorbance of control; Ab = Absorbance of sample

Statistical analysis: The data was analyzed using SPSS software (version 23.0). Mean and standard error for all the parameters were calculated. One-way analysis of variance (ANOVA) was applied to observe the significant difference between the nutritional and antioxidant properties among all the four drying techniques used for drying corn silk. Tukey-Post HOC test was applied for determining the significant difference.

RESULTS AND DISCUSSION

Corn silk of PMH 11 maize variety was processed by different drying techniques (Shade drying, Sun drying, Tray drying and Microwave drying) to optimize the best drying technique for corn silk in context to proximate composition, mineral content and antioxidant properties.

Proximate composition of corn silk (PMH 11) dried with different methods is given in the Table 1. Number of folds increase in proximate composition of corn silk with different drying techniques is presented in Figure 1.

The results of the current study revealed that significantly higher moisture content was found in corn silk dried by shade drying i.e., 6.15 per cent whereas minimum moisture content was observed in microwave dried corn silk i.e., 4.21 per cent. Satwase *et al.* (2013) reported that moisture content of shade dried drumstick leaves was maximum i.e., 6.2 per cent amongst four drying methods namely sun drying, shadow drying, cabinet tray drying and oven drying.

The protein content of corn silk amid all four drying techniques varied from 18.96 to 20.78 per cent

Table 1: Effect of different drying techniques on proximate composition of corn silk

Drying method	Fresh (PMH 11)	Shade drying	Sun drying	Tray drying	Microwave drying
Moisture (%)	$83.48^{a}\pm0.29$	$06.15^{b}\pm0.07$	$04.78^{c}\pm0.03$	$04.82^{c}\pm0.07$	$04.21^{d}\pm0.08$
Protein (%)	$2.84^{d}\pm0.05$	$19.81^{b}\pm0.02$	$19.23^{c}\pm0.02$	$18.96^{c}\pm0.03$	$20.78^{a}\pm0.20$
Fat (%)	$0.21^{c}\pm0.02$	$01.38^{b}\pm0.02$	$01.72^{a}\pm0.02$	$01.28^{b}\pm0.04$	$01.74^{a}\pm0.01$
Crude fibre (%)	$1.58^{d}\pm0.05$	$08.87^{c}\pm0.01$	$08.82^{c}\pm0.02$	$09.37^{b}\pm0.01$	$09.88^{a}\pm0.03$
Ash (%)	$0.97^{d}\pm0.04$	$04.90^{c}\pm0.03$	$05.90^{b}\pm0.01$	$05.91^{b}\pm0.02$	$06.03^{a}\pm0.03$
CHO (%)	$10.94^{d}\pm0.33$	$58.88^{b}\pm0.02$	$59.54^{a}\pm0.07$	$59.65^{a}\pm0.05$	$57.35^{c}\pm0.20$
Energy (Kcal/100g)	$57^{d}\pm1.29$	$327.18^{bc}\pm0.31$	$330.60^{a}\pm0.09$	$325.97^{c}\pm0.37$	$328.21^{b}\pm0.29$

Values are expressed as Mean ± SE

Means with different notations (a, b and c) indicate significant differences at 1% level of significance ($p < 0.01$)

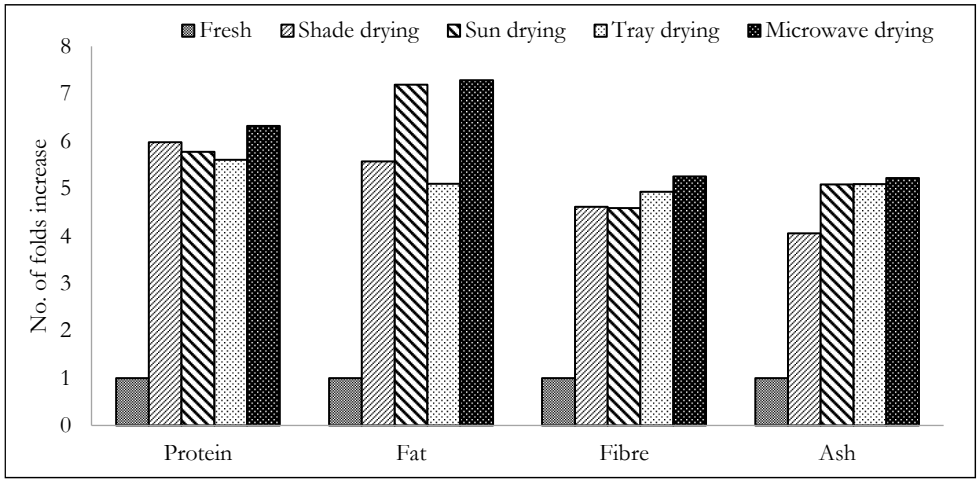


Figure 1: No. of folds increase in proximate composition of corn silk with different drying techniques

being maximum in microwave dried corn silk (20.78%). Fat content was also found to be maximum in microwave dried corn silk which was 1.74 per cent followed by sun dried corn silk (1.72%) but no significant difference was observed among both of these techniques. A study on drying of karonda fruit conducted by Chauhan *et al.* (2015) revealed that protein and fat content of microwave dried karonda fruit was maximum i.e., 2.51 and 1.51 per cent, respectively followed by sun dried (2.41% and 1.50%) and freeze dried (2.04% and 1.29%) which is comparable to the results of the current study.

Crude fibre content of corn silk dried by different drying techniques was in the range of 8.22 to 9.88 per cent being maximum in microwave dried corn silk and minimum in sun dried corn silk. In accordance to the present study, Bashir *et al.* (2020) also reported the similar findings in drying of oyster mushrooms which conveyed that microwave dried oyster mushrooms had maximum fibre content i.e., 25.38 per cent followed by oven dried oyster mushrooms i.e., 25.26 per cent.

Total ash content in corn silk dried by tray drying, sun drying, shade drying and microwave drying method was observed to be as 5.91, 5.90, 4.90 and 6.03 per cent respectively. Maximum ash content was found in microwave dried corn silk. The results of ash content were comparable to Shivanna and Subban (2014), who studied the effect of different drying methods on curry leaves which showed the ash content of oven, sun, shade and microwave dried curry leaves as 10.0, 9.8, 9.5 and 10.6, respectively.

The mineral content of corn silk (PMH 11) dried with different techniques is given in the Table 2. Minerals viz calcium, potassium and magnesium were significantly higher in microwave dried corn silk as compared to other techniques. Figure 2 depicts the number of folds increase in mineral content.

The calcium content in microwave dried corn silk i.e., 139.47 mg/100g, was found to be maximum followed by shade dried corn silk (124.45 mg/100g). Chauhan *et al.* (2015) stated that microwave dried karonda fruit had maximum calcium content i.e., 286.35 mg/100g than sun dried karonda fruit i.e., 275.67 mg/100g. Similarly, Sonkamble and Pandhure (2017) reported maximum retention of calcium was in shade dried spinach leaves i.e., 26.05 mg/100g than oven dried spinach leaves i.e., 17.31 mg/100g. The maximum magnesium content of microwave dried corn silk was

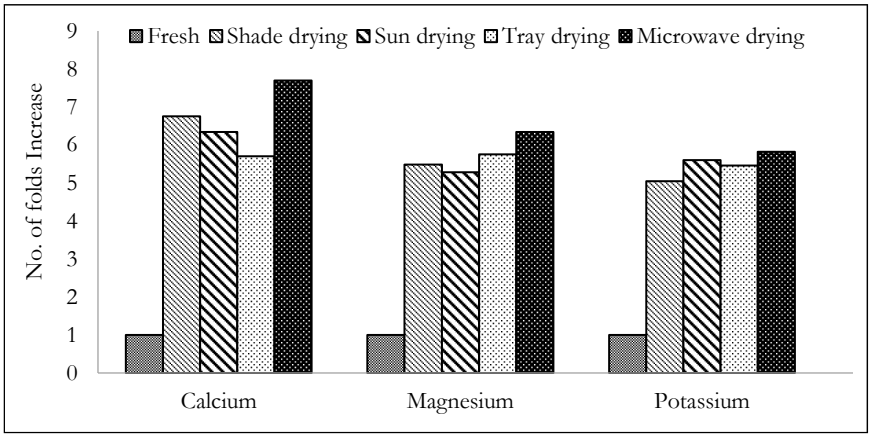
Table 2: Effect of different drying techniques on mineral content of corn silk (mg/100g)

Drying method	Fresh (PMH 11)	Shade drying	Sun drying	Tray drying	Microwave drying
Calcium	$16.05^{d}\pm0.63$	$124.45^{b}\pm2.67$	$117.74^{b}\pm0.38$	$107.54^{c}\pm2.55$	$139.47^{a}\pm1.67$
Magnesium	$22.34^{d}\pm0.64$	$144.81^{bc}\pm2.37$	$140.22^{c}\pm1.41$	$150.87^{b}\pm1.56$	$163.93^{a}\pm2.69$
Potassium	$206.32^{e}\pm1.62$	$1246.32^{d}\pm3.56$	$1362.2^{b}\pm6.25$	$1331.21^{c}\pm8.87$	$1406.13^{a}\pm3.96$

Values are expressed as Mean ± SE

Means with different notations (a, b, c…e) indicate significant differences at 1% level of significance ($p < 0.01$)

Figure 2: No. of folds increase in mineral content of corn silk with different drying techniques



found to be 163.93 mg/100g. A study by Shivanna and Subban (2014) exhibited that microwave dried curry leaves had more magnesium content than the sun and shade dried curry leaves.

The potassium content microwave dried corn silk (1406.13 mg/100g) was observed to be maximum. Findings of the study by Shivanna and Subban (2014) also revealed that potassium in microwave dried curry leaves (78.3 mg/100g) was more than shade (76.4 mg/100g) and sun dried (75.2 mg/100g) curry leaves. Liman *et al.* (2014) reported the maximum reduction of potassium content of spinach in oven drying (13.08 mg/100g) as compared to sun (18.41 mg/100g) and moisture analyser drying method (18.16 mg/100g).

The antioxidant properties of corn silk (PMH 11) dried with different techniques is given in the Table 3. Significant difference among all the drying methods in terms of total phenols, flavonoids and antioxidant activity in corn silk was detected. Number of folds increase in antioxidant properties of corn silk powder is presented in Figure 3. The results showed that maximum total phenols (1364.56 mg GAE/100g), flavonoids (370.77 mg QE/100g) and antioxidant activity (84.95%) were observed in microwave dried

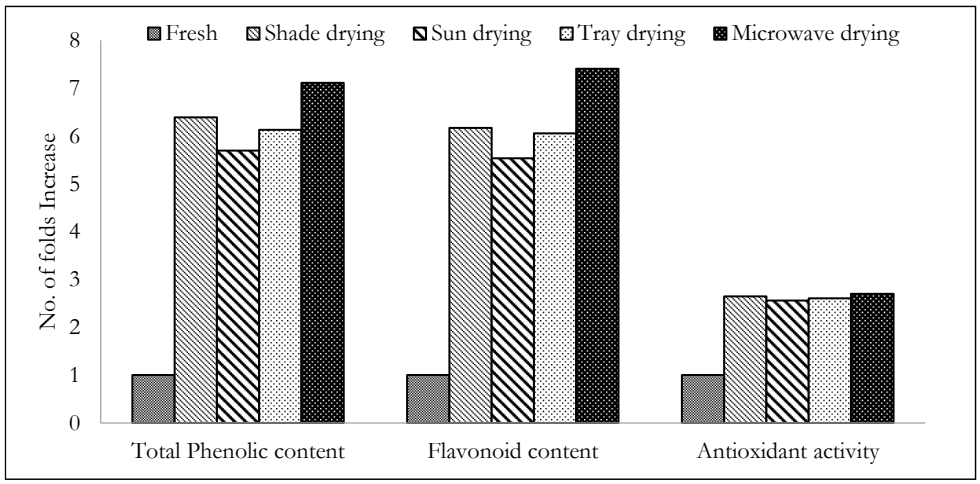
Table 3: Effect of different drying techniques on antioxidant properties of corn silk

Drying method	Fresh (PMH 11)	Shade drying	Sun drying	Tray drying	Microwave drying
Total phenols (mg GAE/100g)	$168.23^{e}\pm0.56$	$1243.34^{b}\pm3.58$	$1126.93^{d}\pm2.50$	$1199.7^{c}\pm0.78$	$1364.56^{a}\pm4.06$
Flavonoids (mg QE/100g)	$44.10^{d}\pm0.14$	$316.09^{b}\pm2.49$	$288.21^{c}\pm2.19$	$311.19^{b}\pm2.45$	$370.77^{a}\pm1.20$
Antioxidant activity (%)	$22.95^{e}\pm0.43$	$83.69^{b}\pm0.06$	$81.68^{d}\pm0.03$	$82.81^{c}\pm0.15$	$84.95^{a}\pm0.31$

Values are expressed as Mean ± SE

Means with different notations (a, b and c) indicate significant differences at 1% level of significance ($p < 0.01$)

Figure 3: No. of folds increase in antioxidant potential of corn silk with different drying techniques



corn silk followed by tray dried corn silk and shade dried corn silk.

In various studies, total phenolic content of microwave dried plants or any part of the plant was ranging from the decrease to the increase of TPC depending on plant material. Lim and Murtijaya (2007) reported that microwave drying instigated a greater reduction in the total phenols of *Phyllanthus amarus* than hot-air drying. So, the highest contents of polyphenols in microwave dried corn silk could be described by the fact that intense heat generation by the microwaves produces a high vapor pressure and temperature inside plant tissue, resulting in the disruption of plant cell wall polymers. Subsequently, in certain cases, cell wall phenolics or bond phenolics can be released, hence triggering more phenolics to be extracted (Inchuen and Pornchaloempong, 2010). On the other hand, Yilmaz *et al.* (2021) compared the natural drying, convective drying and microwave drying methods to figure out the effective method for drying of thyme plant which showed that highest content of total phenols and flavonoids was measured in microwave drying at 200W followed by microwave drying at 600W and convective drying at 50°C. In this study, the microwave drying at 600W was observed to be the most successful method in terms of the drying period and nutrient composition. Bhuwaneshwari and Sivakami (2017) reported that highest antioxidant activity of corn silk was found in microwave dried corn silk and corn silk dried under sun had less total antioxidant activity and also less in phenolic content due to its longer period of exposure (seven hours) under sun dry method.

CONCLUSION

From the results, it is be concluded that microwave drying (900W for 6 minutes) is one of the efficient techniques to dry the corn silk in order to retain the nutrients, total phenols, flavonoids and antioxidant activity as much as possible. Another important factor of microwave drying is its short drying period as compared to other traditional drying methods.

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Research Article

Sowing Diversity, Reaping Stability: Unveiling the Catalysts of Agricultural Diversification in Uttarakhand, India

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ABSTRACT

Despite being a land of vast biodiversity and favourable agro-climatic conditions, Uttarakhand faces challenges of food insecurity and malnutrition. With limited possibilities for horizontal land expansion, vertical diversification through a wider range of crops and activities is crucial. The present study analyzed data from a sample of farmers (n=90), revealing that slightly over half of the farmers practicing moderate level of diversification. Variables such as age, education, and family size had non-significant relationships with diversification. However, landholding size, annual income, economic motivation, information seeking behaviour, and media ownership positively impacted diversification, with economic motivation (r=0.537) and information seeking behaviour(r=0.298) showing significant correlations. Notably, education had a negative, albeit non-significant, relationship with diversification. These findings suggest that economic incentives, access to information, and proactive information seeking play key roles in driving diversification. This highlights the need for policies and interventions that enhance economic viability, improve information accessibility, and encourage information seeking among farmers to promote sustainable and diversified agricultural practices in Uttarakhand.

Keywords: Agricultural diversification, Uttarakhand, Farmer characteristics, Economic motivation, Information seeking, Food security

INTRODUCTION

The cultivation of land has been a fundamental occupation of humanity since time immemorial, meeting the essential needs of sustenance for all living beings. In the context of India, agriculture assumes a pivotal role, contributing 8 per cent to the global Agricultural Gross Domestic Product while sustaining 18 per cent of the world's population on a mere nine percent of the world's arable land and 23 per cent of its geographical area (ICAR Vision, 2030). However, this sector grapples with challenges, as approximately 80 per cent of India's landmass is highly susceptible to droughts, floods, and cyclones, leaving agriculture vulnerable to unpredictable natural calamities (Council on Energy, Environment and Water, 2021). Despite a decline in agriculture's contribution to India's GDP from 53.1 per cent in 1950-51 to 15.87 per cent in 2017-18, it remains vital, with 69 per cent of the population living in rural areas and 47 per cent engaged in agricultural activities (Census, 2011; Labour Bureau, 2015-16). With all the challenges, agriculture and its allied sectors play a vital role not only in supporting economic growth but also in steering the country towards development and directly participating in poverty eradication.

The past half-century, marked by the adoption of the Green Revolution, has seen India's food production surge by 3.7 times while the population multiplied by

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2.55 times. This resulted in a 45 per cent increase in per capita food production, rendering India self-sufficient at the aggregate level and transforming it into a net food-exporting nation. However, the success of the Green Revolution, with its focus on enhancing productivity, was accompanied by adverse effects such as the deterioration of agro-diversity. Traditional mixed cropping systems gave way to monocropping, hybrids overshadowed wild species, and the excessive use of chemicals and fertilizers led to poor soil health and land degradation. Crop diversification plays a crucial role in advancing agricultural growth and sustainability in India. It includes strategies to increase farmers' income, generate employment, eradicate poverty, make wise use of natural resources, and foster ecological management" (Rukshsana and Alam, 2022).

Recognizing the need for a paradigm shift, the Indian agricultural landscape has witnessed an evolution in extension services, moving from the top-down Transfer of Technology (TOT) model to more participatory and demand-driven approaches such as the Agriculture Technology Management Agency. However, despite these efforts, challenges persist therefore increasing and sustaining on-farm diversity is a potential way to improve farming system's sustainability & resilience (Tacconi *et al.,* 2023).

The focus on diversification gains prominence given the declining per capita land availability, rising demand for high-value commodities, and changing consumption patterns in India. Data indicates a stagnation or decline in per capita cereals intake, coupled with an increasing consumption of fruits, vegetables, milk, eggs, meat, and fish. The demand for high-value commodities is expected to surge by over 100 per cent from 2000 to 2030 (ICAR Vision, 2030) offering a substantial opportunity for agricultural diversification at the national level. Grasping the patterns of crop diversity in relation to evolving socioeconomic and climatic conditions is vital for the execution of sustainable farming methods (Jana and Chattopadhyay, 2023). This research, "Exploring the Drivers of Agricultural Diversification in Uttarakhand, India," aims to understand the relationship between farmers' characteristics and agricultural diversification extent in Uttarakhand, a region with diverse agro-climatic conditions and a population heavily reliant on agriculture.

MATERIALS AND METHODS

The research was undertaken in the Udham Singh Nagar district within the state of Uttarakhand. Udham Singh Nagar district consists of seven distinct blocks, and the Gadarpur block was purposively chosen as the focal point for this study. To ensure a representative sample, two villages, specifically Buksaura and Amarpur, were selected randomly using the chit method as part of a Simple Random Sampling without Replacement approach. Among these two villages, a total of 90 farmers were chosen using the Probability Proportional to Size sampling method. The selection of respondents was conducted through the systematic random sampling technique. It's important to note that individuals who derived their primary income from agriculture were the only ones considered as farmers for the purpose of this study. This resulted in the selection of 61 respondents from Buksaura village and 29 respondents from Amarpur village based on their respective populations.

The research was designed as a descriptive study, and data collection primarily relied on personal interviews conducted using a semi-structured interview schedule. This allowed the researchers to gather comprehensive information directly from the participants.

One of the key objectives of this study was to examine the relationship between predictor and outcome variables in ex-post facto setting. To accomplish this, the researchers employed the Pearson correlation coefficient, which is a statistical measure used to quantify the strength and direction of relationships between variables. Specifically, the correlation coefficient was utilized to assess how various profile characteristics of farmers related to the extent of agricultural diversification practiced by them. Additionally, a t-test was conducted to determine whether there was a statistically significant relationship between two variables. For calculating the extent of diversification, the Simpson Index of Diversification (SID) with the following formula was used.

$$SID = 1 - \Sigma P_i^2$$

Where, P_i= Proportion of income coming from source i.

All the calculations, including the determination of correlation coefficients and significance levels, were performed using SPSS (Statistical Package for Social Sciences) software. The values obtained from these analyses provided valuable insights into the relationships and significance levels within the collected data sets.

RESULTS AND DISCUSSION

Regarding the socio-personal traits of farmers, approximately half of the participants (47%) fell within the middle-aged bracket, spanning from 42 to 57 years, with the majority being males (87%). The study also revealed that slightly more than half of the respondents (52%) possessed moderate farming experience, ranging from 22 to 41 years. Roughly 60 per cent of the participants hailed from nuclear families, while the remaining 40 percent belonged to joint family setups. In terms of education, 31 per cent had completed high school, 21 per cent had intermediate qualifications, and 19 per cent had education up to the middle school level. Turning to their economic attributes, the research indicated that the majority of farmers (61%) owned marginal land holdings, with an average of 3.99 acres. Moreover, a significant portion (73%) reported an annual income below 2.67 lakhs.

The measurement of Agricultural Diversification's extent refers to the various agriculture and allied activities undertaken by farmers to generate income. A schedule was created listing the diverse agriculture and allied enterprises practiced by farmers, along with their associated income. The degree of diversification was assessed using the Simpson Index of Diversification (SID). Analyzing Table 1, it's evident that slightly over half of the farmers (52%), specifically 47 out of 90, demonstrated a moderate level of agricultural diversification. Around 39 per cent of the total respondents, or 35 farmers, displayed a high level of diversification, which is noteworthy. Interestingly, only 9 per cent of the total respondents, amounting to eight farmers, had a low degree of agricultural diversification. This highlights the farmers' inclination towards diversifying their agricultural activities, which should be harnessed to enhance their livelihood security and ensure a steady income, ultimately leading to an improved standard of living. In line with our findings (Neogi and Ghosh, 2022) reported that agricultural diversification has taken place in several states of India and due to significant heterogeneity in socioeconomic and agro-climatic conditions, the type of diversification varies among the regions.

Table 1: Distribution of respondents on the basis of extent of agriculture diversification (n=90)

Categories	Frequency	Percentage
Low diversified (<0.34)	8	9
Medium diversified (0.34-0.56)	47	52
High diversified (>0.56)	35	39
Total	90	100

The distribution of agricultural diversification among different farmer categories, as delineated by the Government of India's landholding classifications– Marginal (<1 ha), Small (1-2 ha), Semi-medium (2-4 ha), Medium (4-10 ha), and Large (>10 ha)–reveals notable patterns in strategic diversification approaches. Table 2 presents a comprehensive breakdown of the responses from a sample size of 90 farmers, categorized by their extent of diversification into low (<0.34), medium (0.34-0.56), and high (>0.56) diversification levels.

Analysis of the data indicates a predominant inclination towards medium diversification among the sampled population, with 37.7 per cent of marginal farmers and 4.44 per cent of small farmers classified within this category. This trend suggests that, despite limited landholdings, a significant proportion of

Table 2: Distribution of different categories of farmers on the basis of agriculture diversification (n=90)

Categories	Marginal		Small		Semi-medium		Medium		Large	
	F	%	F	%	F	%	F	%	F	%
Low diversified (<0.34)	5	5.5	3	3.33	0	0	0	0	0	0
Medium diversified (0.34-0.56)	34	37.7	4	4.44	9	10	0	0	0	0
High diversified (>0.56)	16	17.7	9	10	9	10	1	1.11	0	0

F = Frequency; % = Percentage

marginal and small farmers actively pursue diversification strategies to mitigate risks and potentially enhance sustainability. In contrast, high diversification is more evenly distributed among small and semi-medium farmers, each constituting 10 per cent of their respective categories, with a slight representation among medium farmers at 1.11 per cent. The absence of low diversification levels among semi-medium and medium farmers underscores a minimal engagement with minimal diversification strategies within these groups.

Notably, the dataset lacks representation from large farmers, indicating their absence from the sample or a potential disengagement from diversification practices. This gap highlights a critical area for further investigation, necessitating an exploration into the diversification behaviors of larger landholders and the factors influencing their strategic decisions.

In summary, the findings underscore medium diversification as a prevalent strategy among the surveyed farmers, particularly pronounced among marginal and small holders. This trend reflects the adaptive measures employed by farmers with constrained resources to navigate the complexities of agricultural sustainability. The uniform distribution of high diversification among small and semi-medium farmers further illuminates the varied approaches to risk management and resource optimization across different farmer categories.

In the current investigation, ten distinct variables, namely age, education level, total land ownership, farming experience, annual income, risk propensity, economic drive, achievement orientation, information-seeking behavior, and media ownership were examined, with the aim of understanding their relationship with the extent of agricultural diversification.

Table 2 displays our findings, revealing that total land ownership and annual income exhibit a statistically significant and positive correlation with the degree of agricultural diversification at a significance level of five percent. Additionally, economic motivation, information-seeking behavior, and media ownership exhibit a statistically significant and positive relationship with the extent of agricultural diversification at a higher significance level of one percent. In essence, this positive correlation implies that higher values in total land ownership, annual income, economic motivation, information-seeking behavior, and media ownership are associated with greater agricultural diversification.

On the other hand, age, farming experience, risk orientation, and achievement motivation also have positive relationships with agricultural diversification but do not reach statistical significance. Conversely, education displays a negative but non-significant relationship with agricultural diversification.

Based on these findings, we can infer that economic motivation, information-seeking behavior, and media ownership are the primary factors influencing the extent of agricultural diversification. Farmers who possess higher levels of economic motivation, engage more in information-seeking behavior, and have greater media ownership tend to diversify their agricultural activities to a greater extent. Furthermore, substantial total land ownership and higher annual income also lead to increased agricultural diversification.

This study's outcomes align with prior research by Bhardwaj (2019), who observed a positive and significant association between land ownership, information exposure, and enterprise diversification among farmers in pooled samples. Kumar (2015) similarly reported that family income, land ownership, and information-seeking behavior were positively and significantly linked to agricultural diversification. Geetha (2002) and Kumar (2015) found analogous results regarding economic motivation, emphasizing its positive and significant role in agricultural diversification.

Kawa *et al.* (2015); Tesfaye and Tirivayi (2020) reported a similar findings in terms of positive relationship between age, experience and on-farm diversity. It was explained that older & more experienced farmers often possesses more knowledge to manage farm diversity & awareness of its potential benefits. Eyssartier *et al.* (2011) reported that experienced farmers are more inclined towards preserving varieties with a traditional value and inevitably they have selected more species over the years than less experienced farmers (Kawa *et al.,* 2015; Ng' Endo *et al.,* 2015). When farmers age they tend to become more risk-averse and consequently diversification for them becomes a preferred option

to reduce farming risks (Abebe, 2013; Tesfaye and Tirivayi, 2020). However, the present study contradicted concerning age with the findings of Geetha (2002) and Kumar (2015) who reported a negative and non-significant relationship between age and agricultural diversification. Also studies by Huang *et al.* (2014); Ali (2015) and Fan *et al.* (2019) reported a negative correlation between farmers' age and farm diversification.

Herrera *et al.* (2018); Kankwamba *et al.* (2018); Mofya-Mukuka and Hichaaambwa (2018) reported the negative relationship between higher level of education and diversity which is consistent with the findings of present study. This pattern is due to higher incentive in specializing on selected commercial and lucrative crops by more educated farmers (Huang *et al.,* 2014; Hitayezu *et al.,* 2016; Kurdys'- Kujawska *et al.,* 2018). Further this study contradicted the findings of Kumar (2015); Pandey (2015); Fadina and Barjolle (2018); Fan *et al.* (2019); Jana and Chattopadhyay (2023) who reported a positive relationship between increasing education level of farmers and crop diversity. Longpichai (2013) found that when farmers are habituated to grow monocultures or a few products, their lack of education decreases their ability to inculcate additional activities on their farm.

In contrast to our findings, studies conducted by Skarbo (2014); Makate *et al.* (2016); Kankwamba *et al.* (2018) reported that on-farm diversity increase with farm size but up-to certain extent until other factors like labour cost (Kasem and Thapa, 2011), economies of scale (Bowman and Zilberman, 2013) and increased income (Pandey, 2015 and Hitayezu *et al.,* 2016) limit it and makes specialization a easy option.

In parallel to our findings, studies by Longpichai (2013); Mc Cord *et al.* (2015); Das and Kumar (2018); Gummagolmath *et al.* (2020) observed a positive association between income & on-farm diversification. This is clarified by the fact that more affluent farmers possess a greater capacity to manage the financial commitments and potential repercussions of setbacks resulting from the possible failure of new endeavors aimed at diversifying the farm.

The findings of the present study underscore the significance of information-seeking behavior as a key determinant of agricultural diversification. To capitalize on this, it is recommended that agricultural information be disseminated via mobile phones through text messages and calls, as these are widely owned by the majority of respondents. Additionally, regular visits by extension officers to educate and motivate farmers should be encouraged (Table 3).

Table 3: Association between extent of diversification and selected socio-economic & psychological variables (n=90)

Variables	Extent of agriculture diversification	
	R	T
Age	0.064	0.6
Education	-0.109	-1.04
Total Land holding	0.244*	2.36
Total Annual income	0.234*	2.32
Farming experience	0.093	0.87
Risk orientation	0.035	0.33
Economic motivation	0.537**	5.93
Achievement motivation	0.047	0.44
Information seeking behavior	0.298**	3.067
Media ownership	0.294**	3.01

(**Significant at 0.01% level of significance $T_{tab\ @\ 0.01}$ = 2.62)
(*Significant at 0.05% level of significance $T_{tab\ @\ 0.05}$ = 1.98)

CONCLUSION

Despite encountering numerous challenges, Indian agriculture, which transitioned from a history of subsistence farming to becoming a net exporter nation, has consistently served as a crucial driver for economic growth and poverty alleviation. Against the backdrop of a changing climate and evolving consumption patterns, the need for diversification emerges as a critical strategy to ensure sustainability and resilience in farming systems. To understand the drivers of agricultural diversification, this research delved the relationship between selected characteristics of farmers and extent of agricultural diversification practiced by them. It was noted that certain independent variables like total land ownership, annual income, economic motivation, information seeking behavior and media ownership emerged as statistically significant and positively correlated factors. This underscores the influence of economic considerations and suggesting for enough emphasis on these characteristics by relevant agencies for enhancing diversification among farmers.

While age, farming experience, risk orientation and achievement motivation exhibited positive relationships with agricultural diversification, they did not reach statistical significance suggests caution in overemphasizing their role. Additionally, the unexpected negative relationship with education prompts further exploration of factors influencing diversification decisions. However the specific correlations between these characteristics and the extent of agricultural diversification may vary based on regional and individual differences among farmers. By understanding these drivers, stakeholders can formulate context-specific interventions to enhance sustainable farming practices, improve livelihoods, and fortify the resilience of agriculture sector in this region.

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Research Article

Pedagogic Interventions of KVK to Employ Cognitive Domain as an Indicator of Probability to Adopt Poultry Farming

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ABSTRACT

This study was conducted at Krishi Vigyan Kendra (KVK) Ropar to assess and compile the effect of poultry farming vocational training course on knowledge index and adoption. The study included assessment of 83 trainees who acquired the training on poultry farming. A knowledge test was developed with the help from the pertinent literature, personal experience, discussions held with the experts and pilot study conducted in the area of investigation. Study was conducted in four phases. The first phase was pre-test (on day 1 of training); respondents were assessed about their demographic profile by interview method and evaluated for their knowledge level through test method. Knowledge test had multiple choice type questions prepared for the aspects of physiology, disease management, feeding management and housing management of poultry birds. Second phase was the intervention/training for 5 days and classes were organised during the training on the poultry farming. Third phase was post-test I (immediately after the intervention). Fourth phase was conducted in 2023 where data was collected on adoption of enterprise by trainees. Data analysis inferred that knowledge index of trainees improved from 17.39 before training to 79.17 after the training. Knowledge gain data (from pre-test to post-test) indicated that significantly highest gain in knowledge was there for feeding and management practices aspect (3.81/5) ($P<0.01$) and minimum was for physiology aspect (2.15/5). Education level had significant positive correlation with knowledge score in pre-test, however, this correlation was non-significant in post-test. Which interpreted that training camouflaged the effect of independent variables on knowledge level. Correlation between knowledge score and knowledge gain and adoption and reflects that knowledge gain had significant positive correlation with adoption ($P<0.05$). Regression and probability analysis indicated that post test scores had a linear positive effect on adoption tendency, while knowledge gain had a more subtle (logarithmic) but definite effect.

Keywords: Cognitive, Domain, Employ, Interventions, Pedagogic, Poultry farming, Probability

INTRODUCTION

Poultry farming is an ancestral practice of farmers in our country. Now a days, this industry is one of the important contributors to the economy of rural and semi-urban India. India commands 3rd and 5th position in egg and meat production with 129.60 billion eggs and 9.29 million tonnes meat in 2021-22 (pib.gov.in). Though Indian Poultry Industry is 5,000 years old yet its meat production is around 2% of the world meat production. It has been seen that since last 4 decades, poultry sector is emerging from backyard type to an industry. In 2012, total poultry population was 729.21 Million and it increased to 851.81 Million in 2019 and showed (+) 16.81 per cent change (Vipin and Soni, 2020).

In our country, poultry industry is well dominated in southern states like Tamil Nadu, Andhra Pradesh and Telangana with nearly 60-70 per cent total output coming from these states. However, per-capita availability of 6.82 kg meat and 95 eggs per annum is lesser than the recommendation of the Nutritional advisory committee, ICMR i.e. 10.8 kg poultry meat

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and 180 eggs per annum. Higher adoption of this enterprise may not only improve per capita availability but will also improve the nutritional security and aid to poverty alleviation (Kshandakar *et al.,* 2018).

Technology adoption is not a static decision, rather it involves a dynamic process in which information gathering, learning and experience play pivotal roles, particularly in the early stage of adoption. Therefore to minimize the gap between demand and supply and escalate the level of adoption, trainings on scientific poultry farming may prove helpful (Kshandakar *et al.,* 2018) by extending educational advantage, forming sound opinions to make good decisions and inducing changes in voluntary behaviour i.e. the knowledge attitude and skill (Sharma, 2013).

KVKs are the grass root level organization which are involved in imparting knowledge, motivating and directing youth towards adoption of poultry farming as an enterprise through its vocational trainings. But efficacy and viability of these trainings is dependent on improvement in knowledge and also on adoption of the enterprise after acquiring the training. This study is an effort to assess and compile the effect of training on acquiring knowledge and consequently on adoption.

MATERIALS AND METHODS

Situated in the foot hills of Shivalik range, Ropar (longitude/ latitude) is the northeastern district in the state of Punjab. Due to small size of land holdings, the district has immense scope for poultry farming. Poultry farming is one of the prominent arenas of KVK Ropar which caters the district youths' need for training on poultry farming with five days long vocational training courses.

From 2019-2023 KVK Ropar organised 04 vocational training courses on poultry farming wherein 83 farmers/ farm women/ rural youth participated. A knowledge test was developed with help from the pertinent literature, personal experience, discussions held with the experts and pilot study conducted in the area of investigation. The questionnaire had two parts: part one was information on demographic profile of respondents and another was the knowledge test about physiology, diseases, feeding and management of poultry birds.

Total 20 items were there in the knowledge test with each item having an objective answer. Study was conducted in four phases. The first phase was pre-test (on day 1 of training) respondents were assessed about their demographic profile by interview method, and evaluated for their knowledge level through test method. Second phase was the intervention/ training for 5 days on poultry farming. Third phase was post-test (immediately after the intervention) in which their knowledge level was tested with same questionnaire. Knowledge score was the dependent variable and age, education and land holding were the independent variables. Knowledge test was evaluated in a way that each right answer was scored as one and each wrong answer was scored 0. The sum of score was taken as knowledge score. Maximum score possible was 20 and minimum was 0. Fourth phase was conducted in March 2023 where data was collected on adoption of enterprise by trainees. The knowledge index was calculated as follows:

$$KI = \frac{\text{Score obtained}}{\text{Total obtainable score}} \times 100$$

Statistical analysis: The data was analysed through suitable stastistical tools like frequency, percentage, pearson corelation, regression, point biserial corelation, ANOVA, Tukey's Post HOC HSD and t-test.

RESULTS AND DISCUSSION

Table 1 depicts the demographic profile of respondents. Total 83 respondents (trainees of poultry farming at KVK Ropar) were purposively selected for the study out of which 36.14 per cent respondents belonged to category of 20-30 years of age group and least number (25.30%) belonged to the category of >40 years age group. About 74% respondents were of less than 40 years age. Ingle and Kubde (1995) also observed that relatively higher proportion (69%) of KVK trainees were young in age i.e. upto 35 years age.

Out of total, 28.92 per cent respondents had matric as their educational qualification. Maximum percentage (51.81%) had higher secondary as their educational profile. Among the rest, 16.87 per cent respondents were graduates and 2.41 per cent were postgraduates. Average level of education was 11.95 i.e. higher secondary. A study on participants of training in

Table 1: Demographic profile of respondents

Parameter	Participants	Percentage
Age		
20-30	30	36.14
31-40	32	38.55
>40	21	25.30
Education		
Matric	24	28.92
Senior Secondary	43	51.81
Graduate	14	16.87
Post graduate	2	2.41
Land		
Marginal (1-2.5 acre)	58	69.88
Small (2.6-5 acre)	23	27.71
Semi medium (6-10 acre)	2	2.41

GADVASU, Ludhiana by Hundal *et al.* (2016) also revealed that majority of respondents i.e. 17.6, 31.2 and 42.4 per cent respondents were educated upto middle, matric and senior secondary level, respectively whereas merely 8.8 per cent trainees were graduates.

Education and age profile indicates that after acquiring the educational qualification of higher secondary or even after matric, young farmers tend to acquire technical knowledge in the enterprise of poultry farming in order to adopt it as a profession thrivingly. Out of total farmers, 69.88 per cent respondents had a land holding of 1-2.5 acres and merely 2.41 per cent had holding of 6-10 acres i.e. about 98 per cent respondents had the holding of less than 6 acres. Average land holding was 2.97 acres. Comprehensively the sample population was constituted by young respondents with higher secondary education, small land holding.

Table 2 depicts the comparison of score in pre-test and post-test. In pre-test, mean knowledge score for aspect of breeds and breeding was 1.14 and soared to 4.47 in post-test, which was significantly higher (T-test) than pre-test (P<0.01). On the similar note, knowledge score for aspects of physiology, feeding and management practices and disease management also improved significantly (1.21 vs. 3.36, 0.67 vs. 4.48 and 0.37 vs. 3.45, respectively). Improvement of score at the end of training reflected not only the efficacy of teaching methodology and aids but also the high assimilation capacity of trainees. The result was in accordance with Ferreira *et al.* (2016) and Aparna *et al.* (2019).

Comparison among scores of different aspects (Table 3) (one way ANOVA, Tukey's Post Hoc HSD**)** inferred that during pre-test, score was highest for physiology (1.21) and lowest for disease management (0.37); while in post-test, score for both these aspects became statistically similar (3.36 & 3.45, respectively). In pre-test, mean score for feeding and management was 0.67/5 and was statistically at par with disease management (0.37/5). In post-test, score for feeding and management soared from third position to highest 4.48/5 and was statistically at par with score for breeds and breeding i.e.4.47/5, but, this score was significantly higher than other two aspects i.e. disease management 3.45/5 and physiology 3.36/5.

To summarise, in post-test, knowledge score was highest for aspects of feeding and management and lowest for physiology. Knowledge gain data (from pre-test to post-test) indicated that significantly highest gain in knowledge was there for feeding and management practices aspect (3.81/5) (P<0.01) and minimum was for physiology aspect (2.15/5). Thus it can be concluded that participants had highest

Table 2: Comparison of aspect wise mean knowledge score of trainees of Pre-test and Post-test (t-test)

Name of the aspect	Mean knowledge test score (out of 5)		t	P-value
	Pre-test	Post-test		
Breeds and breeding	1.14[a]	4.47[b]	19.79	0.000
Physiology	1.21[a]	3.36[b]	18.75	0.000
Feeding and management practices	0.67[a]	4.48[b]	17.63	0.000
Disease management	0.37[a]	3.45[b]	16.21	0.000

**P<0.001

Table 3: Aspect wise comparison of knowledge score of trainees during Pre-test and Post test

Test	Aspect/ Mean Knowledge test score (out of 5)				F value	P value
	Breeds and breeding	Physiology	Feeding and management	Disease management		
Pre test	1.14[b]	1.21[b]	0.67[a]	0.37[a]	11.48	0.000
Post test	4.47[b]	3.36[a]	4.48[b]	3.45[a]	40.60	0.000
Post-test, pre-test/knowledge gain	3.33[b]	2.15[a]	3.81[c]	3.08[bc]	21.02	0.000

Table 4: Knowledge Index of farmers in Pre test, and Post-test-I

Test	Knowledge index	Minimum score	Maximum score
Pre test	17.34[a]	0	11
Post-test-I	79.17[b]	7	20
PSE	-7.9135	-	-
P Value	<0.00001	-	-

predisposition for learning about feeding and management aspects followed by breeds and breeding, disease management and physiology. This finding could further enhance the efficacy of the pedagogic intervention because in survey on assessment of needs conducted by Senthilkumar and Thanaseelaan (2013), it was revealed that "nutritional aspect" was the most needed area for training in livestock production and Chellapandian *et al.* (2016) reported improved production after cognitive gains in feeding practices.

Analysis of knowledge index data depicted that in pre-test, knowledge index of trainees was 17.34 and in post-test it was 79.17 which was significantly higher than ($P<0.01$). Minimum score in pre-test was 0 and maximum was 11. While in post-test minimum score was 7 and maximum was 20 which was the maximum possible score too.

Correlation data in Table 5 depicts that age and land holding did not have significant correlation with knowledge score in pre and post-test. The findings were in accordance with Bhuyian *et al.* (2013). Education level had positive and significant correlation with knowledge score in pre-test (0.017), however, in post-test the correlation turned out to be negative and nonsignificant for knowledge score (-0.051, $P<0.05$) and knowledge gain (-0.177, $P<0.05$) which indicated higher knowledge gain by less educated participants and efficacy of teaching methodologies. Age and land holding were negatively and non-significantly corelated to level of knowledge in pre-test (-0.674 and -0.034) but it turned positive (0.15, 0.16, and 0.06, 0.07) for knowledge level and its gain. This infers that training at KVK camouflaged the effect of independent variables and cognition of similar level was recorded irrespective of the level of education, age or landholding. Similar findings were reported by Aparna *et al.* (2021) in which they conducted an awareness assay on trainees of Dairy farming at Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana and reported that in pre-test the independent variables affected awareness but in post-test I & II awareness and its retention was statistically similar for all trainees of all education level. This also indicated the high assimilation capacity and positive attitude of participants.

Adoption is a decision to continue full use of innovation and the adoption process is the mental process through which an individual passes from first hearing about innovation to its final adoption. Assessment of outcome of pedagogic intervention of KVK reported that out of 83 trainees 16 trainees had adopted commercial poultry farming as an enterprise (19.27%) and were successfully running it (13.25% adopted it at backyard level). Table 6 indicated the point biserial correlation between knowledge score & knowledge gain and adoption and reflects that during pre test knowledge score had a positive but non-significant relationship with adoption ($P>0.05$) but it turned highly significant at the time of post-test at 1% level of significance ($P<0.01$). Corelation of adoption with gain in knowledge was significantly positive at

Table 5: Correlation of independent variables with knowledge level and gain in knowledge

Variable	Pre test	Post-test	Pre- Post-test
Age	-0.674^{NS}	0.1589^{NS}	0.16^{NS}
Education	0.017^{S*}	-0.051^{NS}	-0.177^{NS}
Land holding	-0.036^{NS}	0.066^{NS}	0.074^{NS}

P< 0.05

Table 6: Point biserial Correlation between knowledge, knowledge gain and adoption

	Pre test	Post-test	Pre- Post-test
R	0.18925	0.6103	0.24366
P	0.08662^{NS}	0 .00001** S	0.02644* S

* The result is significant at P < .05
**The result is significant at P < .01

5% level (P<0.05) which indicated that participants with higher gain of knowledge adopted the enterprise. It can be justified on the basis that knowledge is the cognitive behaviour of an individual and adoption is an information-driven process, where transitions from one stage to the next in the process depend on the gain of knowledge and the speed to process it (Montes de Oca *et al.,* 2021). Once the knowledge is acquired, it produces changes in thinking process of an individual, which would lead to further changes in rational decision that is prerequisite for the adoption of any innovation. These findings were also supported by findings of Sharma (2013) who reported that most of the respondents i.e. 63.00 percent had moderately high gain in knowledge regarding a technology while 55.00 percent developed more favourable attitude towards the technology under study, respectively. This indicated that the pedagogic intervention by KVK effectively catered to the needs of the adoption process i.e. improved knowledge, skill and attitude.

Regression and probability analysis-based prediction model

- The knowledge score (post-test) was used as independent variable to assess the probability of adoption of enterprise. Data (Figure 1) depicted that "As the post-test knowledge score increased, the probability of adoption also increased linearly". For example, probability of adoption increases from 60 to 83% as score goes from 16 to 18.
- While assessing the data in view of knowledge gain vs probability of adoption the changes are subtle in increase i.e. the adoption is increasing logarithmically w.r.t knowledge gain (not linearly) (Figure 2).
- Regression analysis indicated that trainees having post-test knowledge score of above 17 can be assumed to prefer adoption while those having score below this did not opt for the same (Figure 3). Also the regression line (P=0.03* Score -0.15) provided an estimate of the probability of adoption at a given test score.

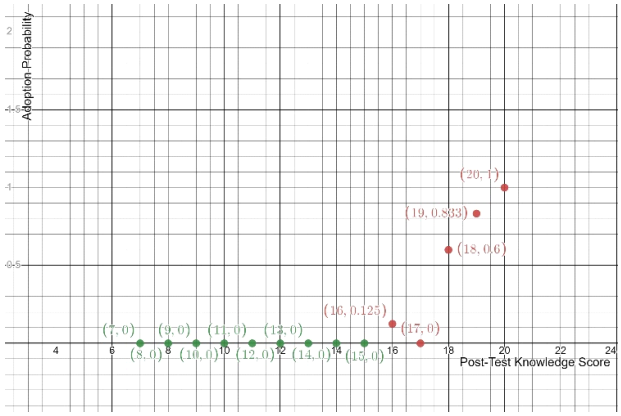

Figure 1: Probability of adoption w.r.t post-test knowledge score

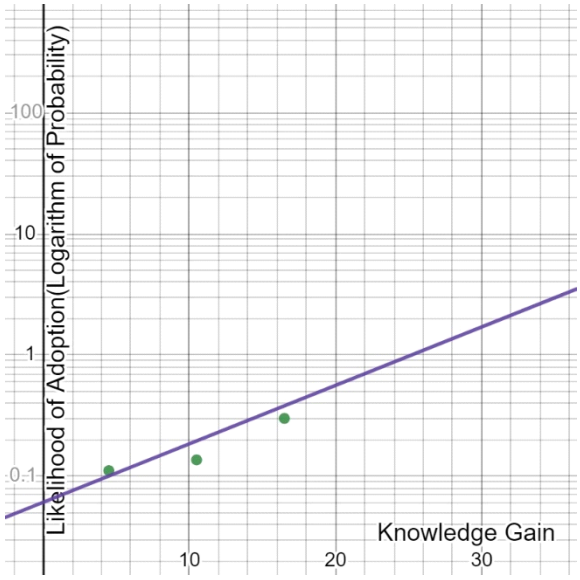

Figure 2: Probability of adoption w.r.t post-test knowledge gain

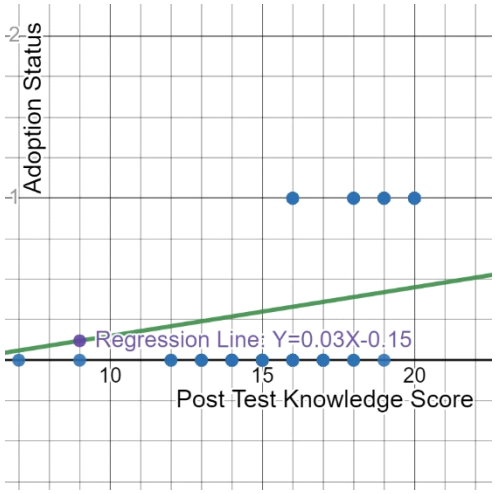

Figure 3: Regression equation and Prediction model based on post-test knowledge score

CONCLUSION

It can be concluded that pedagogic intervention by KVK improved the knowledge index of trainees improved from 17.39 before training to 79.17 after the training with highest gain in knowledge on aspect of feeding and management followed by breeds and breeding, disease management and last being the physiology. Interestingly training camouflaged the effect of independent variables on knowledge gain. It is imperative to mention that higher knowledge level and gain in knowledge significantly influenced the participants to adopt the practice of poultry farming as an enterprise:

Post-test scores had a linear positive effect on adoption tendency, while knowledge gain had a more subtle (logarithmic) but definite effect.

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Research Article

Development of Nutri blended Novel Herbal Fruit Tea from Underutilised Fruit

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ABSTRACT

Roselle-pineapple tea was formulated by using various locally available fruits and analyzed for proximate, phenolic, flavonoid content and antioxidant activities. The sensory quality for consumer acceptance of the fruit tea was analysed by hedonic scale. Roselle pineapple tea infusions contained high amount of total phenolic content of 664.9±0.31 mg GAE/100 g while flavonoid content of roselle-pineapple tea was recorded as 232.2±0.12 mg QE/100 g. Higher antioxidant activity was shown by roselle-pineapple (460.0±0.2 mg Ascorbic acid Equivalent/100 g sample) as compared to other fruit tea (129.7±0.07mg Ascorbic acid Equivalent/100 g sample). The fruit tea infusions also contained high vitamin C content. However, the present fruit tea infusions have shown high sensory quality and infusion time is also directly correlated with sensory quality of roselle pineapple tea.

Keywords: Roselle, Pineapple, Phenolic content, Flavonoid content, Antioxidant activity

INTRODUCTION

Among the beverage, tea is one of the most consumed beverages all over the world (Zieniewska *et al.,* 2020). There are different types of teas however all the types of tea are made from the leaves of the *Camellia sinensis*. The differences in the processing of the tea leaves are the primary reason for producing various types of tea with different test and appearance even though they all are made from the leaves of same plant. They are rich in natural polyphenols and other bioactive compounds which are known to have health beneficial effect. However, tea contains caffeine (3.5%) which regular and high consumption is known to have sides effects in human health. In recent years, caffeine containing foods and beverages received increasing attention due to its pharmacological properties. Caffeine stimulates the central nervous system, peripheral vasoconstriction, relaxation of the smooth muscle and myocardial stimulation (Komes *et al.,* 2009). So people are looking for other beverages which is rich in natural antioxidants but free of caffeine. One such alternative is the herbal tea; generally herbal beverages/tea are prepared from natural ingredients of different morphological plant parts such as leaves, stems, roots, fruits, buds and flowers (Chandrasekara and Shahidi, 2018). Herbal teas/beverages are rich in natural bioactive compounds such as polyphenols, flavonoids, anthocyanins, carotenoids, coumarins, alkaloids, polyacetylenes, saponins, terpenoids etc. The formulation of herbal tea may be of single or mixture of compositions of several plants.

Herbal teas are rich in natural antioxidants it can be considered as an important part of a healthy diet. Antioxidants are compounds which can scavenge the free radicals which are very reactive and harmful to human health. Free radicals or reactive oxygen species

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(ROS) are generated as a part of our body metabolism. Our body also have the endogenous mechanism to deal it with but excess generation of ROS causes oxidative stress which related to etiology many degenerative diseases. So, removal of such excess free radicals is very important for healthy living. Consumption of natural antioxidant rich herbal tea preparations will help in scavenging harmful free radicals from our body. Besides antioxidant activity herbal teas are reported to have several bioactivities such as antidiabetic, anticholesterol, antihypertensive, antibacterial activity etc. Herbal teas especially the fruit tea infusions are successfully replacing sweetened drinks and juices because of its taste, aroma, flavour and attractive appearance. Hence, there is increasing market demand of new products having nutritive and appealing appearance. Considering this, the present study was undertaken with specific objective on formulation of mixed fruit tea with locally available fruits and also analyse the nutritive and antioxidant activities.

MATERIALS AND METHODS

The chemical used for analysis of nutritional content were procured from Sigma Aldrich (Merck, India), Hi-media and SRL. The tea bags used for study were of food grade quality.

The matured and healthy pineapple, roselle and ginger were procured from Imphal market, Manipur. The fruits were washed thoroughly with tap water 2 to 3 times. The peels of the fruits were removed and the fruit pulp was sliced with stainless steel knife then kept separately. Dehydration of the fruit was done by using electric dehydrator at 58°C with different time. Pineapple slices were dehydrated for 17-18 hrs, roselle fruits were dehydrated for 12-13 hrs and ginger slices were dehydrated for 10 hrs respectively till it retain 3-5% moisture level. The dehydrated fruits pulps and ginger were separately transfer to food grade polythene pouch after sealing with electric sealer then stored at room temperature till used.

For preparation of blended herbal tea, the different components were separately ground for 20-30 seconds using a kitchen blender. Fine powders were removed using a sieve (2 mm pore size) and the coarse sizes were selected for the purpose. Herbal tea was formulated by mixing different ingredients (Table 1).

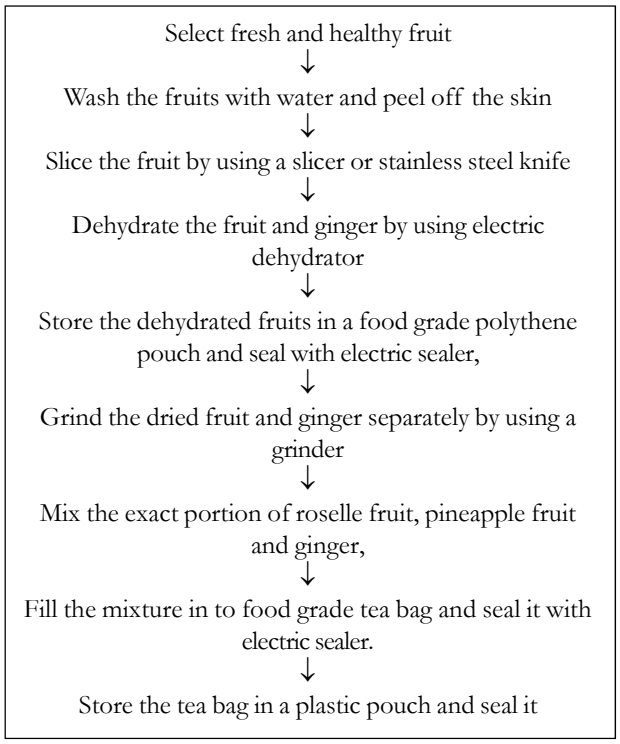

Figure 1: Flow chart for the preparation of blended roselle-pineapple fruit tea

Table 1: Recipe of herbal tea per sachet

Ingredients	Quantity/ 100g	Quantity/tea sachet (g)
Roselle	55.55	1.5
Pineapple	37.03	1.0
Ginger	29.63	0.2

For packaging, 2.5 g of mixture was transferred to each food grade tea bag or sachet and packed it with electric sealer. The individual tea bag was transferred in a plastic pouch and seals it again with the electric sealer. The detail step for the formulation of fruit tea is presented as a flowchart (Figure 1).

Ash (Method No. 930.05), crude protein (Method no. 955.04) and fat (Method No. 2003.05) contents were determined according to AOAC methods (2005). Reducing and non-reducing sugar was estimated according Nelson-Somogyi method (Sadasivam and Manickam, 1992). Total carbohydrate was determined by anthrone method (Sadasivam and Manickam, 1992). Vitamin C present in the sample was determined by spectrophotometric method (Sadasivam and Manickam, 1992).

Three gram of fruit tea samples was soaked into 100 ml (80°C) and kept for 10 min. The mixture was sieved and the tea infusion was used for further analysis of total phenol, flavonoid and antioxidant activity.

The content of polyphenols in every sample was assayed according to the Folin–Ciocalteu method (Singleton and Rossi 1965). The value was expressed as GAE/100 g DW (Gallic acid equivalent per 100-gram dry weight). Flavonoid content was determined according to Barros *et al.* (2007) and value was expressed as QE/100 g DW (Quercetin equivalent per 100-gram dry weight).

Antioxidant activity was determined by DPPH method (Thaipong *et al.* 2006). The antioxidant activity was expressed as mg ascorbic acid equivalent/g of dry weight sample (AAE/g DW).

Sensory evaluation of fruit tea was conducted to assess the consumer preference and acceptability. The sensory qualities were estimated by the 40 semi-trained panelists. Panelists were familiar with fruit product sensory evaluation; most of them having knowledge on fruit tea preparation. Analysis was done using Nine Point Hedonic Scale viz; 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like or dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much, 1=Dislike extremely (Peryam and Pilgrim, 1957; Larmond,1977).

The statistical analysis was performed in triplicate and data are presented as means ± standard deviations (SD). Descriptive analyses, one-way ANOVA ($p = 0.05$), and Duncan's multiple range test (DMRT) at 5% level of significance was used for separation of mean.

RESULTS AND DISCUSSION

Proximate analysis of the fruit tea was presented in Table 2. Roselle pineapple tea had high protein content. While roselle-pineapple fruit tea content low total sugar and total carbohydrate as compared with other fruit tea available in the market. Zieniewska *et al.* (2020) have analyzed seventeen fruit teas available in market where they observed that the protein content ranges from 0.7-1.2 g/100 g, fat content ranges from 0.1-0.7 g/100 g and carbohydrate content from 10.3-18.9 g/100 g. The protein and carbohydrate content of the present study was higher than these seventeen reported commercially available fruit teas. The main components of the present fruit tea viz. roselle and pineapple fruit were not present in the composition of fruit teas used in their studies. The fruit tea infusion was found to contain a good amount of vitamin C. The vitamin C content in roselle-pineapple tea was recorded as 83.86±3 mg/100 g. This value is comparable with fruits which contains high amount of vitamin c such as orange and lemons.

Polyphenols and flavonoids are the two important phytochemicals present in plants. These phytochemicals are responsible for many bioactivities exerted by the plant extracts. Roselle-pineapple tea had higher TPC and flavonoid content than other fruit tea. The TPC value of roselle-pineapple was found to be 664.9±0.3 mg GAE/100g DW. Zieniewska *et al.* (2020) have studied the nutritional and antioxidant property of seven different fruit teas available in market, where they found TPC values ranged from 0. 699± 0.19mg to 51.31± 0.9µg GAE/100g DW. While the flavonoid content of roselle-pineapple fruit tea was found to be 111.0 ±0.14 mg QE/100g DW. This showed that roselle-pineapple tea had much higher flavonoid content than the other fruit tea infusions.

The antioxidant activity analysis revealed that that roselle-pineapple tea (460±0.2 mg AAE/100g) exhibited higher antioxidant activity than the other fruit tea (129±0.07 mg AAE/100g) in DPPH assay. The

Table 2: Proximate composition and in-vitro bioactivity of Fruit tea infusion

Sample	Parameters (g/100g sample)						Vitamin C mg/100g	Antioxidant activity (mg AAE/ 100g	Phenolic content (mg GAE/ 100g)	Flavonoid content (mg QE/ 100g)
	Ash (%)	Protein	Fat	Carbohy-drates	Reducing sugar	Total sugar				
Roselle-Pineapple tea	5.9	5.08	0.16	23.70	0.27	4.68	83.86	460.0±0.2	664.9±0.31	232.20±0.12

Table 3: Mean score for performance of colour, flavour, texture, taste and overall acceptability of roselle-pineapple fruit tea with different times of infusion

Sample Code	Colour	Flavour	Taste	Appearance	Overall Acceptability
S_1	4.82^{e}	4.32^{e}	5.13^{d}	4.61^{d}	5.57^{c}
S_2	5.26^{c}	5.67^{bc}	5.25^{c}	5.17^{c}	5.78^{c}
S_3	6.84^{bc}	6.25^{bc}	6.27^{bc}	6.62^{b}	7.58^{ab}
S_4	7.75^{b}	7.34^{b}	7.58^{b}	7.43^{ab}	7.85^{ab}
S_5	8.20^{a}	8.00^{a}	8.15^{a}	8.24^{a}	8.28^{a}

Means followed by a different letter are significantly different at $p \leq 0.05$ by Duncan's multiple range test (Values are means of three replicates)

higher antioxidant activity of roselle-pineapple tea may be contributed to higher phenolic and flavonoid content. It is well established that phenolic/flavonoid content is positively correlated to antioxidant activity. The fruits used in this study are well-known for exhibiting health beneficial properties. For instance, roselle and pineapple fruits not only having the nutrition properties but also reported for medicinal properties including antioxidant, antimicrobial, antidiabetic and anticancer (Joshi and Pravakar 2020). Pineapple has been reported for anti-inflammatory, antioxidant activity, healing of bowel movement and monitoring nervous system function (Alis *et al.,* 2020). While the roselle calyces have been used in traditional medicine to mitigate many diseases such as hypertension, diabetes and liver disorders (Nguyen and Chuyen, 2020). Hence, consumption of these fruit tea infusions may give various health beneficial effects.

Sensory evaluation is one of the important factor to analyse the acceptability of the food products because it helps in designing and marketing of products to meet consumers' sensory needs, which in turn reduce the risk of product failure (Sidel and Stone 1993). In order to assess the effect of infusion time on sensory parameters, the fruit tea samples (3 g) were infused with 100ml freshly boiled water in a glass cup for 2-minute interval (2,4,6,8 and 10 minutes). One sample was provided at a time and panelists were asked to give scores for the sensory characteristic such as colour, flavour, taste, appearance and overall acceptability of the blended fruit tea. Before starting another sample, water was given to neutralize the taste and other samples were provided to give their preference and overall acceptability. Sensory tests were replicated thrice and water was present for taste cleansing amongst the sample. The mean sensory scores of roselle-pineapple fruit tea were presented in Table 3. It was observed that roselle pineapple tea infusions S_5 scored the highest while S_1 scored the lowest for all the sensory attributes. This showed that the sensory qualities of tea were improved with the increase in time of infusion. The interactions between the sensory parameters were evaluated by correlation, cluster and regression analysis. In order to assess the effect of infusion time on sensory parameters, the fruit tea samples (3 g) were infused with 100ml freshly boiled water in a glass cup for 2-minute interval (2,4,6,8 and 10 minutes). One sample was provided at a time and panelists were asked to give scores for the sensory characteristic such as colour, flavour, taste, appearance and overall acceptability of the blended fruit tea. Before starting another sample, water was given to neutralize the taste and other samples were provided to give their preference and overall acceptability. Sensory tests were replicated thrice and water was present for taste cleansing amongst the sample.

CONCLUSION

The result of the present study revealed that the locally prepared fruit tea infusions have shown promising antioxidant activities and vitamin C content. The antioxidant activity of the fruit tea is because of the presence of high phenolic and flavonoid content. From the sensory evaluation study it was observed that increased in infusion time giving more attractive colour, pleasant flavor and overall acceptability. These fruit tea infusions will be a good alternative for other sweetened drinks. Hence, these fruit tea infusions will not only serve as the beverages but also act as dietary supplements of natural antioxidant and vitamin C.

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Research Article

Contemporizing Garo Artisan Traditions with *Dakmanda* Design Interventions

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ABSTRACT

Contemporising art and tradition infuse new life into conventional elements and keeps ancient designs and techniques alive. Meghalaya is a treasure trove of varied culture and tradition which is clearly reflected in the people's attires. Garo women wear a wrap known as *Dakmanda*, traditional handloom fabric. Traditional diverse collection of *Dakmanda* Garo handloom textile has to curated to represent the potential that exists in the craft space. Now this is the time to introduce youth to the fresh, modern world of India's craft inheritance. Traditional fabrics and handloom designs can be used to turn these into a contemporary outfit catering to today's modern generation. In order to preserve *Dakmanda* handloom craft, Garo craftsmen have to contemporize their traditional art for youth. There is immense possibility to create a synergy between industrial designers and artisan groups to stimulate the development and preservation of a local craft in a sustainable and commercially viable way. *Dakmanda* weaving is a traditional handloom textile practiced by generations of Garo artisans. In present study an effort was done to reinvent *Dakmanda* designs and simulation of these design interventions on cotemporary dresses which appeal to youth of Meghalaya. This study can cultivate the local craft industry and empower artisans to further their own innovations. Design intervention is a process that involves designing new products; redesigning existing products, with changes in shape, size, colour, surface manipulation, function and utility; exploring new markets and reviving lapsed markets; and introduction of new materials, new processes, new tools and technologies. It is seen as an interface between traditional and modernity, that matches craft production to the needs of modern living. Despite the potentially strong relationship between craft and sustainability, there is still only limited research exploring this relationship and how craft can more effectively contribute to contemporary industry. Findings of present study provide an analysis of the current Garo handloom textile crafts in the Meghalaya and identify the challenges and potential for design interventions in this region.

Keywords: Dakmanda, Garo handloom, Traditional craft, Design intervention, Contemporary designing

INTRODUCTION

The Garo tribe, indigenous to the northeastern region of India, boasts a rich cultural heritage manifested in their traditional attire, particularly the Dakmanda, a handloom fabric worn by Garo women. This paper explores the potential of contemporizing Garo artisan traditions through innovative design interventions applied to Dakmanda textiles. By infusing modern elements into traditional craftsmanship, we aim to revitalize and preserve this cultural heritage while catering to the evolving tastes of contemporary consumers, especially the youth.

The preservation of indigenous textile traditions is crucial not only for cultural continuity but also for economic sustainability and empowerment of artisan communities. The Garo tribe, known for its intricate weaving techniques and vibrant motifs, presents a prime example of such traditions. However, in today's rapidly changing world, there is a pressing need to adapt these traditions to suit modern preferences and market

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Figure 1: Traditional Garo Wrap: Dakmanda

demands. This paper proposes a creative approach to contemporizing Garo artisan traditions through design interventions applied to Dakmanda textiles (Figure 1).

Dakmanda Garo handloom wrap of Meghalaya hold a significant cultural and historical importance within the Garo tribe, one of the indigenous communities residing in the Northeastern region of India. These handwoven fabrics, known for their intricate designs and vibrant colors, are an integral part of Garo traditional attire, especially for women. The Dakmanda textiles are typically made from locally sourced natural fibers such as cotton, silk, or a blend of both. The weaving process is carried out on traditional handlooms, a practice that has been passed down through generations of Garo artisans. Each Dakmanda fabric is meticulously crafted, with intricate floral motifs and patterns woven into the fabric using traditional techniques.

The designs found in Dakmanda textiles often reflect the cultural heritage and beliefs of the Garo community. Common motifs include geometric shapes, floral patterns, and symbolic representations of animals and nature. These motifs not only add aesthetic appeal to the fabric but also carry deep cultural significance, conveying stories, traditions, and spiritual beliefs of the Garo people. Dakmanda textiles are primarily used in the creation of traditional Garo attire, particularly for women. The fabric is fashioned into wrap-around skirts, known as Dakmanda, which are worn on special occasions such as festivals, weddings, and religious ceremonies. The vibrant colors and intricate designs of Dakmanda garments serve as a visual expression of Garo identity and pride (Figure 2).

Figure 2: Floral motif on Dakmanda

In recent years, there has been a growing interest in Dakmanda textiles beyond the Garo community, with designers and fashion enthusiasts appreciating the craftsmanship and cultural richness of these handloom fabrics. This has led to initiatives aimed at promoting and preserving Garo textile traditions, as well as exploring opportunities for contemporary interpretations of Dakmanda designs. Despite the challenges posed by modernization and changing lifestyles, Dakmanda Garo handloom textiles continue to thrive as a symbol of cultural heritage and craftsmanship in Meghalaya. Through efforts to sustain traditional weaving practices, empower local artisans, and promote cultural exchange, Dakmanda textiles remain a cherished aspect of Garo identity and a source of inspiration for generations to come.

MATERIALS AND METHODS

The research methodology adopted for this study was a multidisciplinary approach, integrating elements of ethnographic research, design thinking, and collaborative workshops with Garo artisans. Initially, conducted field studies aimed at comprehending the historical importance and cultural context surrounding Dakmanda textiles. These studies provided essential insights into the origins and significance of Garo artisan

traditions within their cultural milieu. Subsequently, we engaged in co-design sessions with local artisans, serving as a platform for dialogue between tradition and innovation. These sessions were instrumental in fostering mutual understanding and appreciation between designers and artisans, as well as in exploring innovative ways to contemporize Garo heritage. Through a process of iterative prototyping and experimentation, efforts made to refine our design concepts to ensure they authentically reflected Garo heritage while resonating with contemporary aesthetics. This approach allowed us to evolve our designs organically, incorporating feedback from both artisans and stakeholders along the way.

RESULTS

The results highlighted the transformative potential of design interventions in revitalizing Garo artisan traditions. By incorporating modern elements such as geometric patterns, minimalist motifs, and eco-friendly dyes, we have successfully contemporized Dakmanda textiles while preserving their cultural authenticity. The collaborative process has also empowered local artisans, enabling them to adapt their skills to new market opportunities and strengthen their socio-economic resilience. Through comprehensive field studies and engagement with local historians, cultural experts, and community members researchers gained insights into the evolution of Garo artisan traditions and their relevance in contemporary society. Through participant observation and in-depth interviews, we found intricate techniques, motifs, and symbolism embedded in traditional Garo textiles, laying the groundwork for our design exploration.

Our approach aligns with the views of scholars who emphasized the importance of blending tradition and innovation in sustainable craft practices. For instance, Smith *et al.* (2018) argued that embracing contemporary design interventions can enhance the market competitiveness of traditional artisans while preserving cultural heritage. Similarly, Zeng and Lu (2020) highlighted the role of design innovation in revitalizing traditional crafts, citing examples where the infusion of modern elements has led to increased market demand & economic opportunities for artisans.

Through co-design sessions with Garo artisans, we recognized them as invaluable custodians of their cultural heritage. These collaborative workshops served as a platform for fostering a dialogue between tradition and innovation, where traditional knowledge intersected with contemporary design principles. During these sessions, artisans shared their expertise, stories, and aspirations, while designers contributed insights into market trends, materials, and design techniques. Collectively, we explored possibilities for reinterpreting traditional Garo motifs and techniques within a contemporary design framework.

The collaborative process employed in present study has proven instrumental in empowering Garo artisans to adapt their skills to new market demands. By engaging in co-design sessions and iterative prototyping, artisans have gained exposure to modern design principles and techniques, enabling them to create products that appeal to contemporary consumers. This finding is consistent with the research of Huybrechts *et al.* (2019), who emphasized the importance of collaboration between designers and artisans in fostering innovation and skill development within traditional craft communities.

Furthermore, the prototyping and experimentation phase involved translating conceptual ideas into tangible prototypes, allowing us to test and refine our design concepts in real-world contexts. Through hands-on experimentation with materials, colors, and forms, we strive to strike a delicate balance between honoring Garo heritage and infusing fresh perspectives. This iterative approach enabled us to evolve our designs iteratively, incorporating feedback from both artisans and end-users. Further developed contemporary design that resonate with both Garo heritage and contemporary aesthetics, drawing inspiration from the rich tapestry of Garo culture and our collaborative exchanges with artisans (Figure 3a and Figure 3b). These concepts are informed by a deep appreciation for Garo craftsmanship, expressed through innovative forms, textures, and narratives. We explored various themes inspired by Garo mythology, nature, and daily life, weaving them into our design narratives. By infusing each design with layers of cultural significance, our study aims to create products that not only captivate the senses but also foster a sense of pride and connection to Garo heritage. Throughout the design process, we engaged in a continuous validation and feedback loop, soliciting input from Garo artisans, community members, and external stakeholders. This inclusive approach ensures that our designs remain rooted in

Figure 3a: Dakmanda Floral Motifs

Figure 3b: Dakmanda Floral Motifs

cultural authenticity while also resonating with contemporary sensibilities. By actively seeking feedback and incorporating diverse perspectives, researchers strive to create designs that are not only visually compelling but also functionally and culturally relevant. This iterative dialogue fosters a sense of ownership and collaboration, strengthening the bond between designers, artisans, and the Garo community.

Furthermore, the revitalization of Dakmanda textiles holds significant implications for the cultural identity and socio-economic well-being of Garo communities. As noted by Brown and Kornberger (2017), cultural heritage plays a vital role in shaping community identity and fostering social cohesion. By preserving and promoting Garo artisan traditions through contemporary design interventions, we contribute to the preservation of cultural heritage and the enhancement of community pride and resilience.

The findings of study underscore the importance of integrating tradition and innovation in sustainable craft practices. By embracing design interventions, Garo artisans can expand their market reach, attract younger consumers, and create value-added products with a global appeal. Moreover, the revitalization of Dakmanda textiles can contribute to the cultural identity and socio-economic development of Garo communities, fostering pride and prosperity for future generations.

CONCLUSION

In conclusion, the contemporization of Garo artisan traditions through Dakmanda design interventions represents a promising and essential pathway for preserving cultural heritage in a rapidly changing world. By harnessing the power of creativity and collaboration, we not only ensure the longevity and relevance of indigenous textile traditions but also embrace the dynamism of modernity. Present study has demonstrated the transformative potential of design interventions in revitalizing Garo artisan traditions. Through the incorporation of modern elements such as geometric patterns, minimalist motifs, and eco-friendly dyes, we have successfully contemporized Dakmanda textiles while preserving their cultural authenticity. This fusion of tradition and innovation not only breathes new life into age-old practices but also empowers local artisans, enabling them to adapt their skills to new market opportunities and strengthen their socio-economic resilience. As these vibrant textiles find their way into modern markets, they serve as tangible symbols of Garo heritage, instilling a sense of pride and connection among community members. Additionally, the economic benefits derived from the production and sale of Dakmanda textiles contribute to local prosperity, paving the way for sustainable development and intergenerational prosperity.

In essence, the contemporization of Garo artisan traditions through Dakmanda design interventions represents a harmonious blend of tradition and innovation. By embracing this approach, we not only honor the rich cultural heritage of the Garo people but also ensure its preservation and relevance for future generations. As we continue on this journey of creative exploration and collaboration, we remain committed to fostering pride, prosperity, and resilience within Garo communities and beyond.

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Research Article

Utilisation and Farmer's Perception of Krishi Mela Towards Agricultural Development

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ABSTRACT

Krishi Mela serves as a platform for knowledge dissemination, technology transfer, and market access in the agricultural sector. This study aims to understand farmers' perceptions of Krishi Mela and explore how they utilize this event to enhance their farming practices and economic outcomes. The research employs a mixed-methods approach, combining quantitative surveys and qualitative interviews with 200 farmers who have attended Krishi Mela. The findings reveal that farmers positively perceive Krishi Mela as an essential gathering of agricultural information and networking opportunities. They view the fair as an effective means to access the latest farming techniques, innovations, and government schemes. Farmers utilize Krishi Mela in various ways to improve their farming practices and economic prospects. This enables them to acquire improved seeds, fertilizers, machinery, and financial services. This research sheds light on the significance of Krishi Mela as a valuable resource for farmers. It emphasizes the positive perception of the fair among farmers and how they utilize it to enhance their agricultural practices and productivity. The findings provide valuable insights for policymakers, agricultural extension agencies, and event organizers to maximize the impact of Krishi Mela on farmers' livelihoods and the agricultural sector as a whole.

Keywords: Krishi mela, Perception, Utilize, Techniques and improved seeds

INTRODUCTION

The advancement of agricultural practices and the adoption of modern technologies are essential for improving productivity, ensuring food security, and increasing farmer incomes. In this context, Krishi Melas, or agricultural fairs, have emerged as significant platforms for knowledge dissemination, technology transfer, and interaction among farmers, researchers, and agricultural experts. Krishi Melas serve as focal points for bringing together stakeholders in the agricultural sector, including farmers, policymakers, agribusinesses, and extension agencies. These events provide a unique opportunity to showcase innovative agricultural practices, demonstrate cutting-edge technologies, and promote sustainable farming techniques. By disseminating information, offering training programs, and facilitating direct interactions, Krishi Melas aim to enhance the knowledge and skills of farmers, ultimately leading to improved agricultural productivity and income generation. The impact, utilization and perception of Krishi Melas on farmers have gained attention in recent years, as policymakers and agricultural organizations recognize the potential of these events to revolutionize traditional farming practices and bridge the knowledge gap between farmers and researchers. Understanding the influence of Krishi Melas on farmers' adoption of new technologies, their attitudes towards modern farming practices, and the overall socioeconomic impact on their livelihoods is crucial for evaluating the effectiveness

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of such initiatives and informing future strategies. This research paper aims to explore the utilization and perception of Krishi Melas on farmers, with a focus on their potential to enhance agricultural practices, promote technological advancements, improve farmer incomes, and foster positive attitudes towards modern farming techniques. The findings of this research paper will contribute to the existing literature on agricultural extension and knowledge dissemination programs, particularly in the context of Krishi Melas. By identifying the strengths and limitations of these events, policymakers, agricultural experts, and organizers can develop more targeted and farmer-centric programs that address the evolving needs of the farming community. Furthermore, the study will shed light on the role of Krishi Melas in empowering farmers, promoting sustainable practices, and ensuring the long-term growth and prosperity of the agricultural sector.

MATERIALS AND METHODS

The study employed a quantitative research design with elements of qualitative analysis to examine the utilization and perception of Krishi Mela by farmers in the Kharif season. The target population was farmers attending the CCSHAU, Hisar Krishi Mela during the Kharif season. A random sampling technique was used to select a representative sample of 200 farmers from the attendees. A structured survey questionnaire was developed to gather quantitative data on various aspects related to the perception of Krishi Mela. The interviews allowed for a deeper exploration of farmers' experiences, perceptions, and specific examples of the impact of Krishi Mela on their farming practices and livelihoods.

RESULTS AND DISCUSSION

The data in Figure 1 revealed that the majority of the farmers who participated in Krishi mela were middle-aged (46.50%) followed by young age participants.

Education is very important tool for the growth of farming community. Figure 2 revealed that majority of the respondents had education up to high school level (28.50%) followed by intermediate level by 24.00 percentage of the total respondents.

The data in Figure 3 reported that majority of the respondents (63.50%) belongs to farming activities and 36.50 percentages respondents were belongs to farming and allied activities.

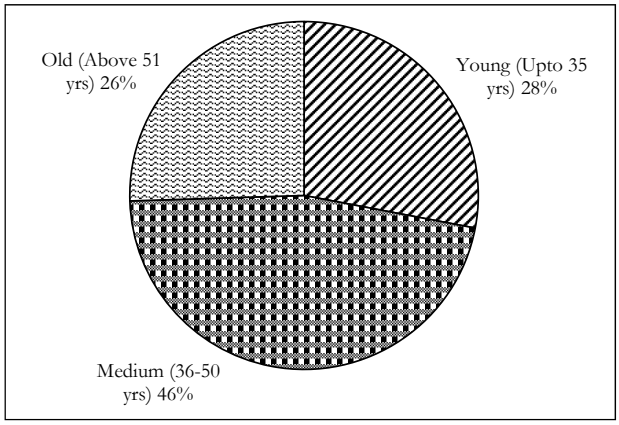

Figure 1: Distribution of respondents according to their age group

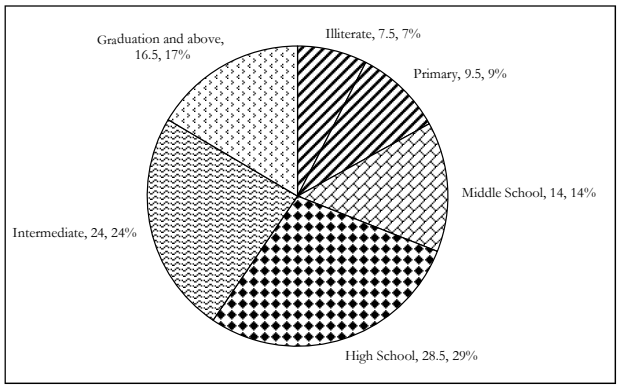

Figure 2: Distribution of the respondents according to their education

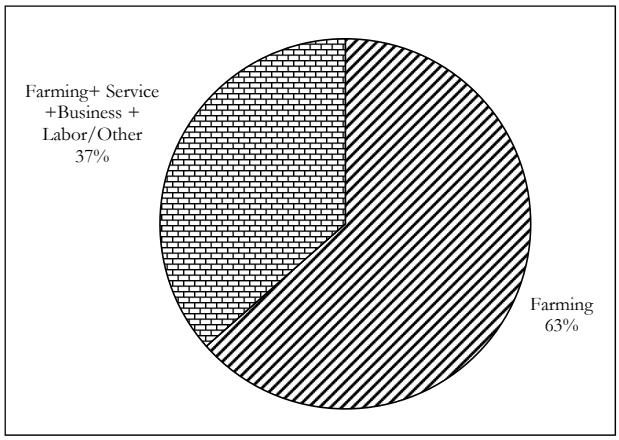

Figure 3: Distribution of respondents according to their occupation

Figure 4 further indicated that 38.50 per cent of respondents were small landholders followed by medium landholding (24.00%).

Table 1 revealed that 42.00 per cent and 44.50 per cent of farmers were regular and occasionally participated in Krishi mela, whereas, 13.50 per cent of

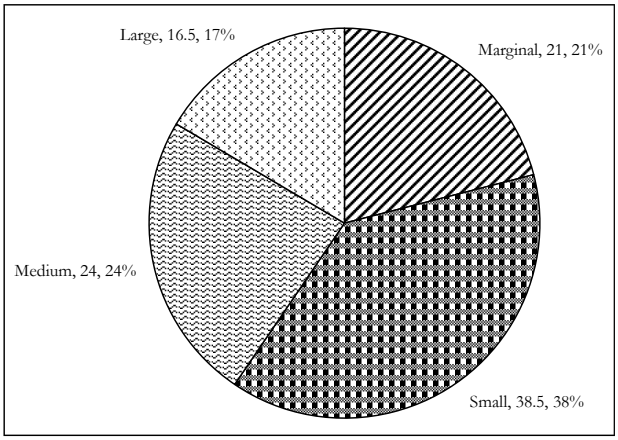

Figure 4: Distribution of respondents according to their landholding

farmers had never participated in Krishi mela. The 35.50 and 48.00 per cent of farmers were regular and occasionally participated in group meetings/group discussions, whereas, 16.50 per cent of farmers had never participated in group meetings/group discussions. The 34.50 per cent and 42.00 per cent of farmers were regular and occasionally participated in result/method demonstration, whereas, 23.50 per cent of farmers had never participated in result/method demonstration activity. Only 26.50 per cent of farmers regularly participated in the training programme, 21.00 per cent of farmers were part of the campaign regularly, whereas, only 10.00 per cent of farmers were regularly involved in farm and home visits.

The extent of utilization of the information and knowledge provided at Krishi mela as perceived by farmers was classified as "more useful, useful and less useful" (Table 2). The data reported that more than fifty per cent of the farmers (55.00%) perceived that purchasing the quality seeds of different crops was more useful at Krishi Mela. The maximum number of farmers found better crop management (43.50%) and plant protection measures (40.50%) information more useful at Krishi Mela. The majority of farmers

Table 1: Distribution of beneficiary farmers according to their extension participation

Extension Activity	Regular		Occasional		Never	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Farm and home visit	20	10.00	107	53.50	73	36.50
Result/ Method Demonstration	69	34.50	84	42.00	47	23.50
Group Meeting/Group Discussion	71	35.50	96	48.00	33	16.50
Krishi Mela	84	42.00	89	44.50	27	13.50
Training programme	53	26.50	81	40.50	66	33.00
Campaign	42	21.00	87	43.50	71	35.50

Table 2: Utilisation of Krishi Mela as perceived by the participating farmers

Statements	More Useful		Useful		Less Useful	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Learning better crop management	87	43.50	73	36.50	40	20.00
Adopting a better cropping pattern	56	28.00	119	59.50	25	12.50
Plant protection measures	81	40.50	79	39.50	40	20.00
Adopting and handling new technologies	66	33.00	77	38.50	57	28.50
Exposure to new varieties and various modern technologies	69	34.50	88	44.00	43	21.50
Purchasing quality seeds	110	55.00	50	25.00	40	20.00
Book seeds online	66	33.00	83	41.50	51	25.50
Getting awards	40	20.00	52	26.00	108	54.00
Increases the overall knowledge	78	39.00	91	45.50	31	15.50
Help in joining the advanced farming community	69	34.50	93	46.50	38	19.00

Table 3: Perception of farmers regarding the visit of Krishi Mela

Statements	Yes		No	
	Frequency	Percentage	Frequency	Percentage
It provides possible solutions for the problems faced by the farmers	143	71.50	57	28.50
Krishi mela is the best means to collect the latest information regarding crops	151	75.50	49	24.50
It provides solutions to problems that arise due to climate change	121	60.50	79	39.50
Access to updated information (price, inputs availability)	163	81.50	37	18.50
Information about high-quality varieties.	149	74.50	51	25.50
Information regarding best irrigation method according to crop	109	54.50	91	45.50
Information regarding different machines for sowing, weeding etc.	134	67.00	66	33.00
Information on different schemes and subsidies provided by Govt.	90	45.00	110	55.00
Increased connectivity with stakeholders (consumers, traders etc.)	105	52.50	95	47.50
The mela has exposed us to different technologies	136	68.00	64	32.00
Allowed us to share our experiences	89	44.50	111	55.50

were found to have information and knowledge regarding adopting better cropping patterns (59.50%), handling new technologies (38.50%), exposure to new varieties and technologies (44.00%), increasing the overall knowledge (45.50%) and 46.50 per cent of farmers were found useful to help in joining the advanced farming community. The farmers (54.00%) were found getting awards at Krishi Mela less useful. This might be due to the reason that the majority of the farmers have good extension activity participation. It will make them eager to get new information and knowledge about advanced technologies and purchase good quality seeds of improved varieties. It is also due to the majority of the farmers being young and medium age groups. This information directly helps the farmers to grow and increase productivity. These findings were in line with the results of Rao *et al.* (1976); Gangadharappa and Jayaramaiah (1985) and Manjula *et al.* (2002).

The farmer's perceptions about different aspects of Krishi Mela like problem solutions, quality seeds, information about climate change, sale of inputs and publication and connecting with stakeholders were elicited and the final results are presented in Table 3. The data presented in Table 3 expressed the perception of farmers about the Krishi Mela visit. The data revealed that more than seventy per cent of the farmers perceived positive perception regarding provided solutions for their problems (71.50%), collecting the latest information (75.50%), access to updated information (81.50%) and high-quality varieties (74.50%). More than fifty per cent of the farmers perceived favourable perception regarding solutions to the climate change problem (60.50%), information regarding best irrigation practices (54.50%), about different types of machines (67.00%) with stakeholders and latest technologies (52.50%), (68.00%) respectively. Less than fifty per cent of the farmers felt that Krishi Mela provided information about subsidies and provided plate forms to express their experience-the findings of the study conformity with Tanusha and Chander, 2019.

CONCLUSION

The research paper demonstrates that Krishi Mela plays a vital role in the agricultural ecosystem by fostering knowledge exchange, technology adoption, and market linkages for farmers. It highlights the positive perception of Krishi Mela among farmers and illustrates how they utilize this platform to enhance their farming practices and economic outcomes. The paper emphasizes the need for continued support, improved accessibility, and effective communication to maximise the potential impact of Krishi Mela on farmers' livelihoods and the agricultural sector as a whole.

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Research Article

Development and Standardization of Millet based Flour

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ABSTRACT

The study was carried out to develop and standardize millet based flour in the Department of Food and Nutrition, College of Community Science, Swami Keshwanand Rajasthan Agricultural University, Bikaner. Flour was prepared by mixing sorghum, buckwheat and cornflour at various proportion. All three samples (T_1, T_2 & T_3) of developed flour were tested for physical properties such as bulk density (0.61 g/ml, 0.53 g/ml & 0.58g/ml), hydration capacity (3.32g/100, 1.91g/100 & 3.27 g/100) and hydration index (0.63, 0.04 & 0.16). Flour developed using sorghum, buckwheat and cornflour (T_1) in the ratio of 50:25:25 was found best as compared to T_2 (25:50:25) and T_3 (40:40:20).

Keywords: Millets, Sorghum, Buckwheat, Physical analysis of developed flour

INTRODUCTION

The twenty-first century is growing difficult due to challenges including climate change, water shortages, rising food costs, expanding global population and other socioeconomic issues. Food security and agriculture are now under danger globally, especially for the world's poorest residents in arid and semi-arid areas. Therefore, a substitute nutritious food supply is required in order to successfully provide food and nutrition security (Kulakarni *et al.,* 2018). The emphasis may now be placed on small-grain cereals, notably millets. Millets are more reliable since they can still provide a crop under adverse growing circumstances. The name millet is derived from the french word "mille" which signifies that a handful of millet contains thousands of seed grains (Taylor and Emmambux, 2008).

India is considered as the largest producer of many kinds of millets that are denoted as coarse cereals or minor cereals and form the principal food for a huge section of the population in Africa and India (Seth and Rajamanickam, 2012). Sorghum [*Sorghum bicolor* (L.) Moench] also known as jowar, is the "king of millets" and the world's fifth most important crop after wheat, rice, maize and barley (Anglani, 1998; Awika and Rooney, 2004). It is planted mostly in dry and semi-arid places because of sorghum's ability to go dormant under harsh conditions and resume growth after a reasonably severe drought. Sorghum, a gluten-free grain, offers higher fiber and micronutrient content compared to other grains. It's particularly favored by individuals with diabetes in India because it's digested slowly, helping to manage blood sugar levels (Klopfenstein and Hoseney, 1995). Studies show that consuming whole grains like sorghum can significantly reduce the risk of cardiovascular disease-related mortality (Kushi *et al.,* 1999). Sorghum is also rich in triglyceride lipids containing beneficial unsaturated fatty acids, such as oleic and linoleic acids (Salunkhe *et al.,* 1977).

Among the numerous grains, buckwheat a pseudo-cereal that grows in basic circumstances has the potential to be an immediate and future nutritional supply for the "Starving World" (Leder, 2009). Buckwheat, a member of the Polygonaceae family is consumed

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worldwide and is also known as *kathu, fafra, ogle* and *bharesh*. "Buckwheat is technically a fruit seed however it is categorised as a cereal grain since its utilisation is comparable to that of other cereal grains" according to Kim *et al.* (2004). Buckwheat, primarily consumed in seed form, offers a nutrient-dense and gluten-free option packed with essential bioactive components like flavonoids, polyphenols, and proteins, garnering significant attention from researchers for its healing and functional food properties (Ge and Wang, 2020). Whole buckwheat groats contain starch, protein, lipids, dietary fiber, and various valuable compounds including antioxidative substances and trace elements. Buckwheat flour boasts a protein content surpassing that of rice, wheat, millet, sorghum, and maize, while also containing rare elements such as potassium, magnesium, iron, and zinc (Krkosková and Mrazova, 2005).

MATERIALS AND METHODS

The materials and methods employed in this study involved the procurement and processing of grains, specifically buckwheat and sorghum, along with cornflour sourced from the local market of Bikaner city. To ensure consistency, all materials were procured in bulk as a single lot, mitigating variations and compositional differences. The grains underwent a meticulous cleaning and washing regimen, involving multiple washes with tap water, followed by rinsing to remove dust, dirt, and other impurities. Subsequently, the cleaned grains were dried on polythene sheets in the shade, covered with muslin cloth to shield them from foreign particles, and left at room temperature for 2-3 days until they became brittle. Once dried, the grains were processed into flour separately using a grinder, and the resulting powder was strained to achieve uniformity. The development and standardization of millet-based flour involved the combination of sorghum, buckwheat, and cornflour in various proportions. This comprehensive methodological approach ensures the quality and consistency of the developed flour, laying the foundation for subsequent investigations into its nutritional and health-related benefits. Table 1 provides insight into the ratios used in each sample, ranging from 20 to 50 per cent levels of flour. Sample T_1 comprised 50 per cent sorghum, 25 per cent buckwheat and 25 per cent cornflour, while T_2 and T_3 had different combinations. This approach aimed to leverage the unique nutritional profiles of each grain, potentially enhancing the overall nutrient content of the flour. Following physical analysis, the most suitable flour sample was selected for further study.

Table 1: Combination of millet based flour

Sample	Flour Percentage		
	Sorghum	Buckwheat	Cornflour
T_1	50	25	25
T_2	25	50	25
T_3	40	40	20

The physical analysis of the developed flour involved testing three samples, T_1, T_2 and T_3, for bulk density, hydration capacity and hydration index. Bulk density, a measure of mass per unit volume, was determined using the method recommended by Okaka and Potter (1977), where a 100 ml graduated cylinder containing 50 g of flour was tapped gently to fill it, enabling the calculation of bulk density. Hydration capacity, indicating the ability of the flour to absorb water, was assessed according to the techniques outlined by Bishnoi and Khetarpal (1993). This involved soaking 50 g of flour in 100 ml of water overnight, measuring the change in weight before and after soaking, and calculating the hydration capacity as a percentage of the initial weight. The hydration index was derived from the hydration capacity per gram divided by the weight of 1 gm of flour. Additionally, statistical analysis was conducted to analyze the collected observations, employing formulas for calculating arithmetic mean and standard deviation as suggested by Gupta (2000). These analytical procedures provided valuable insights into the physicochemical characteristics of the flour samples, aiding in the selection of the most suitable flour for further study or product development.

RESULTS AND DISCUSSION

The physical characteristics of the three developed flour samples (T_1, T_2 and T_3) were thoroughly examined to gain insights into their chemical composition and processing attributes. These characteristics, including bulk density, hydration capacity, and hydration index, were assessed and are summarized in Table 2. Bulk

Table 2: Physical properties of developed flour

Sample	Bulk Density (g/ml) mean±SD	Hydration Index (%) mean±SD	Hydration Capacity (%) mean±SD
T_1	0.61±0.01	0.63±0.80	3.32±0.31
T_2	0.53±0.01	0.09±0.00	1.91±0.04
T_3	0.58±0.01	0.16±0.00	3.27±0.02

Values are mean SD of three replicates

density, an essential parameter for food powders and granules, was observed to be 0.61 g/ml for T_1, 0.53 g/ml for T_2, and 0.58 g/ml for T_3. These values were relatively higher compared to previous findings by Raihan and Saini (2017), who reported bulk density values ranging from 0.43 to 0.50 g/ml for composite flour made of oat, amaranth and sorghum flour. Among the samples, T_1 exhibited the highest bulk density (0.61 g/ml), while T_2 and T_3 had lower values (0.53 g/ml and 0.58 g/ml, respectively). Furthermore, the hydration capacity, also known as water absorption or water holding capacity, was determined for each sample. The hydration index and hydration capacity ranged from 0.63 and 3.32 g/100 (T_1), 0.09 and 1.91 g/100 (T_2), to 0.16 and 3.27 g/100 (T_3), respectively. These findings were in line with studies by Rani and Kulkarni (2020); Adebo and Kesa (2023), which reported hydration index and hydration capacity values for buckwheat and sorghum, respectively. Notably, T_1 exhibited the highest hydration index and capacity among the samples.

CONCLUSION

The development and standardization of millet-based flour present opportunities for product innovation, given their nutrient density. Physical analysis indicates that T_1 exhibits the highest mean value across examined parameters. This suggests its potential for superior quality. Furthermore, commercializing these flours could contribute to delivering health benefits, potentially mitigating lifestyle-related diseases. Thus, leveraging the nutritional richness of millet-based flour not only offers avenues for product diversification but also aligns with health-conscious consumer preferences, thereby fostering a promising market niche with significant health implications.

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Research Article

Entrepreneurial Behaviour and its Influencing Factors: A Case of Small-scale Mushroom Growers of Meghalaya

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ABSTRACT

Mushroom cultivation is a potentially lucrative enterprise that can bring self-reliance to rural communities. The study was conducted during 2022 in the East Khasi Hills and Ri-Bhoi districts of Meghalaya to investigate the entrepreneurial behaviour of mushroom growers and find out the factors influencing it. The study sampled 60 mushroom growers from the two districts as respondents and collected primary data through well-structured interview. The relationship between entrepreneurial behaviour and selected variables was determined using ordinal logistic regression. The findings revealed that majority of respondents (50.00%) possessed medium level entrepreneurial behaviour. Dimensions of entrepreneurial behaviour having lowest score was information seeking behaviour (51.09) followed by technical competency (61.49). Experience in mushroom cultivation, and trainings attended on mushroom, extension contact and usage of internet were found significantly influencing the entrepreneurial behaviour of the respondents. The study recommends development of a comprehensive entrepreneurial ecosystem catering to the varied needs of the growers.

Keywords: Mushroom, Meghalaya, Entrepreneurial behaviour and Ordinal logistic regression

INTRODUCTION

Mushroom cultivation is one of the most profitable agri-business that can be started with low investment and less space. Mushroom technology can be an additional source of income for the rural population where land is a limiting factor and agro-wastes are available plenty and cheaply. In addition to its economic benefits, mushrooms are also a rich source of nutrients. They can serve as a viable vegetarian alternative to protein sources such as meat, eggs and milk (Gruen and Wong, 1982). According to the data released by National Horticulture Board (2021), India in 2013-14 produced 17,100 metric tonnes of mushrooms, and by 2021 this increased to 2,58,810 metric tonnes (about 15-fold increase in eight years). Yet India only accounts for about 2 per cent of the world's mushroom production, as the lion's share is with China which accounts for over 75 per cent of global production (Gupta and Morris, 2022). An article by Singh (2020) highlighted that the per capita consumption of mushroom is still low in India at 30 gram per person when compared to USA or Europe (2 kg-3 kg per person). These data indicate a huge opportunity, both domestically and for exports, yet to be harnessed.

Meghalaya state of North-east India is home to many wild edible mushrooms and the climate of the state is highly conducive for commercial cultivation of mushroom. Given the potential of Meghalaya and the existing favourable ecosystem for mushroom production, mushroom growers are mushrooming gradually. On 30th May 2019, the Meghalaya Mushroom Mission (MMM) was launched with the target to produce at least 5000 metric tonnes by the end of five-year Mission period, i.e., 2024. In its first year of

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implementation, the mushrooms production in the state went up from 27 metric tonnes to 287.43 metric tonnes (MT), and 432 new farmers had been trained and drawn into the Mission (Kumar, 2021). The most extensively grown mushrooms in Meghalaya are Oyster and White Button mushrooms. Apart from the state Government, the Indian Council of Agricultural Research (ICAR), Central Agricultural University (Imphal) and many Civil Society Organizations are working towards improving the status of the farmers of Meghalaya through mushroom cultivation.

The opportunity for mushroom cultivation is enormous given the insatiable local demand, export potential, scope for value addition and favourable climatic conditions (Kumar, 2021). This provides a huge scope for development of mushroom entrepreneurs for increased income and socio-economic upliftment of the people. Cole (1959) defined entrepreneurship as the purposeful activity of an individual, or a group of associated individuals which is undertaken to initiate, maintain or aggrandize profit by production or distribution of economic goods and services.

Entrepreneurial behaviour is the combination of various socio-psychological, cognitive, affective and skill attributes of an individual entrepreneur to operate his enterprises successfully to earn higher economic returns (Shirur *et al.,* 2017). The entrepreneurial behaviour of farmers as a socio-psychological attribute plays an important role in the success of their farming enterprise. In order to comprehend the elements that support or restrict an entrepreneurial activity, entrepreneurial behaviour must be examined. Although there has been a favourable growth in the number of mushroom growers in the state, understanding how much the growers possess entrepreneurial drive and engage in entrepreneurial activities is important. Entrepreneurial behaviour is directly concerned with the understanding, predictions and control of human behaviour in enterprise. Understanding the entrepreneurial behaviour of the mushroom growers as well as the factors influencing it is important for any capacity development efforts for them.

MATERIALS AND METHODS

The study was conducted in East Khasi Hills and Ri-Bhoi districts of Meghalaya which has the highest area and production of mushrooms in the state. Primary data was gathered through structured interview schedule. 30 mushroom growers were sampled from each district using snowball sampling technique as the growers were scattered throughout the districts. The maximum respondent from one village was restricted to 10. The sample inclusion criterion for respondents was growers cultivating at least one variety of mushrooms for at least one cycle per year for the last three years. Taking into consideration the scope and objectives of the study, entrepreneurial behaviour was considered as the dependent variable and fifteen independent variables which were assumed to affect the dependent variable were selected as per review of literature as well as discussion with experts.

For measuring the dependable variable, the entrepreneurial behaviour index developed and used by Shirur (2015) was adopted. The index consists of eleven dimensions *viz.,* 'Innovativeness', 'Achievement motivation', 'Economic motivation', 'Technical competency', 'Decision making ability', 'Risk bearing ability', 'Information seeking behaviour', 'Scientific orientation', 'Leadership ability',' Management orientation', and 'Marketing strategy'. The index was subjected to minor modifications to suit the study context. The items of the modified index were evaluated by 7 experts for their content validity. The index was then administered to 30 non-sample growers and Cronbach's alpha was calculated for each dimension to assess the reliability of the index. The Cronbach's alpha value was found to be 0.7 or above for all dimension of the index, indicating good internal consistency.

The entrepreneurial behaviour index was calculated for all the individual mushroom growers**.** The mean score (Raw score/ maximum possible score) obtained by each respondent mushroom grower for different dimensions was multiplied with the scale values of respective dimension. The summation of values obtained for all the dimensions gives the composite index measuring the entrepreneurial behaviour of the mushroom growers. The formula used in arriving at EBI values is given below:

$$\text{EBI} = \frac{\sum_{i=1}^{11} \frac{Actualscore of D_i \times Scalevalue of D_i}{Max.score of D_i} \times 100}{\sum Scalevalue of D_i}$$

The respondents were grouped into six categories based on their scores on entrepreneurial behaviour.

Dimension	No. of items	Range of Item-Total Correlation	Cronbach's Alpha	Range of Cronbach's Alpha if Item Deleted
Innovativeness	7	0.168-0.694	0.786	0.727-0.822
Achievement motivation	6	0.371-0.842	0.820	0.753-0.856
Economic motivation	8	0.316-0.801	0.786	0.723-0.828
Technical competency	7	0.053-0.761	0.729	0.627-0.807
Decision making ability	7	0.094-0.757	0.787	0.733-0.822
Risk bearing ability	7	0.012-0.779	0.790	0.710-0.887
Information seeking behaviour	13	0.157-0.563	0.738	0.709-0.755
Scientific orientation	6	0.220-0.815	0.765	0.651-0.831
Leadership orientation	5	0.502-0.806	0.855	0.787-0.895
Management orientation	10	0.148-0.734	0.731	0.661-0.759
Marketing strategy	6	0.341-0.840	0.818	0.747-0.889

Sturge's Rule was employed to arrive at the number of groups.

Sturge's Rule is given by, $k = 1 + 3.322 (\log_{10} n)$

Where, k is the no. of classes and n is the sample size.

Primary data for the study was collected during March-May 2022.

RESULTS AND DISCUSSION

The profiles of the sampled mushroom growers as per the selected independent variables are presented in the Table 1.

More than half (65.00%) of the respondents were middle aged akin to the findings of Kumar (2001) and Sharma *et al.* (2011). One-third (33.33%) of them were educated upto primary school. Being less education is not a barrier to earning higher returns provided enough training and demonstrations are offered, the respondent mushroom growers took advantage of this opportunity regardless of their educational background. These results are in accordance with Sharma *et al.* (2011) and Jha (2012).

More than half (55.00%) of the respondents had medium sized family (4-6 members) and more than half (53.33%) of the respondents had received mushroom related training for 2-7 days. The respondents have attended training from various institutions such as ICAR, College of Post Graduate Studies in Agricultural Sciences (CPGS-AS), Mushroom Development Centre (MDC) and Directorate of Mushroom Research (DMR), Solan, Himachal Pradesh. A little less than half (41.67%) of the respondents had 3-8 years' experience in mushroom cultivation. 58.33 per cent of respondents were growing oyster mushroom and 53.33 per cent of respondents took up mushroom cultivation as a subsidiary enterprise. The fact that growing oyster mushrooms is easier and cheaper as compared to button mushrooms could be main explanation for why most farmers choose to grow oyster mushrooms widely in the study area. In Ri-Bhoi district which is relatively warmer, cultivation of button mushroom requires additional care and therefore all the button mushroom growers were from East Khasi Hills.

More percentage (35.00%) of the respondents had high level of extension contact and low (40.00%) level of usage of internet, and few respondents from East Khasi Hills reported using YouTube videos to learn mushroom cultivation.

The mean Entrepreneurial Behaviour Index (EBI) score was calculated to be 70.59 with a range of 56.73 - 84.21. The distribution of the respondents according to their EBI is presented in Figure 1.

It is observed from the Figure 1 that maximum number of respondents (28.33%) fall in the lower medium category, followed by 21.67 per cent in upper medium category of entrepreneurial behaviour. The proportions of respondents with high and very high level of entrepreneurial behaviour were 13.33 per cent and 11.67 per cent respectively. Whereas 10.00 per cent and 15.00 per cent respondents belonged to very low to low level of entrepreneurial behaviour. The findings

Table 1: Distribution of respondents according to the selected independent variables (n=60)

Variable	Categories	Frequency	Percentage
Age	Young (less than 35 years)	8	13.33
	Middle (35-50 years)	39	65.00
	Old (Above 50 years)	13	21.67
Gender	Male	24	40.00
	Female	36	60.00
Education	1-Illiterate	4	6.67
	2-Primary school (1-5)	20	33.33
	3- Middle school (6-8)	8	13.33
	4-Secondary school (9-10)	12	20.00
	5-Higher secondary (11-12)	5	8.33
	6-Graduation	8	13.33
	7 -Post graduate and above	3	5.00
Family Size	Small (<4 members)	8	13.33
	Medium (4-6 members)	33	55.00
	Large (>6 members)	19	31.67
Experience in mushroom cultivation	Less (<3 years)	20	33.33
	Medium (3-8 years)	25	41.67
	High (>8 years)	15	25.00
Trainings attended on mushroom	1 day	6	10.00
	2-7 day	32	53.33
	Above 7 days	22	36.67
Extension contact	Low	20	33.33
	Medium	19	31.67
	High	21	35.00
Usage of internet	Low	24	40.00
	Medium	22	36.67
	High	14	23.33
Type of mushroom cultivated	Oyster	35	58.33
	White button	25	41.67
Area of production unit (in sq. ft.)	Less than 240	29	49.00
	240-582	5	8.00
	Above 582	26	43.00
Type of enterprise	Sole	9	15.00
	Major enterprise	19	31.67
	Subsidiary enterprise	32	53.33
Source of raw materials	Owned	23	38.33
	Bought	37	61.67
Credit utilization	Yes	19	31.67
	No	41	68.33
Type of labour	Paid labour	22	36.67
	Family labour	38	63.33
Marketing channel	Grower-consumer	42	70.00
	Grower-wholesaler-consumer	18	30.00

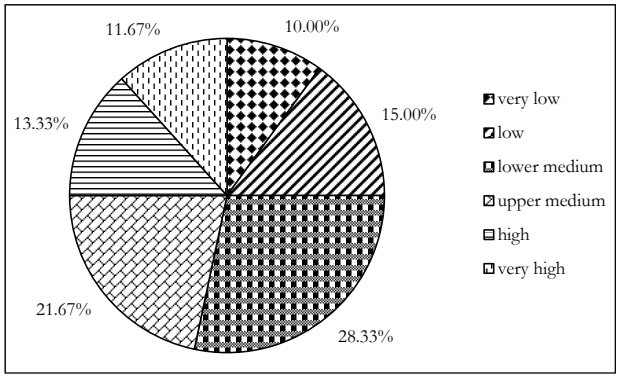

Figure 1: Distribution of the respondents based on their EBI

are in accordance with Shirur (2015); Shanker *et al.* (2019). Parameshwaranaik *et al.* (2020); Jamir and Jha (2020) and Kharlukhi and Jha (2021).

It is observed from Figure 2 that Information seeking behaviour and technical competency had the lowest mean score among the components of entrepreneurial behaviour which indicates a potential barrier or lack of skill in seeking out information and technical knowledge, which may hinder the farmers' ability to adapt and innovate in their entrepreneurial endeavors. The low mean scores suggest an opportunity for farmers to further enhance their entrepreneurial skills by actively seeking out information and technical knowledge to improve their innovative capabilities. Farmers who proactively seek out information and technical knowledge are better equipped to adapt to changing market conditions, implement sustainable practices, and explore new opportunities for growth.

Table 2: Summary of pseudo R-square

Pseudo R-Square	
Cox and Snell	0.820
Nagelkerke	0.847
McFadden	0.498

Link function: Logit.

An ordinal logistic regression model was used to find out the relation between entrepreneurial behaviour and the selected independent variables (Table 3). The pseudo R^2 Values (e.g. Nagesha R^2 = 84.70%) indicated that all the variables together can account for 84.70 per cent of the variance in the entrepreneurial behaviour.

From Table 3, it can be observed that experience in mushroom cultivation (p=0.001), Trainings attended on mushroom (p=0.49), Usage of internet (p=0.48), Extension contact (p=0.41) and Type of labour (p=0.15) were positively and significantly contributing to the entrepreneurial behaviour of the respondents. The reason might be because more experience in their

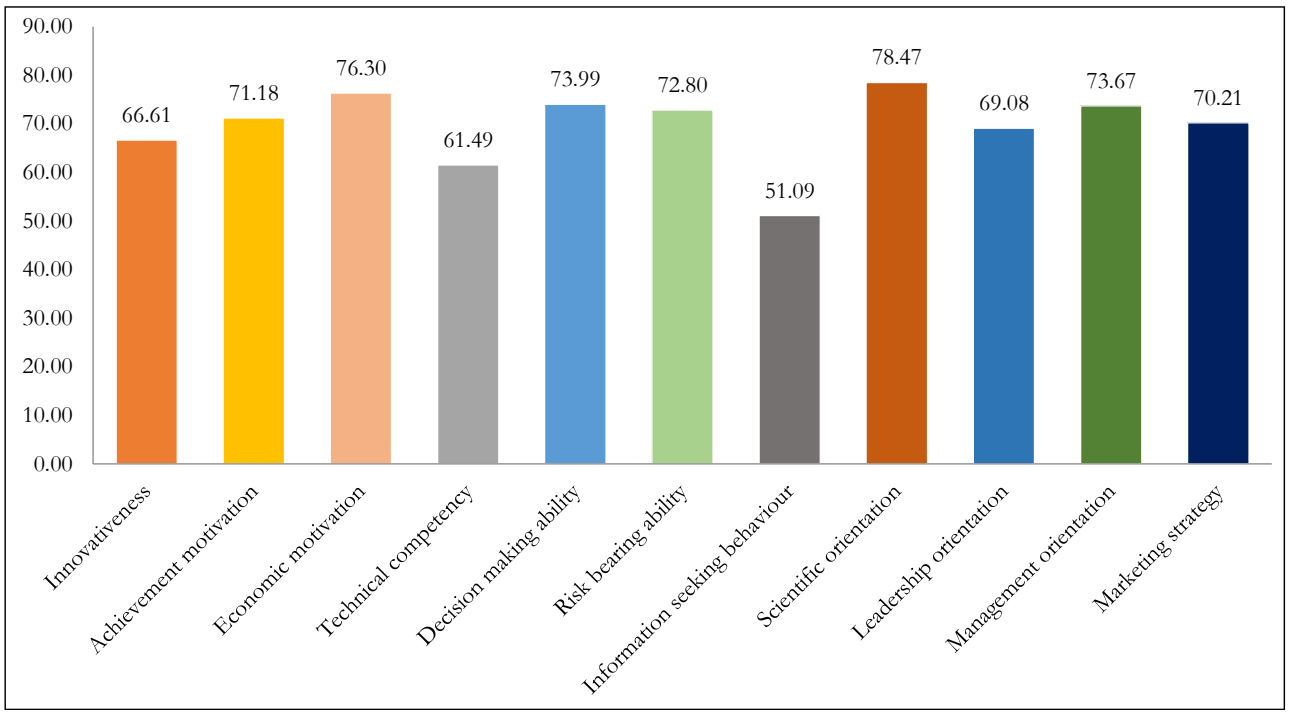

Figure 2: Mean Score of the dimension of Entrepreneurial Behaviour

Table 3: Ordinal logistic regression between explanatory variables and entrepreneurial behaviour (n=60)

Variables	Coefficient	Std. Error	Sig.
Age	.057	.035	.107
Gender	-1.041	.813	.200
Education	-.051	.215	.812
Family size	-.652	.511	.202
Experience in mushroom cultivation	**2.764****	.858	.001
Trainings attended on mushroom	**.325***	.165	.049
Extension contact	**.347***	.170	.041
Usage of internet	**.381***	.192	.048
Type of mushroom cultivated	.973	1.476	.510
Area of production unit	.345	.751	.646
Type of enterprise	-.162	.645	.801
Source of raw materials	-1.249	1.146	.276
Credit utilization	.784	.713	.271
Type of labour	**2.655***	1.092	.015
Marketing channel	1.205	1.071	.261

(*Note:* ** &* denotes significance at 1% & 5% level)

enterprise helps them to understand and rectify their mistake and learn from it and thus help them to improve their skill. And more number of training might increase their scientific orientation thus them giving them confidence and motivation to cultivate mushrooms, Also the farmers' usage of internet to learn about pest and disease management through you tube, and also marketed their produce through WhatsApp might be the reason why the usage of internet had a significant influence on entrepreneurial behaviour.

Rakesh *et al.* (2016) also revealed that educational qualification, dairy farming experience, extension contact, mass media exposure were found to have positive and significant relationship with entrepreneurial behaviour. Kumar and Sharma (2009) reported that sources of information utilization, training received and farming experience had a significant influence on entrepreneurial behaviour. Shah *et al.* (2010) revealed mass media exposure had positive and significant contribution on the entrepreneurial behaviour. Sharma *et al.* (2011) revealed that information source utilization, mass media exposure, and cosmopoliteness significantly influence on entrepreneurial orientation. Entrepreneurial behaviour of agricultural and allied enterprises was also reported to be influenced by source of information and experience in enterprises (Ram *et al.*, 2014). Shirur *et al.* (2017) also reported that mass media participation, extension participation and training were significantly contributing to the entrepreneurial behaviour.

CONCLUSION

Mushroom cultivation if promoted well in the rural areas will achieve multiple benefits like nutritional security, livelihood security and employment generation among rural people. There is need to improve the entrepreneurial behaviour of respondents through investing in improving their information seeking behaviour, technical competency and leadership orientation. Farmers should be provided opportunity and facilitated to participate in training and workshops, seek online resources, join farmer networks, and seek mentorship from experienced growers and experts. Emphasis should be on development of a well knit comprehensive entrepreneurial ecosystem catering to both backward and forward chain needs of the growers.

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Research Article

Exploring the Impact of an Intervention on the Metacognitive Abilities of Adolescents

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ABSTRACT

Metacognition, recognized as a valuable tool in cognitive psychology, plays a crucial role in the learning process. It is acknowledged as a key skill for individuals striving to become proficient, self-regulated learners with mastery over their learning trajectories-a vital attribute in the 21st century. Essentially, metacognition involves higher-order thinking, encompassing an awareness of one's own thought processes. The essential support to optimize educational outcomes through intervention strategies, the key focus should be on a student's cognitive aspect. Achieving this requires a prioritization of stimulating metacognitive activities through reinforced interventions in the direction. The present study was conducted in the Bikaner district of Rajasthan, focusing on the assessment of intervention program on metacognitive awareness among adolescents and comparisons between both the gender's metacognitive abilities. A purposive sampling method was employed to select a sample of 800 respondents, evenly distributed among government and private schools in both rural and urban settings, while also ensuring equal representation based on gender and grade. The study employed an adapted version of the Metacognitive Awareness Inventory by Schraw and Dennison (1994) to gauge the metacognitive awareness of adolescents. The findings indicated that male respondents did not seem to differ from female respondents in metacognition scores. The intervention was very effective for improving level of metacognition of adolescents as pre scores of metacognition of control group and experimental group does not significantly different but there were significant difference in post scores of metacognition of both the groups and experimental group were having higher scores as compared to their counterparts.

Keywords: Metacognition, Meta-cognitive strategies, Adolescents and intervention

INTRODUCTION

Metacognition, recognized as a valuable tool in cognitive psychology, plays a crucial role in the learning process. It is acknowledged as a key skill for individuals striving to become proficient, self-regulated learners with mastery over their learning trajectories-a vital attribute in the 21st century. Essentially, metacognition involves higher-order thinking, encompassing an awareness of one's own thought processes. Recently, it has been succinctly defined as the "Consciousness and control over one's own thoughts." Metacognition is composed of two essential elements: knowledge about cognition and the regulation of cognition. Often identified as a type of executive control, it entails monitoring and self-regulation, a viewpoint shared by researchers like McLeod (1997) and Schneider & Lockl (2002). Schraw (1998) goes beyond this characterization, portraying metacognition as a multifaceted collection of general skills, not confined to specific domains. These skills, differing from general intelligence, possess the potential to offset deficiencies in intelligence or previous knowledge when engaging in problem-solving activities. The significance of metacognitive skills lies

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in their ability to enhance intellectual capacities by allowing individuals to reflect on and control their thinking processes. This heightened awareness of the learning process ultimately leads to increased self-regulation and autonomy in education. Students equipped with metacognitive skills demonstrate a profound understanding of their learning processes across various subjects and tasks.

Metacognitive growth continues throughout childhood, adolescence, and adulthood. It is not a binary trait, with individuals demonstrating varying degrees of metacognitive effectiveness. Additionally, metacognition can be enhanced through appropriate instruction, and the relationship between metacognition and learning is bidirectional. Teaching metacognition requires pedagogical understanding, where teachers impart knowledge of metacognitive skills and strategies, showing students how to implement them effectively. The impact of these cognitive variables on educational performance is substantial, emphasizing the need for researchers to understand self-regulatory processes that facilitate learning. In today's intellectual landscape, demonstrating control over learning pace and continually improving cognitive awareness are crucial for establishing one's presence in the intellectual world.

The push for changes in the educational system primarily stems from the goal of enhancing individual learning. To optimize educational outcomes through intervention strategies, the key focus should be on a student's cognitive aspect. Achieving this requires a prioritization of mental abilities and an exploration of existing metacognitive awareness. This can be further reinforced by interventions aimed at enhancing metacognitive abilities in declarative, procedural, and conditional knowledge, along with regulatory functions such as planning, monitoring, evaluation, and error debugging in cognitive functioning.

Objective of the study

- To assess the metacognitive levels of adolescents of both genders.
- To develop and validate the intervention program module.
- To examine the impact of the intervention on the respondents' metacognition levels.

MATERIALS AND METHODS

The research was conducted in the Bikaner district of the Rajasthan state, purposefully selected as the study locale. Its primary aim was to examine the disparity in metacognitive levels among male and female adolescents and to evaluate the impact of an intervention on the metacognitive abilities of adolescents. The final sample comprised 800 adolescents enrolled in the 9th and 11th standards, equally distributed across rural-urban and government-private schools, encompassing both genders. Purposive sampling was employed as the sampling technique as targeted sample fit the profile characteristics finalized for study context. A self-prepared questionnaire gathered information on respondents' personal variables, including age, gender, rural/urban setting, family type, number of siblings, parental educational qualifications, and school type (government/private). The adapted Metacognitive Awareness Inventory (Schraw and Dennison, 1994) was utilized to assess adolescents' metacognition. Strategies for the intervention were formulated and implemented on the targeted sample. Data were collected from various government and private schools in rural and urban areas of Bikaner, Rajasthan. After coding and tabulation, statistical analysis ensued, involving checks for data normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. Due to non-normally distributed data, Mann-Whitney tests were employed for comparing two independent conditions (metacognition levels by gender). The Wilcoxon signed-rank test gauged the pre and post effects of the intervention, while the Kruskal-Wallis test assessed differences between multiple independent groups in alignment with the study's objectives.

RESULTS

The data were gathered in accordance with the outlined objectives and subsequently analyzed for the corresponding means. Figure 1 illustrates the demographic profile of adolescents based on the gender of the respondents. The Figure 1 illustrates that adolescents considered for the current study were in equal proportion as 50% were male and 50% were female.

Results showed that Male respondents were seems to significantly differ from female respondents in their

Table 1: Gender wise difference in metacognition of adolescents (N=800)

Component of metacognition	Gender		Mann Whitney U	Wilcoxon W	Z	Monte-Carlo Significance (2-tailed)
	Male (400) Mean rank	Female (400) Mean rank				
Knowledge about cognition	384.27	416.73	7.351E4	1.537E5	-1.987	.05*
Regulation of cognition	388.27	412.73	7.511E4	1.553E5	-1.497	.13
Metacognition	385.94	415.06	7.417E4	1.544E5	-1.783	.07

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

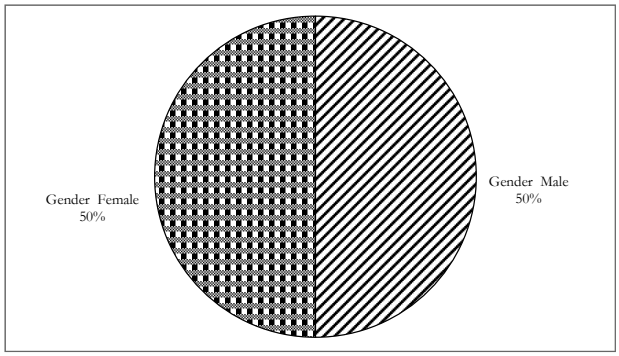

Figure 1: Distribution of adolescent in relation to Gender (N=800)

knowledge about cognition component of metacognition (U=7.351E4, p=0.05 and r=-0.07). As male respondents were having high value of mean rank so they were having higher scores of Knowledge about cognition component as compared to female respondents.

Here r value represents the small effect size (it is close to zero and below the 0.3 criterion for a medium effect size). Which tells that there was negligible effect of gender on scores of knowledge about cognition component.

Further findings revealed that male respondents did not seem to differ from female respondents in their Regulation of cognition component of metacognition and Metacognition scores (U=7.511E4, p=0.13, r=-0.05 and U=7.417E4, p=0.07, r=-0.06). Therefore, Null hypothesis is accepted.

Aljaberi and Gheith (2014) also carried out a study to investigate the relationship between the university students' metacognition thinking and their ability to solve mathematical and scientific problems. He also reported that variables of sex had no effect on student's level of meta-cognitive thinking. Similar findings were reported by Siswati and Corebima (2017) as gender did not have an effect on students' meta-cognitive skills in TPS (think-pair-share) learning model which is a meta-cognitive skill. There was no significant difference in the meta-cognitive awareness of male and female students (Rahman *et al.,* 2011).

Generally both the gender uses their meta-cognitive skills, although the dimensions of the meta-cognitive skill used were different. The difference in meta-cognitive skills may be due to different learning models or because of differential cultural influence.

Though we found a difference in knowledge about cognition component, where boys were scoring higher compared to girls. This implies that boys had comparatively good knowledge of own thinking and learning activities. They were better aware about learning strategies those are useful for them as compared to their female counterparts.

The intervention programme module was developed to strengthen metacognition of adolescents. It comprises three phases and its each phase corresponds to three days activities, one and half hour each day. Likewise phase I was having activities focused on Orientation of module, adolescents & their characteristics, metacognition and its component, importance of metacognition. Activities of phase II were focused to strengthen Declarative, procedural and conditional knowledge (Metacognition: knowledge cognition). Activities of phase III were focused to strengthen planning, information management strategies, comprehension monitoring, debugging strategies and evaluation component (Metacognition: Regulation of cognition).

The intervention module was carefully designed to enhance the metacognition of adolescents. Face validation of intervention was done by four experts in the field of Human Development from various colleges

Table 2: Kruskal Wallis test for control and experimental grouping variable [N=400; control group (200) and experimental group (200)]

Variable	Group	Mean Rank	(H-value)	d.f.	Monte Carlo significance
Knowledge about cognition (before intervention)	Control	197.46	0.28	1	0.59
	Experimental	203.54			
Regulation of cognition (before intervention)	Control	190.98	2.71	1	0.10
	Experimental	210.02			
Metacognition (before intervention)	Control	191.74	2.30	1	0.12
	Experimental	209.26			
Knowledge about cognition (after intervention)	Control	142.37	101.17	1	0.00**
	Experimental	258.63			
Regulation of cognition (after intervention)	Control	153.23	66.89	1	0.00**
	Experimental	247.77			
Metacognition (after intervention)	Control	142.69	100.02	1	0.00**
	Experimental	258.31			

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

in Mumbai. Their suggestions were incorporated and required changes were made in the module.

Knowledge about cognition, Regulation of cognition and metacognition were significantly improved by the intervention programme implemented on respondents (H (1) = 101.17, $p<0.05$; H (1) = 66.89, $p<0.05$ and H (1) = 100.02, $p<0.05$ respectively).

Further follow up test of Mann-Whitney tests were used. Through this test, pre scores of knowledge about cognition, Regulation of cognition, metacognition of control and experimental group were compared. Similarly post scores of knowledge about cognition, Regulation of cognition, metacognition of control and experimental group were also compared.

That's how intervention programme for metacognition includes various metacognitive strategies that functions as a navigational guide, enabling individuals to cultivate refined approaches in the utilization and oversight of their learning methods. Exposure to a stimulating learning environment provides learners with the necessary skills to adeptly apply metacognitive techniques, benefiting them across various facets of the learning journey, including task completion, concentration, information assimilation, and error rectification. Diverse metacognitive strategies stand ready to support learners in the effective execution of tasks, the honing of focus, the interpretation of content, and the correction of errors. These strategies encompass methodologies such as connecting new information to existing knowledge, organizing factual data through techniques like chunking, summarization, and paraphrasing, enhancing comprehension through practices like mind mapping and mnemonic associations, recitation, verbalizing thoughts, collaborative problem-solving, questioning, visualization, cultivating meta-comprehension, fostering critical thinking, engaging in self-dialogue, and more.

Similarly Van de Kamp *et al.* (2015) reported the similar kind of results that explicit instruction of metacognitive knowledge had a positive effect on fluency and flexibility. Likewise, Du Toit (2013) reported that metacognitive Intervention had a statistically significant impact on learner metacognition in respect of the metacognitive Awareness Inventory total score, the Knowledge of cognition (KC) factor, the Regulation of cognition (RC) factor, and the subscales as Declarative knowledge, Planning, and Monitoring.

CONCLUSION

The present study was undertaken to assess the metacognition of adolescents on the basis of different variables. It was also intended to develop intervention module and check the impact of intervention on

metacognition of adolescents. Metacognitive learning of children is possible through instructions. As more the child is able to understand his learning process the easier it will be for him to figure out what strategies and supports work best for him. This is the knowledge that will help him encountering the problems of present and future life. It will make him perfect in successful accomplishment of task assigned. Male respondents did not seem to differ from female respondents in metacognition scores. The intervention was very effective for improving level of metacognition of adolescents as pre scores of metacognition of control group and experimental group does not significantly different but there were significant difference in post scores of metacognition of both the groups and experimental group were having higher scores as compared to their counterparts

Experimental group were having significantly higher post scores of meta-cognition as compared to their counterparts. This reflects the positive impact of intervention program on metacognition of respondents. The intervention's contributed in various ways, including improvements in declarative, procedural, and conditional knowledge. Declarative knowledge pertains to factual information, procedural knowledge involves understanding processes and methods, while conditional knowledge relates to understanding when and why to apply certain strategies. Additionally, the intervention targeted regulatory functions such as planning, monitoring, evaluation, and error debugging in cognitive functioning. Positive changes in these areas could signify an increased ability to plan and organize tasks, monitor one's progress, evaluate the effectiveness of strategies, and rectify errors in thinking or problem-solving. Adolescents has shown exceptional interest in use of metacognitive strategies like mnemonic technique, self –interrogation, cooperative learning, self reflection. They have submitted their mnemonic statements related to different subjects. They found the intervention sessions interesting and useful for routine study.

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Research Article

A Cross Sectional Study into Assessing Drug Awareness Among Youth of District Kangra of Himachal Pradesh, India

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ABSTRACT

Substance abuse by students in high schools, colleges and universities is a serious problem because drugs have strong appeal to young people who are beginning their struggle for individual (identity). Innate curiosity, thirst for new experiences, media, peer pressure and faulty motivation lead many of the youth population to substance abuse. Therefore, a cross sectional study was conducted to assess the level of drug awareness and gender differences among school and college students in district Kangra, H.P. The study population comprised of 250 school students (12-17 years) and 250 college students (18-25 years). Results revealed that most of the respondents i.e. 39 per cent from both schools and colleges (40.8% and 37.2%) respectively had moderate level of drug awareness followed by 31 per cent students who had inadequate knowledge. Nearly half of the total sample i.e. 44.6 per cent got information about ill effects of drug abuse by media/ television and 22.8 per cent became aware about drugs at schools, colleges and home (by parents). However, 15.6 per cent of respondents are unaware and only 6.6 per cent have gain knowledge through their friends. Significant gender difference was found between school sample at .005 confidence level and at .001 confidence level for total sample. Also positively significant correlation was found between drug awareness and fathers and mothers education along with caste and it is negatively correlated with family income. It is concluded from the study that an early intervention and awareness on the adverse effects of psychoactive substance at an early age helps in avoidance of such illicit habits and addiction among students. Community programs focus on educating parents and caregivers about how to talk to their children about drugs by preventing drug use in the first place by promoting healthy lifestyles and positive social norms or by providing support to people who are struggling with addiction or recovery.

Keywords: Drug awareness, Gender, Media, Psychoactive drugs

INTRODUCTION

The use of various psychoactive drugs /substances has been observed in every part of the country in which the rate of illicit drugs use among youth is at its peak. With the evolving globalisation and various lifestyle changes, an increase in the acceptance of ill habits is clearly seen in low and middle income countries specifically in adolescents and adults (Sheltonh, 2006). Drug abuse has hit all regions and all sections of our society. It is found in rural and urban areas, among poor and the rich, among men and women, among young or old. But it is most overwhelmingly practiced by young boys and girls especially in hostels and in almost all educational and technical institutions. Thus, drug abuse is there in almost all the countries of the world. Addiction has become really a curse upon human beings. Drug abuse affects not only the drug addicts but also others directly or indirectly (Mohammed *et al.,* 2021).

Substance use has a major impact on individuals, families and societies. It contributes to the social, physical and mental health problems. Young people who are indulged in substance use cause problems at school, at work place, have physical and mental health-related issues, poor peer relationships are prone to motor-vehicle accidents and put stress on the family. They can

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also develop lifelong issues such as substance dependence, chronic health problems and social and financial problems. The effects of drug abuse are not limited to the individual or drug abuser but extend to their family and society. Even many of these youth will lose their lives due to multiple substance use and a significant number of them are likely to grow up to become drug addicts. Tobacco is the main drug used by the youth followed by alcohol and inhalants. Various risk factors like peer pressure, curiosity and parental use of drugs are significantly associated with use of substances among them (Katoch *et al.,* 2023). Many factors responsible for the substance use by both young and adult are lack of drug related awareness, media/ TV, easy availability of drugs, family disputes, parental substance use, peer relationship at an early stage or later on life. These drug use related issues could be reduced by offering early drug abuse education throughout childhood and adolescence.

An early intervention, awareness and knowledge on the harmful effects of narcotic substances greatly reduces the risk factor of drug abuse among adolescents (Haripriya and Ganapathy, 2020). Many studies confirmed that adolescents used addictive substances in spite of having the knowledge about their hazardous influence on their health (Nieradko *et al.,* 2002). However, some studies reported that adolescents had less knowledge about drug abuse, its effect on body and daily life. Therefore, the present study has been designed to assess the students level of drug awareness and gender difference among school, college and total sample. Also, the correlation between drug awareness and socio demographic factors has been studied.

MATERIALS AND METHODS

The study was conducted in district Kangra of Himachal Pradesh. Out of 12 districts of Himachal Pradesh, Kangra district was purposively selected for the purpose of the study, as Kangra is the most populous district of Himachal Pradesh.

Research design: The study has adopted a mixed method, exploratory - descriptive research design. Under which the drug awareness of youth is explored by using self-designed questionnaire and secondly the awareness difference is observed between gender.

Sample size: The sample for the study comprised of 500 respondents in the age range of 12-25 years.

Procedure for selection of subjects: Kangra district is further subdivided into 15 blocks. Therefore, out of 15, five blocks namely Nurpur, Rait, Bhawarna, Dharmashala and Dehra were selected randomly. The list of Senior Secondary schools and colleges has been procured from the portal of Education department of Himachal Pradesh. From the list 5 schools and 5 colleges were randomly selected i.e. one school and one college each from selected blocks were identified for sample selection. From each school under the selected block 50 students in the age range of 12-18 years and similarly 50 students from each college in the age range of 19-25 years under the respective block were selected for collecting the data. Therefore, 250 students were selected from schools and 250 were selected from colleges, thus making a total of 500 sample size. The principals of these schools and colleges were contacted through phone and prior permission was taken for data collection.

Background information Proforma: A self-structured proforma that comprises the socio demographic factors like name, age, gender, name of school/college, parental educational and occupational status, religion, caste, type of family, No. of family members and Family income of the respondent.

Questionnaire on drug awareness: This is a self-structured Questionnaire where information is generated about the awareness about drugs and problems associated with it and source of information regarding drug abuse.

Method of data collection: Primary data was collected through Questionnaire method in group setting. A group of 10 students each were given the questionnaire. The researchers gave brief introduction about the project. Consent is being taken and respondents were assured about the anonymity and confidentiality of their names along with data privacy. After seeking their approval in participating in the survey it was also notified that they can cancel their participation in survey if they want. After giving the introduction about the questionnaire, it was administered. It took about 20-30 minutes to complete the questionnaire. The researchers were present during the whole time the questionnaire was administered and

any query sought was cleared there and then only. This survey followed the Guidelines for Ethical Considerations in Social Research and Evaluation in India.

Data analysis: The collected data were collected and information was tabulated in excel sheets. The tables were quantified using frequency and percentages were calculated. The drug awareness was measured by their levels in terms of their drug knowledge i.e. (Very Inadequate, Inadequate, Moderate, Adequate and Very Adequate). The data were further subjected for testing the significance of awareness difference by using Mann Whitney U-test for comparing means of two groups. The relationship between drug awareness and socio demographic factors have been studied by using Pearson's correlation.

RESULTS AND DISCUSSION

The percentage distribution of school sample and college sample with regard to their socio-demographic attributes as reported by them has been presented in Table 1.

Table 1: Frequency and percentage distribution of socio-demographic factors among school, college and total respondents

Variables	School Sample (N=250) n (%)	College Sample (N=250) n (%)	Total Sample (N=500) n (%)
Age			
12-14	63 (12.6)	-	63 (12.6)
15-17	187 (37.4)	-	187 (37.4)
18-21	-	188 (37.6)	188 (37.6)
22-25	-	62 (12.4)	62 (12.4)
Gender			
Male	190 (76.0)	168 (67.2)	358 (71.6)
Female	60 (24.0)	82 (32.8)	142 (28.4)
Type of Institute			
Government	150 (60.0)	200 (80.0)	350 (70.0)
Private	100 (40.0)	50 (20.0)	150 (30.0)
Father Educational Status			
Illiterate	2 (0.8)	3 (1.2)	5 (1.0)
Primary	6 (2.4)	8 (3.2)	14 (2.85)
Middle	49 (19.6)	19 (7.6)	68 (13.6)
Matric	55 (22.0)	63 (25.2)	118 (23.6)
Sr. Sec	53 (21.2)	68 (27.2)	121 (24.2)
Graduate	57 (22.8)	65 (26.0)	122 (24.4)
Post Graduate & above	28 (11.2)	24 (9.6)	52 (10.4)
Father Occupational Status			
Govt.	71 (28.4)	66 (26.4)	137 (27.4)
Private	64 (25.6)	84 (33.6)	148 (29.6)
Business	38 (15.2)	44 (17.6)	82 (16.4)
Agriculture	11 (4.4)	29 (11.6)	40 (8.0)
Daily wage earner	52 (20.8)	16 (6.4)	68 (13.6)
Non-working	14 (5.6)	11 (4.4)	25 (5.0)
Mother Educational Status			
Illiterate	7 (2.8)	3 (1.2)	10 (2.0)
Primary	14 (5.6)	12 (4.8)	26 (5.2)
Middle	44 (17.6)	29 (11.6)	73 (14.6)
Matric	64 (25.6)	100 (40.0)	164 (32.8)
Sr. Sec	42 (16.8)	53 (21.2)	95 (19.0)
Graduate	59 (23.6)	44 (17.6)	103 (20.6)
Post Graduate & above	20 (8.0)	9 (3.6)	29 (5.8)
Mother Occupational Status			
Govt.	28 (11.2)	15 (6.0)	43 (8.6)
Private	17 (6.8)	15 (6.0)	32 (6.4)
Business	10 (4.0)	5 (2.0)	15 (3.0)
Agriculture	5 (2.0)	10 (4.0)	15 (3.0)
Daily wage earner	18 (7.2)	6 (2.4)	24 (4.8)
Home maker	172 (68.8)	199 (79.6)	371 (74.2)
Religion			
Hindu	244 (97.6)	243 (97.2)	487 (97.4)
Sikh	5 (2.0)	5 (2.0)	10 (2.0)
Muslim	1 (0.4)	2 (0.8)	3 (0.6)
Caste Category			
General	95 (38.0)	111 (44.4)	206 (41.2)
SC	60 (24.0)	41 (16.4)	101 (20.2)
ST	30 (12.0)	20 (8.0)	50 (10.0)
OBC	65 (26.0)	78 (31.2)	143 (28.6)
Type of Family			
Nuclear	154 (61.6)	162 (64.8)	316 (63.2)
Joint	96 (38.4)	88 (35.2)	184 (36.8)
Family Income (monthly)			
Less than 10,000	80 (32.0)	43 (17.2)	123 (24.6)
10,000-25000	59 (23.6)	73 (29.2)	132 (26.4)
25,000-50000	54 (21.6)	49 (19.6)	103 (20.6)
50000-75000	34 (13.6)	40 (16.0)	74 (14.8)
75000-1 lakh	16 (6.4)	18 (7.2)	34 (6.8)
1 lakh and above	7 (2.8)	27 (10.8)	34 (6.8)

Table 1 presents the socio demographic characteristics of the study sample. Among the school sample 37.4 per cent respondents belonged to the age range 15-17 years and 12.6 per cent belonged to the age 12-14 years. In college sample 37.6 per cent were in the age group of 18-21 years, followed by 12.4 per cent who were in the age range of 22-25 years respectively. Majority of the sample taken from both the educational institutes were boys i.e. 76 per cent of school sample and 67.2 per cent of college respondents. Out of total sample (N=500), majority 71.6 per cent were males and remaining 28.4 per cent were females. In case of type of educational institute 60 per cent of respondents were from government schools and remaining 40 per cent were from private schools respectively. In case of colleges, 80 per cent of youth belonged to government institutes and remaining 20 per cent were from private colleges. Maximum number of participants i.e. 70.0 per cent were taken from government institutions followed by 30 per cent from private institutes. Regarding educational status of the fathers of the school participants, 22.8 per cent of them had studied upto graduation level followed by those who studied upto matric. In case of college students, 27.2 per cent father's education level was up to senior secondary and 26 per cent had studied upto graduation level. It has been seen that 24.4 per cent and 24.2 per cent of respondent's fathers had their education upto graduation and senior secondary respectively. About 23.6 per cent were educated upto 10th standard and 10.4 per cent educated upto post graduate level and above. In case of father's occupational status of the school respondent's majority i.e. 28.4 per cent were working in government sector followed by 25.6 per cent who were working in private sector and 20.8 per cent were daily wage earner. Among college participants, majority of fathers i.e. 33.6 per cent were working in private sector and 26.4 per cent were in government sector. About 29.6 % were in private sector and 27.4 per cent were doing jobs in government sector. Only 16.4 per cent of fathers had their own business. Only 5 per cent of them were non-working and 13.6 per cent were daily wage earner. Furthermore, there were25.6 per cent mothers who had studied upto matric and 23.6 per cent had educated upto graduation. While less than half of the mothers (40.0%) of college goers had education upto matric and 21.2 per cent had studied upto senior secondary. It was seen that majority of mother's i.e. 32.8 per cent had education upto 10th standard followed by graduation i.e. 20.6 per cent. Only 5.8 per cent were highly educated i.e. post graduate and above. However, mother's occupational status suggested that majority of mothers i.e. 68.8 per cent and 79.6 per cent were homemakers. Majority of school respondents as well as college respondents i.e. 97.6 per cent and 97.2 per cent, respectively were Hindus and most of them 38% and 44.4% of college respondents belonged to General category followed by OBC i.e. 26 per cent and 31.2 per cent respectively. A very small number of respondents belonged to Scheduled caste and Scheduled tribes. Furthermore, majority of respondents from schools and colleges i.e. 61.6 and 64.8 per cent, respectively were living in nuclear families and remaining 38.4 per cent and 35.2 per cent belonged to joint families respectively. About 32 per cent of school subjects had family income less than Rs 10,000- Rs 25,000, followed by 23.6 per cent who had income between Rs 10,000- Rs 25,000. In case college students, 29.2 per cent of families had their income between 10,000- Rs 25,000 followed by 19.6 per cent who had income between Rs 25,000- Rs 50,000. However, very few percent of families had monthly had monthly income above Rs 75000- 1lakh and above.

Table 2: Frequency and Percentage distribution of level of awareness among school, college and total sample

Awareness	School (n=250)			College (n=250)			Total Sample (N=500)		
	Boys (%)	Girls (%)	Total (%)	Boys (%)	Girls (%)	Total (%)	Boys (%)	Girls (%)	Total(%)
Very Inadequate	14(7.3)	5(8.3)	19(7.6)	18(10.7)	4(4.8)	22(8.8)	32(8.9)	9(6.3)	41(8.2)
Inadequate	68(35.7)	14(23.3)	82(32.8)	52(30.9)	21(25.6)	73(29.2)	120(33.5)	35(24.6)	155(31.0)
Moderate	80(42.1)	22(36.6)	102(40.8)	57(33.9)	36(43.9)	93(37.2)	137(38.3)	58(40.8)	195(39.0)
Adequate	26(13.6)	19(31.6)	45(18.0)	38(22.6)	20(24.4)	58(23.2)	64(17.8)	39(27.4)	103(20.6)
Very Adequate	2(1.0)	0(0.0)	2(0.8)	3(1.7)	1(1.2)	4(1.6)	5(1.4)	1(0.7)	6(1.2)

From Table 2 it is clear that most of school boys i.e. 42.1 per cent and 36.6 per cent of school girls, had moderate level of drug awareness which is followed by inadequate and adequate level of awareness among school boys (35.7%) and school girls (31.6%) respectively. Out of total school sample (n=250) about (40.8%) had moderate level of drug awareness followed by 32.8 per cent of students with inadequate awareness level. About 18 per cent of students were adequately aware about drug/ substance use while a few percent of study subjects had adequate knowledge regarding drug abuse/ use. Similarly, from college subjects 33.9 per cent were moderately aware regarding drugs use followed by 30.9 per cent with inadequate awareness level. Among total college sample, about 37.2 per cent of participants had moderate level of drug awareness followed by 29.2 per cent of students with inadequate knowledge and 23.2 per cent with adequate knowledge of substance use. If we further look into table 2, in case of total sample there were 39.0 per cent of students who had moderate level of drug awareness knowledge. About 31.0 per cent of participants reported inadequate knowledge regarding drugs followed by those who had adequate awareness level (20.6%). A very few number of students had very adequate knowledge about drug abuse from both the study institutes. Similar results were reported by Divya *et al.* (2018) on the awareness scores of adolescent on ill-effects of substance abuse where more than half i.e. (54%) of the adolescents had average awareness, 29 per cent had good awareness, 16 per cent had poor awareness and least 1% had very good awareness. Another study by Theou *et al.* (2015) found that 90.6 per cent of students had average knowledge and 1.9 per cent of the students had poor knowledge whereas only 7.5 per cent had good knowledge of drugs and their ill effects. Acc. to study of Paul and Ramya (2012) revealed that 58 per cent adolescents had average and 18 per cent had poor knowledge while 21 per cent had good knowledge regarding alcoholism.

As shown in Figure 1, nearly half of the school sample i.e. 48.4 per cent acquired information regarding drugs through media and television followed by 18.8 per cent who gained knowledge on drugs by schools, colleges and parents. Only 2.8 per cent of them were influenced by peer groups. About 23.2 per cent were not aware regarding the drug abuse and its side effects. Similar to school sample, about 40.8 per cent of college respondents reported media and television to be major source of information regarding drugs, succeeded by 26.8 per cent who acquired knowledge on drugs by

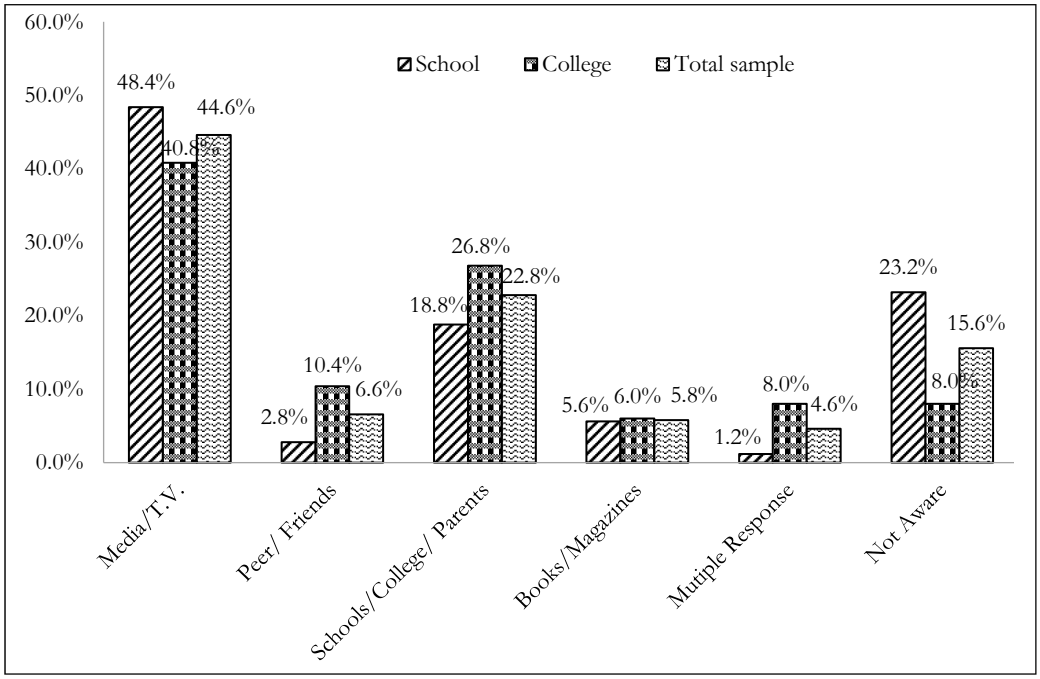

Figure 1: Frequency and percentage distribution regarding source of information among school, college and total sample

schools, colleges and parents. Furthermore, 10.8 per cent of college students were influenced by their friends and have gained knowledge regarding drugs by their peers. Only 8 per cent are those students who were not aware related to any substance use at college level. As we look into total sample, nearly half of the total sample i.e. 44.6 per cent had drug related information from media/television and 22.8 per cent were made aware about drugs at schools, colleges and home (by parents). However, 15.6 per cent of respondents were unaware and only 6.6 per cent had gained knowledge through their friends. The study by Narain *et al.* (2020) also had similar findings that reported that majority of the students i.e. 90, 80 and 58 per cent were aware about the abusive nature of drugs by media campaigns, information from family members and from school curriculum respectively. The results are also supported with study of Faizi *et al.* (2021), who observed that most of the students (89%) agreed that they have received prior information on substance use. About 55.3 % reported TV/Cinema or internet being the most common source, 47.6 per cent obtained knowledge from the school and 27.1 from friends.

Contradictory to our results a study revealed that friends being the major source of information (85.18%) followed by TV (81.85%) and schools (48.51%); Mir *et al.* 2023.

From Table 3, it has been observed that extremely significant gender difference was found with regard to total study sample at 1% level of significance. Mean score for girls (283.71) was higher as compared to boys (237.33). Highly significant difference was found between school boys and girls with p value less than 0.05 (p=.012). As table suggested mean value of girls was found to be higher than boys among school, college and total sample, that means girls were found to be more aware about ill effects caused by drugs and less prone to use psychoactive drugs as compare to boys. For college students, no significant gender difference was observed.

Table 3: Awareness difference among school, college and total sample on the basis of gender

Gender		Sample (%)	Mean Rank	Mann Whitney U-Value	Z-value	P-value
School	Boys	190 (76.0)	119.03	4470.0	-2.523	.012**
	Girls	60 (24.0)	146.00			
College	Boys	168 (67.2)	119.84	5937.50	-1.775	.076
	Girls	82 (32.8)	137.09			
Total Sample	Boys	358 (71.6)	237.33	20702.50	-3.243	.001***
	Girls	142 (28.4)	283.71			

Significant level 99%*** 95%**

Table 4: Correlation between Socio-demographic factors with drug awareness among sample

Variables	Mean ± Std. Dev.	1	2	3	4	5	6	7	8	9	10
1. Age	17.9100±2.97718	1									
2. Father Education	3.8160±1.33631	.084	1								
3. Father Occupation	1.6580±1.53419	-.077	-.427**	1							
4. Mother Education	3.4680±1.36260	-.015	.638**	-.330**	1						
5. Mother Occupation	4.1240±1.67518	.059	-.184**	.001	-.307**	1					
6. Religion	1.0320±.20751	.021	057	-.047	.046	-.017	1				
7. Caste	2.2520±1.26162	-.085	-.112*	.121**	-.127**	.145**	.030	1			
8. Family Type	1.3680±.48274	-.022	.024	-.033	-.025	.055	.042	.025	1		
9. Family Income	1.7380±1.49460	.191	.417**	-.370**	.443**	-.136**	.027**	-.150**	-.044**	1	
10. Drug Awareness	14.3080±5.29388	.122	.051**	.007	.060**	-.001	-.060	.041**	-.077	-.006**	1

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

Results from Table 4 illustrated that drug awareness was positively and significantly correlated at 0.01 level (2 tailed) of significance with father education (r=.051), mother education (r=.60) and caste category (r=.041) while negatively correlated with family income (r= -.006). This may be due to the fact that if parents are well educated, they also educate their children regarding ill effects of drugs. They know the harmful effects caused by substances used and their parental involvement may reduce the risk of substance abuse among. The higher drug awareness is also seen in people from general category due to their higher socio economic status in society. On the other hand, scheduled tribe youth of Himachal have access to substances like locally made alcohol, cannabis that grows wildly and even alcohol consumption is a customary practice in these hilly areas making it more accessible. Poverty is the one of main reason for initiation of drugs. But in today's scenario people from rich families have been easily approachable by drug peddlers and they might have access to varied drugs. Another reason might be that in families in which both parents are working have no time to spend with their children and are easily trapped by peers for abusing drugs. That's why drug awareness is inversely correlated with family income. However, no such researches have been conducted to find the correlation between socio demographic factors and drug awareness.

CONCLUSION

There is great need for creating awareness about drug abuse among students. Awareness regarding harmful effects of substance use is high in college as well as school students. The school being an essential part in a student's life can include and promote an effective and healthy life-style. An early intervention and awareness on the adverse effects of psychoactive substance at an early age helps in avoidance of such illicit habits and addiction. These interventions help parents to enhance and create self-efficacy and in enforcing attitude shaping for their children could reduce adolescent substance use. Further, we can see that the Government is lacking to ensure strict protocols against drug smugglers which is the main reason for the increase in drug smuggling cases in the country.

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Research Article

Problems of Adolescents with Orthopaedic Disability in Relation to Causation of Disability

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ABSTRACT

All over the world and in all stages of history, a section of the population is afflicted with disabilities. Disabilities, in spite of the advances made in medical and social sciences persist and the disabled are cut off from one way or another from the mainstream. About 15 per cent of the world's population have some form of disability and are increasing due to population ageing, chronic health conditions, among other causes. Disabilities means incapacity to perform any activity in the usual manner or within the range considered normal for the human beings. Orthopaedically disabled are those who can not move spontaneously as normal human beings. The needs and problems of the disabled should be viewed as an essential part of overall social development of the country. In the wake of the country's rapid industrialization and urbanization, many changes are taking place in the social fabric of the society. As a result besides material and economic deprivation, disability causes great psychological strain for an adolescents as this period is known as "storm and stress" with increase dependency on others. There is a growing awareness both in the Government and society about the need to reach out to the disabled people to enable them to become self sufficient and independent. But all these programme and intervention programme can be effective only when one understand their needs and problems. Society which fails to respond affectively to the problems of disabled accepts not only a huge loss of human resources, but a crucial waste of human potential. Keeping this view in mind, an attempt was made to explore the problems of orthopedically disabled adolescents. Hundred adolescents between the age-group of 13-18 were selected from some schools of Coimbatore district. Result highlighted that there is significant differences among the three types of causative factors.

Keywords: Problems, Disability, Orthopaedic disability, Adolescents

INTRODUCTION

All over the world and in all stages of history, a section of the population is afflicted with disabilities. Disabilities, in spite of the advances made in medical and social sciences persist and the disabled are cut off from one way or another from the mainstream. Disability means incapacity to perform any activity in the usual manner or within the range considered normal for the human beings. The term 'disabled' includes those who are partially or totally blind, mentally retarded, deaf and dumb, slow learner and those and those who are orthopaedically disabled. Orthopaedically disabled are those who cannot move spontaneously as a normal human being. According to the Rehabilitation Council of the Indian Act (1992) "Orthopaedically disability means inability of a person to execute distinctive activities associated with moving, both himself and objects, from place to place and such inability resulting from affliction of either bones, muscles or nerves.

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Gupta (1981) exhorted that the needs and problems of the disabled are many and complex. It should be view as an essential part of overall social development of the country. Earlier times, life was simple. Under the umbrella of joint family system, people had a feeling of social obligation towards the poor, the sick and the physically disabled. In the wake of the country's rapid industrialization and urbanization, along with other changes in the social fabric of the country, the joint family system has been affected and there is progressive decline in its capacity to provide the needs. Besides material and economic deprivation, disability causes great psychological strain and erodes their family life as a whole. This virtually becomes a vicious circle which holds him in its thrall leading to sociological alienation and consequently economic deprivation.

Adolescence has been considered a more developmental period than the middle childhood years. A number of prominent clinicians and psychoanalytic theorists still view adolescence as a psychological disturbed state and introduced the notion of adolescence as a period of great "storm and stress", as well as immense physical. Mental and emotional potential (Mussen *et al.*, 1990). The impact of physical disability during adolescence can be great. At a time when the youngster is trying to establish his or her own identity apart from the family, a condition that increases dependency on others can be extremely disruptive.

It is not only a matter of great concern that the ability and potentials of this chunk of populations have not been fully explored and tackled but it is a great loss of human resource which, if, discovered, nurtured and appropriately utilized could have added a new force to the progression of the world and society in every dimension. If serious attempts are not made by the people with a missionary spirit, may Miltons and Hellen Kellers may go un-identified and unrecognized to the humble graves. Any society which fails to respond effectively to the problems and potentials of disabled accept not only a huge loss of human resources, but a cruel was of human potential.

Besides this, it is regrettable to know that, despite sporadic scientific advances, studies in the field of orthopaedically disabled are still passing through the stage of infancy. Hence, the category orthopaedically disabled was selected for this exploratory study as they have a peculiar problem of suffering from a deficit which hampers their movement and reactions, though not sensorily affected as the visually and hearing impaired.

MATERIALS AND METHODS

Avinashi lingam Higher Secondary School, St. Michael Boy's Higher Secondary School, R.G. Boy's Higher Secondary School, R.G. Girl's Higher Secondary School, Star School, Families for Children of Coimbatore District were selected as the universe as they had integrated orthopaedically disabled in their school (Table 1). Hundred adolescents between the age-group of 13 to 18 were selected as the target group. Goldberg (1981) has highlighted adolescence as period of "Conflict and Strife" for an orthopaedically disabled adolescent and hence this age-group was selected to study their problems and personality dimensions. Forty two per cent of the selected sample were in the age-group of 13-15 years and 58 per cent were in the age-group of 16-18 years. Purposive sampling technique was adopted as it offers good judgement and appropriate strategy and one can handpick the cases to be included in the sample (Wilkinson and Bhandarkar, 1982).

As pointed out by Choudhury (1996), questionnaire is considered to be an effective tool. A questionnaire was developed eliciting details regarding family members, their education, occupation, total income of the family and the type of the family. Details on the nature of the handicap, onset of handicap and history of handicap in the family were also explored.

Table 1: Tools selected for the study

Aspects Studied	Tools	Content
General information about the family	Family Background Questionnaire	Number of Family Members, Income, Nature of Handicap, On set of Handicap and History of Handicap in the Family
Problems faced by the Orthopaedically Disabled	Problem Checklist	Home and Family, Educational, Social, Emotional, Financial, Recreational, Mobility and Problems Relating to day-today Activities.

A check-list was developed to spot out the problems of orthopaedically disabled adolescents. According to Burg and Gall (1983) checklist is a collection of items presented to the individual to check and tick mark those items that are applicable to him/her. Initially 160 problem statements were evolved by the investigator. They were submitted to the experts for scrutiny after which it was reduced to 120 statements. This was classified into eight areas that is Home and Family, Educational, Social, Emotional, Financial, Recreational, Mobility and Problems related to day-to-day activities. Each area consisted of 15 problem statements and the respondents were to tick 'yes' or 'no' for each item.

The respondents were instructed to tick (√) under 'yes' column if those statements were applicable to them and if it were not applicable they had to tick (√) under 'no' column. A score on 'yes' was given one mark whereas a score on 'no' was given a zero mark. A higher score on 'yes' indicated more problems, whereas a higher score on 'no' indicated less problems. Initial contact with the officials who are in charge of the institutes were established. After getting their permission, the adolescents were contacted and a rapport was established. The purpose of the study was explained. Efforts were made to collect data under conditions conducive to the selected sample.

RESULTS AND DISCUSSION

The family background information of the sample is an important variable in any research as it helps to understand clearly the diverse factors that affect an individual. Hence, the general background information of the selected group was probed into.

According to Housing and Urban Development Corporation (1994), low income is income less than Rs. 2000/-per month and middle income ranges between Rs. 2001 to Rs.6000 and income group which falls above Rs. 6000 is high income group. As for the family income of the selected sample, 51 per cent of the sample belonged to low income group, while 49 per cent of the sample belonged to middle income group. One of the striking finding of this study is that there was not a single sample in the higher income group. This shows that the incidence of the orthopaedic disability is more prevalent among the low and middle income groups.

All the samples reported that there was no incidence of disability in their family earlier. It may be said that heredity is not a causative factor for orthopaedic disability. Concerning occupation of the parents of the selected sample, 49 per cent of the parents were engaged in clerical jobs such as clerk, typist and laboratory assistantship, while 21 per cent of the parents were engaged as drivers, chowkiders and casual labours and 16 per cent were in business line. Only 14 per cent of the parents of the sample were in professional line such as teachers, engineers.

Thirty one per cent of fathers of the sample were degree holders, while 38 per cent of the father had completed higher secondary level and the rest were in high school level. As regards maternal educational level, 16 per cent of the mothers were degree holders, 30 per cent were in higher secondary level and 54 per cent had completed high school level. Among the sample, 63 per cent of the sample belonged to nuclear family and the rest belonged to joint family. The physical handicap and the consequent social, economic and psychological disabilities that arise from it distinguishes the disabled from others in no small way. It is therefore a matter of relevance to know the onset and cause of disability.

In this study, poliomyelitis (62%) was the most common cause of disability among the sample followed by congenital defects (21%). Basu and Sokhey (1984) and Kumar *et al.* (1990) have also reported that poliomyelitis was the main contributory cause of disability. This study also confirms that in spite of Intensive National Poliomyelitis and Immunization Programmes, Poliomyelitis predominantly affects children. Majority of the sample were afflicted during the early years (below 3 years) of their lives which may perhaps be due to their vulnerability to infection and diseases. Family and education is vital to the process of mainstreaming the disabled persons as it helps to face highly competitive and complex society. Thus, it is necessary to identify their problems in the family and education context. Table 2 depicts the problems stated by the sample in their home environment and education.

As for home and family problems, (89%) of the selected sample stated that 'parents are overprotective', 'parents treat me as a child (79%)', 'parents expect

Table 2: Home, family and educational problems of the selected adolescents (N=100)

Problem areas	Percentage
Home and family problems	
Parents are overprotective	89
Being treated me as a child	79
Parents expect beyond my capacity	76
Hesitation to talk about problems with parents	73
Parents not being able to solve my problems	65
Educational problems	
Inability to participate in educational programme	88
Afraid of expressing their problems to teachers	73
Scared of teachers	60
Missed too many days due to health problems	56
Teachers do not show concern to our problems	53

beyond my capacity (76%) 'hesitation to talk about problems with parents (73%)' and 'parents not being able to help to solve problems (65%)'. From their responses, it can be concluded that parents hinder the development of the sample by overprotecting them. Tayal (1993) rightly stated that most of the parents overprotect their disabled children leading to more serious disability condition than their actual disability and hamper their emotional stability.

Eighty eight per cent of the sample stated that they were 'not able to participate in educational programme', 'afraid of expressing problems to teachers (73%)', 'scared of teachers (60%)' and 'missed too many days of their school due to health problems (56%)', this shows that as the orthopaedically disabled have restricted mobility, it affects their education even though they are not mentally affected. It is disheartening to note that majority of the sample stated that they were afraid of telling their problems to teachers and scared of teachers. It is a serious concern on the part of the teachers when they are regarded as an important agency to bring the disabled in to the mainstream. A continuing problem for many people with disability is lack of acceptance as contributive members by the society and their emotional problems as they affect their socialization. Table 3 reveals the predominant social and emotional problems faced by the sample.

It is not encouraging to note that 73 per cent of the sample cannot make friends easily, 'feel awkward in meeting people (71%)', 'spend time alone (66%)', 'uncomfortable to participate in social affairs (65%)' and 'being treated differently by neighbours (60%)'. This shows that inspite of many efforts by the government and non-government organizations to bring the disabled into the mainstream, people still have a negative attitude towards the disabled because a disabled person's functioning and attitude towards other peoples result from the attitude of the society towards them. This finding is in consonance with the finding of Harris (1986), who reported that disabled persons, faced restriction in their mobility around the community, attending cultural events, socializing with friends outside their home as they feel uncomfortable due to society's attitude.

Table 3: Social and emotional problems of the selected adolescents (N=100)

Problem areas	Percentage
Social problems	
Cannot make friends easily	73
Feel awkward in meeting people	71
Spend time alone	66
Uncomfortable to participate in social affairs	65
Treated as being different by neighbours	60
Emotional problems	
Get to hurt easily	90
Unable to control emotions	83
Worried about future	75
Get to crying easily	68
Display aggressive behaviour when parents puts restriction	68
Submit easily to other's command	54

In emotional area, 90 per cent of the sample stated that they 'get hurt easily', 'unable to control emotions (83%)', 'worried about future (75%)' and 'get to crying easily (68%)'. This shows that majority of the sample were emotionally not very secured. This finding is in tune with the finding of Advani (1994) and Goldberg (1981) that physically disabled adolescents' serious problems are feeling of insecurity, emotional instability and anxiety for the future. This high incidence of emotional problems may be due to restrictions in their mobility. Thus, this should be a serious concern for the planners, educators and teachers to evolve suitable

strategies in order to help them to cope up with their disability.

Money plays an important role in one's life and influences one's social interaction. William *et al.* (1992) stated that recreation is very important for a disabled person because it can be used for intervention in physical, emotional and social behaviour to modify behaviour and promote individual growth and development. Thus, it becomes necessary to assess their financial and recreational problems. Table 4 projects the predominant financial and recreational problems of the sample.

Table 4: Financial and recreational problems of the selected adolescents (N=100)

Problem areas	Percentage
Financial problems	
Want to earn money on our own	100
Pocket money given is inadequate	91
Not enough money to entertain friends	83
Parent's do not give pocket money regularly	76
No bank account	55
Recreational problems	
Afraid of participation in games	87
Lack ability to play games	85
Get too tired after playing	80
Dropped from participating games due to health problems	59
Peers discourage my participation	53
Did not get enough leisure	51

'Wanting to earn money on our own (100%)', 'pocket money given being inadequate (91%)' and 'parents did not give pocket money regularly (76%)' were the financial problems expressed by the orthopaedically disabled adolescents.

Antia (1990) stated that the ultimate goal for many disabled people is to be economically independent and financial secure. Access to employment is vital for them. Opportunities to undergo vocation based education would form a sound basis for the orthopaedically disabled. Concerning recreational problems, 87percent of the sample stated that they were 'afraid of participating in games' and 'lacked ability to play games (85%). Fifty three per cent of sample stated that 'peers discourage their participation', while 51 per cent of the samples mentioned that their leisure time was inadequate. This might be due to the reason that as there was restriction in their mobility, they might not have been able to keep pace with their abled peers in games. This finding perhaps reflects that they are discriminated on the grounds of their disability.

Beggi (1991) and Bannerjee (1990) stated that recreation is an important fact of extending services to persons with disabilities. As the adolescents in this study have projected inadequate use of leisure time, it is suggested that appropriate and interesting for them both at home and schools. Tatenini (1990) exhorted that there is definitely a need to study the actual barriers orthopaedically disabled persons face in their environment, transportation and day-to-day activities to evolve schemes which can reduce the constraints they recently face. Table 5 provides a glimpse of the dominant problems in mobility and daily activities faced by the sample.

Table 5: Mobility and problems in daily activities of the selected adolescents (N=100)

Problem areas	Percentage
Mobility Problems	
No ramp facilities in schools	100
Very difficult to climb up steps	89
Public transport is frightening	81
Major institutions are inaccessible to me	71
Problems in daily activities	
Unable to share household activities	77
Unables to read for a long time	73
Not able to lift heavy things	64
Unable to write for a long time	61
Dependent on others for shopping	55

'Schools lacking ramp facilities' stand uppermost in the minds of all the orthopaedically disabled adolescents and hence, they had serious 'difficulties to climb up steps (89%)'. Public transport is frightening to travel (81%)' and 'major institutions are inaccessible to me (71%)' were the other reasons put forward by the adolescents. This finding stresses the importance of providing ramp facilities at all public places and vehicles specially for orthopaedically disabled to enable them have no problems in mobility.

It is rather striking to note that 77 per cent of the sample stated that they were 'unable to participate in household activities', 'unable to read for a long time (73%)', 'unable lift heavy things (64%)'. It is very disheartening to note that 55 per cent of the sample stated that they were 'dependent on others for shopping'. Perhaps provision of public vehicles for the disabled exclusively at selected timings would reduce these problems to a great extent. To test whether there was any significant difference between congenital, poliomyelitis and accident group, ANOVA was applied for the three groups in all the problem areas (Table 6). There was a significant difference among the three groups in all areas except in problems related to financial and daily activities. The 'F'- ratio was found to be 5.65 for home and family, 3.14 for educational, 18.40 for social, 15.73 for emotional, 4.50 for recreational and 4.86 for mobility and 13.22 for overall problems which were highly significantly at one per cent level. The L.S.D (least significance procedure) test was applied to find out which of the three groups (based on groups) differed significantly. It was found that in all areas, the problems of the accident group was significantly. It was found that in all areas, the problems of the accident group was significantly higher than those affected by congenital and poliomyelitis. This showed that the

Table 6: Problems of selected adolescents in relation to causation of disability

Problem areas	Causative factors	(N=100)	Mean	S.D.	S.E.	F-ratio
Home and Family	Congenital	21	4.14	1.79	.39	5.65*
	Poliomyelitis	62	5.17	1.60	.20	
	Accident	17	5.76	2.33	.56	
Educational	Congenital	21	4.28	2.19	.47	3.14**
	Poliomyelitis	62	4.83	1.84	.23	
	Accident	17	5.88	2.14	.52	
Social	Congenital	21	3.28	1.45	1.45	18.40**
	Poliomyelitis	62	3.91	1.72	1.72	
	Accident	17	6.35	1.65	1.65	
Emotional	Congenital	21	8.85	2.79	.61	15.73**
	Poliomyelitis	62	8.80	2.98	.37	
	Accident	17	13.00	1.93	.46	
Financial	Congenital	21	10.95	2.22	.48	.83NS
	Poliomyelitis	62	10.37	2.77	.35	
	Accident	17	11.11	1.53	.37	
Recreational	Congenital	21	3.90	2.07	.45	4.50**
	Poliomyelitis	62	4.46	1.84	.23	
	Accident	17	5.76	2.16	.52	
Mobility	Congenital	21	4.57	1.71	.37	4.85**
	Poliomyelitis	62	4.53	1.78	.22	
	Accident	17	6.05	2.10	.51	
Daily activities	Congenital	4.61	2.17	.47	1.24	NS
	Poliomyelitis	4.30	1.79	.22		
	Accident	5.11	1.96	.47		
Overall	Congenital	44.61	10.61	2.31	13.22**	
	Poliomyelitis	45.41	10.04	1.27		
	Accident	59.05	9.81	1.13		

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

hypothesis 'there is no difference on problem scores in relation to type of disability' is rejected. It may be inferred that the variation in problem among the three groups might be due to the fact that the accident group have face in the primes of their lives, a change in environment to which it is very difficult to adapt unlike those who are born as orthopaedic disabled and are affected to be so due to poliomyelitis. This accident group perhaps would have had a traumatic effect having lead a very active and vigorous life and then suddenly facing a drastic change.

CONCLUSION

It is said "Strengths does not come from physical capacity. It comes from an indomitable will". Efforts are needed to induce this indomitable will in every orthopedically disabled child's mind so that there is an eternal flame, a ray of hope to help them realize that each one of them can be a useful and productive member of the family and society and instill to belief that "to have a stunted body does not mean to have a stunted life" and Show to the world that "Disability is no Liability".

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Research Article

Dyeing of Protein Fabric using Eco-friendly Dye Sources

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ABSTRACT

Natural dyes are used primarily to impart color to textiles, leather, paints, photographs, cosmetic and pharmaceutical products, biological stains, and food. Natural dyes offer better UV absorption in the fabrics on which they are used. By wearing naturally dyed clothing, you are therefore able to better protect your skin from the sun's harmful rays. Hence, in the present study natural dyes were extracted from Rubia Cordifolia (*Manjistha*), Log Wood (*Haematoxylum campechianum*), and Charcoal using conventional extraction method. To enhance the dye ability Alum mordant was used in power form along with natural dye solution. The results indicates that the dye source of Rubia Cordifolia (*Manjistha*) gives Burgundy Red, Log Wood (*Haematoxylum campechianum*) gives Vivid Purple and Charcoal gives Gray color with the concentration of 8% at PH 7 with extraction time of 160 min at 80°C using Eco-Friendly Silk Fabric.

Keywords: Natural dye-Rubia Cordifolia (*Manjistha*), Log Wood *(Haematoxylum campechianum),* Charcoal, Eco-friendly extraction process, Natural mordants-Alum, Color fastness

INTRODUCTION

The major users of dyes in India are textiles, paper, plastics, printing ink and foodstuff industries Natural dye comprise those colorants (dyes and pigments) that are obtained from animals and vegetables matter without chemical processing (Vankar *et al.*, 2016). They are mostly used to dye cellulose-based materials. It is inexpensive, has good wash-fastness, and has poor sunlight resistance. "Natural Colors" are generally derived from fruits, vegetables and minerals.

A mordant or dye fixative is a substance which is used to set dyes on fibers. It forms a coordination complex with the dye which attaches to the fiber. As a result, mordants enhance the wash- and lightfastness of the dyed yarn or fabric. Mordanting is very important for dyeing. There are two processes concerned with the mordant process. The first is mordanting and the second is the actual natural dye coloring (Behera *et al.*, 2016). Aluminum salts are the most commonly used mordants. They are easy to use and make natural dyes *lightfast, washfast,* and *vibrant*. Cotton and silk is a oldest and natural protein fiber, some forms of which can be woven into textiles. Silk is finer than human hair yet is as strong as an iron wire of the same diameter. Silk is resistant to moths and dust mite (Yadav *et al.*, 2018).

Natural dyes are biodegradable, non-toxic and non-allergenic. Provided they are processed in a way that avoids the use of harmful chemicals during the dyeing and finishing process, they have a much lower environmental impact than synthetic dyes. Textile dyes include acid dyes, used mainly for dyeing wool, silk, and nylon; and direct or substantive dyes, which have a strong affinity for cellulose fibres (Table 1). Mordant dyes require the addition of chemical substances, such as salts, to give them an affinity for the material being dyed.

Rubia Cordifolia (Manjistha): The dye source concentration was optimized by keeping temperature and time as constant. Dye was extracted by taking

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Table 1: Three natural dye source were selected

Name of the dye source	Form of dye source	Colour
Rubia Cordifolia (*Manjistha*)	Power form	Burgundy Red
Log Wood *(Haematoxylum campechianum)*	Power form	Vivid Purple
Charcoal	Power form	Grey

various concentrations of Rubia Cordifolia (*Manjistha*) powder (1g-10g) in 100 ml of water individually. The dye source concentration which showed Rubia Cordifolia (*Manjistha*) gives Burgundy Red colour with the concentration of 8% at PH 7 with extraction time of 160 min at 80°C highest optical density value was fixed as optimum dye concentration for further study.

Log Wood *(Haematoxylum campechianum)*

The dye source concentration was optimized by keeping temperature and time as constant. Dye was extracted by taking various concentrations of Log Wood (*Haematoxylum campechianum*) powder (1g-10g) in 100 ml of water individually. The dye source concentration which showed Log Wood (*Haematoxylum campechianum*) gives Grey colour with the concentration of 8% at 7 pH and with extraction time 160 min at 80°C highest optical density value was fixed as optimum dye concentration for future study.

Charcoal: The dye source concentration was optimized by keeping temperature and time as constant. Dye was extracted by taking various concentrations of Charcoal powder (1g-10g) in 100 ml of water individually. The dye source concentration which showed Charcoal gives Grey colour with the concentration of 7% at PH 8 with extraction time of 160 min at 80°C highest optical density value was fixed as optimum dye concentration for future study.

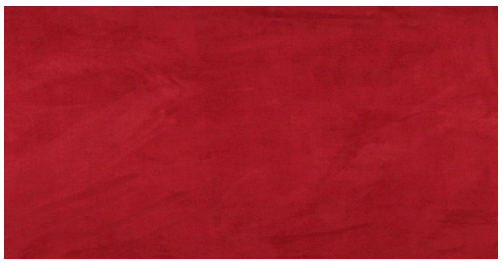
Dye source concentration: The dye source concentration was optimized by keeping temperature and time as constant. Dye was extracted by taking various concentrations of various sources was taken in (1g-10g) in 100 ml of water individually.

Dry Form

Powder Form

Extraction of dye source

Dyed cotton fabric using extracted Rubia Cordifolia

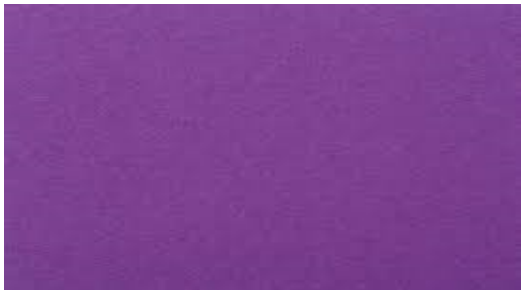


Optimization of dye source with various parameters for dye extraction

Dry form **Powder form** **Extraction from source**



Dyed Cotton Fabric using Log Wood



Optimization of dye source with various parameters for dye extraction

Dry form **Powder form** **Extraction from source**



Dyed cotton fabric *(Pathak wood)* Charcoal

Optimization of various parameters for dye extraction

COLOUR FASTNESS Test for Washing and Perspiration

Source of Sample	Washing Fastness		Perspiration Fastness	
	ALT	ST	Acidic	Alkaline
Rubia Cordifolia (*Manjistha*)	3\5	3|5	4|5	4|5
Log Wood *(Haematoxylum campechianum)*	3|5	4\5	3\5	4|5
Charcoal	3|5	3\5	3\5	3|5

COLOUR FASTNESS Test for Rubbing

Source of Sample	Dry Rubbing		Wet Rubbing	
	Colour Staining	Colour Change	Colour Staining	Colour Change
Rubia Cordifolia (*Manjistha*)	4\5	4|5	4|5	5
Log Wood *(Haematoxylum campechianum)*	4\5	3\5	4\5	4|5
Charcoal	3\\|5	3|5	3|5	4|5

COLOUR FASTNESS Test for Light

Source of Sample	Light Fastness	
	Colour Staining	Colour Change
Rubia Cordifolia (*Manjistha*)	4|5	4|5
Log Wood *(Haematoxylum campechianum)*	5|5	5|5
Charcoal	3||5	3|5

Time: To determine the optimum dye extraction time, the dye was extracted at different time intervals such as 30, 60, 90, 120, 150, 180 mins. The time at which the dye yield maximum was selected as optimum time for extraction of dye.

Temperature: To determine the optimum temperature for dye extraction, extraction was carried out at different temperatures namely 60, 70, 80, 90 and 100°C, with optimum dye extraction time and dye source concentration. The temperature at which the optical density value was highest was selected as optimum temperature and followed.

pH: To determine the optimum pH for dye extraction, the pH of the solvent was adjusted. The pH at which the color intensity was maximum was selected as optimum pH and used for subsequent studies.

DYEING

To start dyeing process, water is boiled in a huge copper container. Once water is boiled at high temperature, the dye materials–washing soda, soap oil, dye color are added to the boiling water. The off-white silk fabric is dipped into the colored boiling solution.

MORDANTING TECHNIQUE

Selection of mordant: The importance of the "mordant" comes in when the dye has no affinity to the fiber. Most of the natural colorants require an intermediate to fix in to the fiber, which is called mordant (Ammayappan *et al.*, 2013). Hence to fix the dye on the selected fabric, the mordant namely Alum powder was selected for the present study.

Extraction of mordant: Required quantity of mordant powder (8g) was taken in 1000 ml of water and boiled for 30 minutes and then it was cooled for 1 hours. Then the boiled solution was filtered using clean filter paper. This extracted mordant solution was used for mordanting.

Selection of mordanting technique: For simultaneous mordanting techniques, dyeing and mordanting was carried out in same bath.

COLOUR FASTNESS

The selected cotton fabric was dyed with the selected natural dye sources such as Rubia Cordifolia (*Manjistha*),

Log Wood *(Haematoxylum campechianum),* and Charcoal using conventional method. The dyes samples were tested for its colour fastness property using washing method. The result shows that washed fabric showed good colour fastness towards washing, Rubbing, Light and Perspiration. The colour fastness is the important factor of Natural Dyeing process. his test measures the color fastness of textiles in domestic and commercial laundering processes according to the EN ISO 105-C standard.

CONCLUSION

Textile industry has been one of the most important sectors in the Indian Economy. Indian textile industry has great potential to dominate the Global Textile Market. Textile industries are facing a challenging condition due to the globalization of the world market. Recently the interest in the use of natural dyes has been growing rapidly due to the result of stringent environmental standards imposed by many countries in response to toxic and allergic reaction associated with synthetic dyes. Growing consciousness for use of eco friendly products in daily life has generated renewed interest of consumers towards use of textiles from natural fibers dyed with eco friendly natural dyes. Traditionally the extraction of natural dyes from plant materials was done by soaking method or boiling method which requires longer extraction time, higher temperature and higher consumption of water. The present study reveals that Conventional extraction is an efficient techniques for the extraction of natural dye from Rubia Cordifolia (*Manjistha*), Log Wood (*Haematoxylum campechianum*), and Charcoal. The Conventional dye extraction reduces the extraction time and improved the dye yield. The dyed fabrics showed good UV protection property.

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Research Article

Interplay of Age and Gender on Mental Health Problems and Coping Skills among College Students of Ankola Taluk

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ABSTRACT

This cross-sectional research is intended to explore the interplay of age and gender on mental health problems (anxiety, depression, and stress) and coping skills (Problem-focused, Emotional-focused, and dysfunctional-focused) among college students of Ankola Taluk, Uttara Kannada District, Karnataka. The sample consisted of 1455 college students. A self-structured questionnaire was used to gather socio-demographic information. Anxiety Depression Stress Scale (ADSS) and COPE Inventory were used to assess mental health problems and coping skills respectively. The results indicated that the maximum samples constituted females (66.8%) and a higher percentage of the samples were of 19 years of age (37.73%) followed by 18 years (33.12%), and 20 & above years (29.14%). Age differences in mental health problems emerged significantly, while gender differences in mental health problems were not significantly noticed. Females aged 18 years displayed higher mean scores for all mental health problems, in contrast, males aged 19 years exhibited higher mean scores for all mental health problems. Females aged 20 and above years displayed higher mean scores for anxiety and stress, while males aged 20 and above years showed higher depression scores. Regarding coping skills, both age and gender differences were significantly noticed. Both Males and Females aged 20 and above years showed higher mean scores for problem-focused and emotional-focused skills while males and females aged 19 years depicted higher mean scores for dysfunctional coping skills. As per multivariate analysis, there was no significant interplay of gender and age on mental health problems and coping skills. These findings confirm that age and gender independently influence on mental health problems and coping skills of college students.

Keywords: Anxiety, Depression, Stress, Coping skills, College students

INTRODUCTION

College students navigate a unique life stage marked by ongoing mental maturation yet lingering immaturity. The intricacies of their interpersonal communications contribute to mental stress (Juru Yang and Lei Zhang, 2005). Globally, higher education students experience elevated levels of stress, anxiety, and depression, as highlighted in a study by Mohammad *et al.* (2020). Research conducted by Rosenberg (2018) indicates that 1 in 5 college students grapple with anxiety and depression. The prevalence of depression among college students is notably high, reaching 30.6 per cent, a significant increase compared to the general population, as reported by Ibrahim *et al.* (2013). Lawton's findings in 2019 underscore that students in higher education face substantial levels of stress and anxiety.

Coping is considered a stabilizing factor aiding psychosocial adaptation during stress (Walton, 2002). Students employ various stress-reducing methods, including effective time management, social support, positive reappraisal, and leisure activities. In medical school, initial coping often involves emotion-based strategies like self-blame, shifting towards

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confrontation, cognitive, and planned problem-solving in later years (Sayedfatemi *et al.,* 2007; Wolf, 1994; Supe, 1998; Stern *et al.,* 1993). Engaging coping strategies show a capacity to modify situations and yield more adaptive outcomes, with fewer reported depression symptoms (Lerner, 1995; Wolf, 1994).

MATERIALS AND METHODS

The study employed a cross-sectional design, utilizing a survey method to collect data. A self-structured questionnaire was designed to gather socio-demographic information. The mental health of participants was assessed using the Anxiety Depression Stress Scale (ADSS) developed by Bhatnagar *et al.* (2011), while coping skills were measured using the COPE Inventory (Complete version) developed by Carver *et al.* (1989). The sample consisted of 1455 students, including 972 females and 483 males, aged between 18 to 24 years. The ADSS Scale comprises three sub-scales focusing on Anxiety, Depression, and Stress. It includes 48 items covering physical, cognitive, emotional, and behavioural symptoms categorized into three subscales: Anxiety (19 items), Depression (15 items), and Stress (14 items). Responses were scored as 'Yes' (1) or 'No' (0). The score ranges from 0-19 for the anxiety subscale, 0-15 for depression, and 0-14 for stress. A higher score indicated a higher level of anxiety, depression, or stress.

The COPE Inventory included 60 items under different coping dimensions. These dimensions were categorized into Problem-focused coping (e.g., active coping, planning, restraint, instrumental social support, separation of competing activities), Emotion-focused coping (e.g., positive reinterpretation and growth, religious coping, humour, acceptance, use of emotional and social support), and less useful coping/ dysfunctional coping (e.g., mental disengagement, focus on and venting of emotion, use of denial, behavioral disengagement, substance use). Participants rated their responses on a four-point Likert scale: 'I usually don't do this at all,' 'I usually do this a little bit,' 'I usually do this a medium amount,' and 'I usually do this a lot,' with scores 1, 2, 3, and 4, respectively.

The study obtained informed consent from the participants and institutional ethical approval from the University of Mysore. Permission was also secured from college authorities before administering the research tools. Data were entered into Excel and statistically analysed using SPSS version 16.0 for Windows.

RESULTS AND DISCUSSION

Table 1 presents the distribution of students for personal details in the research study. Each variable is categorized, and the table shows the frequency / counts (number of participants) and percentage for each response within the given category. The study consists of 66.8% (N=972) female students and 33.19% (N=483) male students. The most common age group is 19 years, accounting for 37.7% (N=549) of the respondents, followed by 18 years, accounting for 33.12% (N=482), and 29.1% (N=424) 20 years & above. Among 18 years 39.41% (N=190) were male and 60.58% (N=292) were female. Among 19 years age group 31.69% (N=174) were male and 68.30% (N=375) were female. Among 20 and above years 28.06% (N=119) were male and 71.93% (305) were female.

Table 1: Age and gender distribution among study sample

Age (Years)	Male	Female	Total
18	190(39.41%)	292(60.58%)	482(33.12%)
19	174(31.69%)	375(68.30%)	549(37.73%)
20& above	119(28.06)	305(71.93%)	424 (29.14%)
Total	483(33.19%)	972(66.80%)	1455(100%)

The statistical findings presented in Table 2 indicates that age differences in mental health problems emerged significantly, among 18 years females demonstrated highest mean score of anxiety (7.98±5.90), depression (6.24±4.86) and stress (6.48±4.48) than males' anxiety (7.85±6.52), depression (5.99±5.33) and stress (6.06±5.15) mean scores. Whereas among 19 years males demonstrated highest mean score of anxiety (8.25±6.75), depression (6.63±5.48) and stress (6.59±5.01) than females' anxiety (7.85±5.50), depression (6.02±4.81) and stress (6.43±4.41). Mixed results were observed among 20 years and above age group that is females demonstrated high mean scores in anxiety (6.70±5.28) and stress (5.79±4.31) than males mean score of anxiety (6.59±5.76) and stress (5.66±4.57). whereas males show high mean score in depression (5.37±4.89) than females (4.91±4.65).

Table 2: Age, gender and mental health among study sample

Age (Years)		Gender	Total anxiety score *	Total depression score *	Total stress score*	Total mental health score *
18	Female	Mean	7.98	6.24	6.48	20.70
		N	292	292	292	292
		Std. Deviation	5.901	4.866	4.483	14.819
	Male	Mean	7.85	5.99	6.06	19.90
		N	190	190	190	190
		Std. Deviation	6.524	5.339	5.158	16.703
	Total	Mean	7.93	6.14	6.32	20.38
		N	482	482	482	482
		Std. Deviation	6.148	5.054	4.760	15.577
19	Female	Mean	7.85	6.02	6.43	20.30
		N	375	375	375	375
		Std. Deviation	5.501	4.813	4.412	14.185
	Male	Mean	8.25	6.63	6.59	21.46
		N	174	174	174	174
		Std. Deviation	6.753	5.486	5.012	16.925
	Total	Mean	7.98	6.21	6.48	20.67
		N	549	549	549	549
		Std. Deviation	5.923	5.039	4.607	15.102
20	Female	Mean	6.70	4.91	5.79	17.40
		N	305	305	305	305
		Std. Deviation	5.281	4.657	4.315	13.699
	Male	Mean	6.59	5.37	5.66	17.61
		N	119	119	119	119
		Std. Deviation	5.766	4.890	4.578	14.775
	Total	Mean	6.67	5.04	5.75	17.46
		N	424	424	424	424
		Std. Deviation	5.415	4.722	4.385	13.992
Total	Female	Mean	7.53	5.74	6.24	19.51
		N	972	972	972	972
		Std. Deviation	5.580	4.809	4.410	14.288
	Male	Mean	7.68	6.07	6.15	19.90
		N	483	483	483	483
		Std. Deviation	6.451	5.298	4.971	16.365
	Total	Mean	7.58	5.85	6.21	19.64
		N	1455	1455	1455	1455
		Std. Deviation	5.882	4.977	4.602	15.005

The result of the present study is persistent with other studies like, Kessler *et al.* (2005) their study says most mental health disorders have their peak onset during young adulthood. Among college students, mental health problems not only are common, but they often persist for several years, (Zivin *et al.,* 2009). Common mental health problem among college students is depression, with prevalence rates in college students of 7 to 9% (Blanco *et al.,* 2008; Eisenberg *et al.,* 2013). Zisook *et al.* (2007), in their study found that over half

skill (39.73±14.14) and dysfunctional coping skill (36.83±12.41) mean scores. Among 19 years also females demonstrated highest mean score of problem-focused coping skill (48.15±11.69), emotion-focused coping skill (48.61±11.91) and dysfunctional coping skill (42.33±9.85) than males' problem-focused coping skill (41.90±14.59), emotion-focused coping skill (41.66±14.43) and dysfunctional coping skill (39.58±13.06). Even among 20 years and above age group females demonstrated high mean scores in problem-focused coping skill (49.94±10.19), emotion-focused coping skill (50.31±10.70) and dysfunctional coping skill (41.80±7.99) than males mean score of problem-focused coping skill (43.24±12.75), emotion-focused coping skill (43.60±13.38) and dysfunctional coping skill (39.17±9.88).

Gender differences were evident in both coping dimensions and individual coping strategies used. Females were found to utilize the emotion-focused coping dimension and endorsed the use of four coping strategies more often than males, these included self-distraction, emotional support, instrumental support, and venting (Graves *et al.,* 2021). Gender-specific differences in coping strategies have yielded inconclusive findings across various studies. While some past research (Hamilton and Fagot, 1988; Rosario *et al.,* 1988) did not identify these differences, other studies have shown that females tend to utilize more problem-focused coping strategies in terms of seeking social support (Matud, 2004; Kieffer *et al.,* 2006). Conversely, additional research suggests that males lean toward more emotion-focused strategies compared to females (Kieffer *et al.,* 2006; Sigmon *et al.,* 1995). However, these findings have been challenged by studies indicating that females actually employ more emotion-focused coping strategies than males (Eaton and Bradley, 2008; Harju and Bolen, 1998). In contrast no gender differences in coping with stress were found in a study by Donaldson *et al.* (2000). Consequently, these collective studies underscore the absence of a universally accepted consensus regarding gender-specific coping strategies. While the differences were not statistically significant, females had higher mean scores than males on the express emotion, social support, problem avoidance and social withdrawal primary coping scales; and males scored higher than females on the problem-

Table 3: Multiple comparisons in between age and mental health

Mental health aspects	(I) Age (years)	(J) Age (years)	Mean difference (I-J)	Std. error	Sig
Anxiety	18	19	-.05	.366	.990
		20	1.26*	.390	.006
	19	18	.05	.366	.990
		20	1.31*	.379	.003
	20	18	-1.26*	.390	.006
		19	-1.31*	.379	.003
Depression	18	19	-.07	.309	.975
		20	1.10*	.330	.004
	19	18	.07	.309	.975
		20	1.17*	.320	.001
	20	18	-1.10*	.330	.004
		19	-1.17*	.320	.001
Stress	18	19	-.16	.287	.853
		20	.57	.306	.182
	19	18	.16	.287	.853
		20	.73	.297	.050
	20	18	-.57	.306	.182
		19	-.73	.297	.050

* The mean difference is significant at the .05 level

of all cases of depression had a first onset during childhood, adolescence, or young adulthood. According to the Spring 2019 Health Assessment by the American College of Health Association, 34.2% of undergraduate college students had indicated the top impediment to learning was stress, with 45.3% having more than average stress, which may indicate an individual could be more prone to certain illnesses and accidents. This stressful environment has left college students vulnerable to mental health problems, such as anxiety, depression, self-harm, and suicidality

Table 3 shows Age differences in mental health problems emerged significantly. Young adults ages 18–25 have higher prevalence of any psychiatric disorder (29.4%) compared with other adult age (National Institute of Mental Health, 2021). Hunt and Eisenberg (2010) noted that mental health among college students is a growing concern (Ex. 95% of university counselling centre directors surveyed reported an increase in student psychological problems). Students reportedly are experiencing more severe stress (Benton *et al.,* 2003) and fewer psychosocial development and prevention programmes at the university level (Shek and Wong, 2011).

Table 4 shows there is no significant interplay of gender and age on mental health. In Table 2 we can clearly see that females aged 18 years displayed higher mean scores for all mental health problems, in contrast, males aged 19 years exhibited higher mean scores for all mental health problems. Females aged 20 and above years displayed higher mean scores for anxiety and stress, while males aged 20 and above years showed higher depression scores. This result is consistent with the study by Graves *et al.* (2021) the majority of undergraduate female students experienced medium to higher levels of stress. The males experienced much lower perceived stress levels than the females. In contrast Kumar and Archana (2020), in their cross-sectional study, using DASS questionnaire to assess the depression, anxiety and stress levels of students of 18-22 years of age found significantly high percentage of male students had higher scores in depression, anxiety and stress compared to the female students. But further statistical analysis in Table 3 in the present study shows no significant gender differences among study sample. This result is consistent with the study by Gao *et al.* (2020) where they analysed 1892 undergraduate students from 15 universities in China, with 898 females and 994 males, where female students scored significantly higher in anxiety than males, but there was no significant gender difference in students' average depression and stress levels

Coping mechanisms play a vital role in mitigating and alleviating the experiences of anxiety, depression, and stress among students. These individuals employ various coping strategies to address their mental health challenges. (Ganesan *et al.*, 2018). Coping is not a fixed trait, but a dynamic ability to prevent or control stress by applying appropriate methods to manage intrapersonal, interpersonal and environmental demands. For Folkman and Lazarus (1980). Coping can take different forms such emotion-focused coping in which individuals focus on reducing the adverse emotional reaction, and problem focused coping in which the focus is on finding out a practical way of solving stressful situation (Lazarus and Folkman, 1984), also described as active and passive (Jex *et al.,* 2001) or approach and avoidance (Anshel, 1996) stress coping styles. Examining the coping process among students may offer further insight about how students differ in their response to anxiety, depression and stress.

The statistical findings presented in Table 5 indicates regarding age, gender and coping skills. Among 18 years females demonstrated highest mean score of problem-focused coping skill (45.70±14.06), emotion-focused coping skill (45.76±13.90) and dysfunctional coping skill (41.09±11.94) than males' problem-focused coping skill (40.25±14.85), emotion-focused coping

Table 4: Tests between-subjects effects in age, gender and mental health

Dependent variable	Source	Type III sum of squares	df	Mean square	F	Sig.
Anxiety	Gender * age in years	20.040	2	10.020	.292	.747
Depression	Gender * age in years	47.596	2	23.798	.970	.379
Stress	Gender * age in years	19.393	2	9.696	.459	.632

Table 5: Age, gender and coping skill among study sample

Age (Years)	Gender		Problem focused coping skill	Emotion-focused coping skill	Dysfunctional coping skill
18	Female	Mean	45.70	45.76	41.09
		N	292	292	292
		Std. Deviation	14.065	13.904	11.944
	Male	Mean	40.25	39.73	36.83
		N	190	190	190
		Std. Deviation	14.858	14.148	12.410
	Total	Mean	43.55	43.39	39.41
		N	482	482	482
		Std. Deviation	14.612	14.294	12.294
19	Female	Mean	48.15	48.61	42.33
		N	375	375	375
		Std. Deviation	11.691	11.916	9.856
	Male	Mean	41.90	41.66	39.58
		N	174	174	174
		Std. Deviation	14.599	14.438	13.062
	Total	Mean	46.17	46.40	41.46
		N	549	549	549
		Std. Deviation	13.002	13.160	11.037
20	Female	Mean	49.94	50.31	41.80
		N	305	305	305
		Std. Deviation	10.198	10.700	7.997
	Male	Mean	43.24	43.60	39.17
		N	119	119	119
		Std. Deviation	12.959	13.388	9.883
	Total	Mean	48.06	48.42	41.06
		N	424	424	424
		Std. Deviation	11.430	11.891	8.638
Total	FEMALE	Mean	47.98	48.29	41.79
		N	972	972	972
		Std. Deviation	12.136	12.317	10.023
	MALE	Mean	41.58	41.38	38.40
		N	483	483	483
		Std. Deviation	14.338	14.124	12.131
	Total	Mean	45.85	45.99	40.66
		N	1455	1455	1455
		Std. Deviation	13.250	13.343	10.882

solving and cognitive restructuring coping scales. (Monteiro *et al.,* 2014). This finding (Monteiro *et al.*, 2014) that female students seem more likely to withdraw as a way of coping may also be related to gender roles that encourage young women to engage in fantasy instead of concrete behavioural or cognitive approaches to solving problems, particularly those that may involve conflict [e.g. Bem's (1974) conceptualisation of gender role orientation, Brems and Johnson, 1989].

Table 6: Multiple comparisons in between age and coping

Coping skills	(I) Age (years)	(J) Age (years)	Mean difference (I-J)	Std. error	Sig
Problem -focused	18	19	-2.62*	.801	.005
Coping Skills		20	-4.51*	.855	.000
	19	18	2.62*	.801	.005
		20	-1.89	.830	.076
	20	18	4.51*	.855	.000
		19	1.89	.830	.076
Emotion -focused	18	19	-3.02*	.802	.001
Coping Skills		20	-5.04*	.855	.000
	19	18	3.02*	.802	.001
		20	-2.02	.831	.052
	20	18	5.04*	.855	.000
		19	2.02	.831	.052
Dysfunctional	18	19	-2.05*	.671	.009
Coping Skills		20	-1.65	.716	.069
	19	18	2.05*	.671	.009
		20	.40	.695	.848
	20	18	1.65	.716	.069
		19	-.40	.695	.848

Table 6 that comparison between age groups shows both Males and Females aged 20 and above years showed higher mean scores for problem-focused and emotional-focused skills while males and females aged 19 years depicted higher mean scores for dysfunctional coping skills. A study by Bamuhair (2015) and Shaik *et al.* (2004) shows female students used more coping strategies to overcome the stress. Multiple coping methods were used for a specific stressor. Studies in Malaysia (Al-Dubai *et al.,* 2011); United Arab Emirates (Carter *et al.,* 2003) and Jordan (Bataineh *et al.,* 2006) reported similar findings. Hamarat *et al.* (2001) found that perceived stress decreased with age and that middle-aged and older adults reported more effective coping resources than younger adults. Monteiro *et al.* (2014), findings reveal that age significantly predicts the use of problem-focused engagement. Specifically, the older students are more likely to use problem-focused strategies. D'Zurilla, Maydeu-Olivares, and Kant's (1998) findings also suggested that older adults tend to adopt problem-solving coping strategies and that older adults have more effective coping resources (Hamarat *et al.,* 2001).

Table 7 shows as per multivariate analysis, there was no significant interplay of gender and age on coping skills. The result is consistent with the study conducted by Monteiro (2014) shows there were no significant gender differences in coping strategies and difference between genders was not significant in using coping strategies (Adasi *et al.,* 2020). But Graves *et al.* (2021) found that gender differences were evident in both

Table 7: Tests between-subjects effects in age, gender and coping skills

Dependent variable	Source	Type III sum of squares	df	Mean square	F	Sig.
Problem-focused Coping Skill	Gender* Age in years	82.810	2	41.405	.251	.778
Emotion-focused Coping Skill	Gender * Age in years	52.378	2	26.189	.159	.853
Dysfunctional Coping Skill	Gender * Age in years	179.273	2	89.636	.776	.461

coping dimensions and individual coping strategies used.

Differences in coping strategies have been observed between males and females. Studies suggest that females tend to rely on social support and seeking assistance when dealing with difficult situations. In contrast, males often opt for either active adaptive methods or avoidant behaviors, such as turning to alcohol or drugs (Aldwin, 2007; Dyson and Renk, 2006). Females commonly choose emotionally focused coping tactics, like seeking help or reframing situations positively (Desmarias & Alksnis, 2005; Dyson and Renk, 2006). However, some research indicates no significant gender differences in the coping approaches used by males and females to manage stress (Donaldson *et al.,* 2000). Similarly, Thoits (1995) reported that although gender is believed to influence the relationship between anxiety and the type of coping strategies chosen, these findings might occasionally lack reliability.

Overall summery of the present study findings confirm that age and gender independently influence on mental health problems and coping skills of college students. In combination these independent variable age and gender had no significant influence on mental health and coping skills in this present research.

CONCLUSION

This study contributes to the current body of knowledge by shedding light on the extent of anxiety, depression, and stress experienced by female and male undergraduate students. It also examines the diverse coping mechanisms employed by these students. Consequently, there is a growing need for educational interventions aimed at fostering sustainable and beneficial coping strategies that can positively impact students throughout their lives. Faculty and university staff would benefit from recognizing and comprehending these factors to prioritize the well-being of their students in academic settings.

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Research Article

Gellan Gum as a Sustainable Alternative in Textile Conservation for Gel Cleaning of Metal Leaf Printed Textiles

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ABSTRACT

Warak printed textiles is a traditional handicraft of India. It refers to the transfer of gold and/or silver leaf on fabric, adhered with a binding medium. Literary sources date back this craft to the Mughal Era with examples of furnishings, royal costumes and religious adornments present with museum collections globally. This alleviates the importance of conservation of these textiles. The binding medium of leaf printed textiles printed with gum acacia present the challenge of being water sensitive. The use of gels was explored for administering chelating agents for cleaning of silver leaf. Agarose gel is a commonly used gel in textile conservation. Experimentation with agarose gave promising results. Limitations of agarose gel included rigidity of gel, high cost, higher quantity required for optimum release mechanism and excess use of natural resources for the extraction of raw material. Gellan gum was explored as an alternative for administering chelating agents in gel form. High acyl and low acyl gellan gums provided advantages over agarose in the form of higher flexibility of gel formed, lower quantity of material used, and alternate source of raw material for extraction. Two most commonly used chelating agents in textile conservation were administered through gellan gum. The results were compared with those obtained from agarose gel administration. The results were qualitatively analysed through visual and microscopic evaluation and quantitatively analysed through spectrophotometry & contact time obtained. Gellan gum proved to be a successful alternative for agarose gel for administering non-ionic and ionic chelating agents. Agarose gel gave better results for administering cationic chelating agents.

Keywords: Textile conservation, Cleaning, Metal leaf printing, *Warak* printing, Gel cleaning, Gellan gum, Chelating agents

INTRODUCTION

India, the land of cultural diversity has been a storehouse of rich handicrafts for centuries. Textiles have been a significant contribution to these handicrafts. Whether it is through religious adornments, through the opulence of royalties or simply an expression of exquisite craftsmanship, textiles have explicitly displayed the socio-cultural context of this diverse India. One such craft of India is known to be *warak* printed textiles. Warak printing is a technique whereby gold and/or silver leaf is printed onto the textile and affixed with a binding medium. This traditional handicraft of India rose to prominence during the Mughal era as a substitute for brocaded fabrics. However, the dexterity of the technique gave the craft a recognition of its own (Mathur, 1994).

Literary sources have revealed that among various centres of production across India, Rajasthan has known to be a popular centre. *Warak* making is known to have been popularly practiced in Jaipur, predominantly by the *Pannigar* community (Craft Revival Trust, 2016) and *warak* printing has been prominent in the region in and around Udaipur. Over the years, the craft has seen a significant decline in

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production, with *warak* printed textiles now considered a languishing craft of India.

Primary and secondary data revealed the socio-cultural importance of the craft, with a variety of *warak* printed objects present within museums nationally and internationally. Examples of these textiles include male costumes, female costumes, religious ornamentations, furnishings such as tents etc. *Warak* printed textiles fall under the broader umbrella of tinsel printing. Other variations of tinsel printing include *khari* printing and *chamki*/ flock printing. While visually these textiles may seem similar, the difference in the materials used for manufacturing each of these tinsel printed textiles play a vital role determining the treatment plan that would be used for the conservation of these textiles. Warak refers to the application of gold and/or silver applied in the leaf form, using a natural binding medium such as gum acacia. Flock printing uses crumbs of gold and silver metal applied on the textile, affixed using rogan paste and *khari* printing involves mixing of fine mica powder in a synthetic binder and block printing the paste on the textile. A conservation procedure used for one textile may not suit the other variants due to the mere difference in nature of the material used for manufacturing. Thus, each textile requires customized treatment plans.

The presence of *warak* printed textiles in museums across the globe, and the socio-cultural significance associated with the craft emphasizes the importance of conservation of these textiles. Metal leaf printed textiles are a composite material. It consists of a base material (the fabric), a binding medium (the print paste) and the metal leaf. The nature, composition and effect of ageing of each component differs and thus each layer responds in a unique manner to the process of degradation. Thus, formulation of conservation procedures requires the study of each component with respect to the process of manufacturing and their response to ageing.

The process of documentation of the craft, collection of primary and secondary data, and material analysis of *warak* printed textiles is not in the scope of this paper.

This paper focuses on the experimental gel cleaning using gellan gum for the conservation of warak printed textiles. Prior to the experimentation of administration of chelating agents through gellan gum, the effect of ageing, process of degradation, effect of moisture and administration of chelating agents through agarose gel was studied. The paper briefly outlines the outcome of these experiments. This is followed by the detailed experimentation of administration of two popularly used chelating agents in textile conservation namely Ethylenediamine tetraacetic acid (EDTA) and Triammonium citrate (TAC) via low acyl gellan gum and high acyl gellan gum.

Cleaning of historic textiles: Cleaning is an important component of curative conservation. It refers to the removal of dirt, dust and soiling from the object, with an aim to prolong the life of the textile by slowing the rate of deterioration. At times certain soiling holds significance and removing the soiling will result in loss of critical information. In such cases conservators prefer to not remove the soiling matter. However, in other cases, the soiling poses a risk of further deteriorating the object through either physical or chemical means. The dirt and dust particles can either physically exert pressure on the fibres by lodging in the interstices of the fabric matrix, or chemically by attracting pollutants in the environment that can cause damage to the components associated with the textile such as dyes and pigments or even the fibre molecules themselves. An effective cleaning of textiles can in itself reduce the rate of deterioration by great extent.

Removal of tarnishing from metal surfaces also comes under the process of cleaning. Depending on the requirement of the object and the museum/private collector/owner, decision can be made to retain or remove the tarnishing of gilded surfaces.

Gels in conservation: Cleaning of textiles can be performed in multiple ways, depending upon the need and condition of the textile. Traditionally, cleaning can be categorized as mechanical cleaning, aqueous cleaning and solvent cleaning. The guidelines for performing these methods have been provided by international governing bodies in the field of conservation such as AIC (American Institute for Conservation), ICOM (International Council of Museums) and CCI (Canadian Conservation Institute), among many others.

Thickeners, gelling agents and rigid gels have been used by art conservators in the process of cleaning to administer various cleaning agents in a controlled

manner. Gels made of polysaccharides such as agarose and gellan gum have particularly been seen used as a delivery system for water and other polar solvents (AIC, n.d.).

Agarose: Agarose is a non-ionic gelling agent, derived from seaweed belonging to the family of Rhodophyceae. In the field of conservation agarose gained popularity due to its ability to be used with various additives, including chelating agents (Scott, 2012). While agarose has extensively been used in textile conservation and has given promising results for various applications, there is a need to find alternatives with respect to physical gels. This attributed to the fact that Rhodophyceae has now been declared an endangered species (Schmitt and Fosket, 2016).

Gellan gum: Gellan gum is a water-soluble anionic polysaccharide derived by fermenting the bacteria Sphingomonas elodea (Giraud *et al.*, 2021). Gellan gum is available in two variations, namely low acyl gellan gum and high acyl gellan gum. The difference in both the types is the degree of deacylation. Low acyl gellan gum is partly deacylated whereas high acyl gellan gum consist of higher number of acyl groups. With respect to gelling properties, low acyl gellan gum forms a stiffer and more transparent gel. In conservation a range of 2%-4% concentration produces gels which are able to find their application in the field. On the other hand, low acyl gellan gum forms a more flexible, opaque and requires the addition of cations to form a stable gel. Usually, concentrations of 0.25% to 1% produce results suitable for application in conservation (Magee, 2019).

When compared with agarose, it is seen that gellan gum is more abundantly available. The source of this gum is not at a threat of being endangered. Like agarose, low acyl gellan gum can form a transparent gel. Same may not be said about high acyl gellan gum, however it is still theoretically possible to produce the gel and use it in manner similar to agarose gel.

Exploring the usage of gellan gum also reduces the excessive usage and over exploitation of agarose, making it a reliable alternative to explore for textile conservation treatments. Gellan gum being anionic in nature may not be compatible with certain additives. This is a limitation which is well handled by agarose gel. However, when we consider the ethical and economical use of resources, the benefits of exploring the usage of gellan gum far outweighs the cons.

MATERIALS AND METHODS

For this study, Warak printed samples were sourced from artisans known to have been practicing the craft for generations. The artisan was selected based on documentation of the craft performed in Phase 1 of the research. The samples consisted of silver *warak* printed on white cotton fabric, with the binding medium of gum acacia and natural sand.

To simulate the ageing process, the samples were wet heat aged at a temperature of 80°C and relative humidity 65% for 72 hours. This is equivalent to natural ageing of approximately 25 years. The effect of ageing was studied of the aged samples (Liu *et al.*, 2021). It was observed that there was reduction in tensile strength, both in the warp and weft direction. There was also a reduction in tear strength. Microscopic images displayed development of crack in the metal leaf and yellowing of fabric as well as binding medium. There was also tarnishing of silver, analysed through microscopic images as well as quantified through spectrophotometry.

To test the efficacy of conservation procedures on aged warak printed textiles, the samples were subjected to mechanical cleaning, aqueous cleaning and solvent cleaning.

- For mechanical cleaning, the samples were subjected to brush cleaning, HEPA vacuum cleaning, microsuction unit cleaning, vulcanized eraser and latex free soft sponge were used. The aged samples were sensitive to HEPA vacuum cleaning and vulcanized eraser cleaning, resulting in detachment of leaf from the fabric surface. Microsuction unit cleaning had a lower suction pressure and was thus able to clean the samples without detachment of metal leaf. Latex free soft sponges were used for removal of dust which were effective and did not result in the detachment of metal leaf from the aged sample.
- For aqueous cleaning, the samples were subjected to the immersion bath technique as well as controlled humidity through a breathable membrane. In both the cases, the binding medium was altered due to the exposure to water.

- For solvent cleaning, ten most commonly used solvents were tested on warak printed samples. Few gave promising results and did not alter the binding medium.
- For the removal of tarnish from the silver leaf surface, the samples were to be subjected to EDTA and trimannonium citrate, two most commonly used chelating agents for textiles. Since the samples were sensitive to moisture, these chelating agents were administered through gel formations. 7% agarose gel gave quantitatively and qualitatively effective results, however, the treatment had the following limitations:

– 7% agarose gel concentration was required for administration of chelating agent. For optimum utilisation resources it is imperative to explore substitutes which would require a lesser quantity of material to be used.

– Agarose is derived from the red algae Rhodophyta. Rhodophyta is known to be an endangered species and thus alternatives need to explored to minimize the over-exploitation of this resource.

– The gel formed using agarose forms a rigid gel. While it is effective for cleaning of flat, smoother surface, it is not able to reach the ridges of any uneven surface. In such a case, a more flexible gel would prove to be efficient in cleaning of leaf printed surfaces.

– To address the limitations faced by agarose gel, high acyl and low acyl gellan gum were used.

– Two types of gellan gum, Low acyl and High acyl were used for the purpose of testing the administration of chelating agents through gel for the cleaning of *warak* printed textiles. Specifically, CpKelco gellan gum was sourced.

– The methodology to test the efficacy of gellan gum for the administration of chelating agents was as follows:

- ***Optimisation stage:*** This stage included testing low acyl gellan gum and high acyl gellan gum for the optimum level for concentration for the administration of chelating agent.

  For low acyl gellan gum, 5 concentrations ranging from 2% to 4% were tested and for high acyl gellan gum, 5 concentrations ranging from 0.5% to 1.5% were tested. Their interaction with the warak printed samples were studied and the optimum concentration was selected for administering the chelating agents.

- ***Administration stage:*** Selected optimum concentration of low acyl and high acyl gellan gums were used for the administration of the chelating agents EDTA and Triammonium citrate.

  For each chelating agent, 3 concentrations of 1%, 3% and 5% were selected. Each concentration was administered through the optimum gel concentration of low acyl and high acyl gellan gum.

- ***Combination gel testing stage:*** A combination gel of optimum concentrations of low acyl and high acyl gellan gum was prepared. The properties of this gel were studied and was used for the administration of chelating agents.

RESULTS AND DISCUSSION

- ***Optimum concentration of low acyl gellan gum for administration of chelating agent:*** Low acyl has been widely used in the field of paper and painting conservation. Low acyl gellan gum is usually used in the concentration range of 2-4% (Magee, 2019). With respect to warak printed samples, 5 concentrations of 2%, 2.5%, 3%, 3.5%, and 4% were tested. The results were as follows:
- All 5 concentrations resulted in clear gel preparation:
- Concentration of 2% could only be placed for 15 minutes on the samples. Post that the *warak* was detaching
- Concentration of 2.5% could be placed for 30 minutes. Concentration of 3% to 4% could be placed for 40 minutes (Figure 1).

Figure 1: Clear rigid gel of 2.5% low acyl gellan gum

- Optimum concentration of high acyl gellan gum for administration of chelating agent
- High acyl has not been widely explored in the field of textile conservation. High acyl gellan gum is usually used in the concentration range of 0.5% onwards (Magee, 2019). With respect to warak printed samples, 5 concentrations of 0.5%, 0.75%, 1%, 1.25% and 1.5%. The results were as follows:
- All 5 concentrations resulted in milky white opaque gel preparation
- Gels produced were more flexible in nature compared to low acyl gellan gum
- Concentration of 0.5% produced a flexible but dimensionally unstable gel.
- At 0.75% concentration, the gel was dimensionally stable and could be placed for 25 minutes.
- At 1% concentration onwards the gel was clumping and could not be set evenly. It was difficult to obtain an even gel (Figure 2 & 3).

Figure 2: Opaque flexible gel of 0.75% high acyl gellan gum

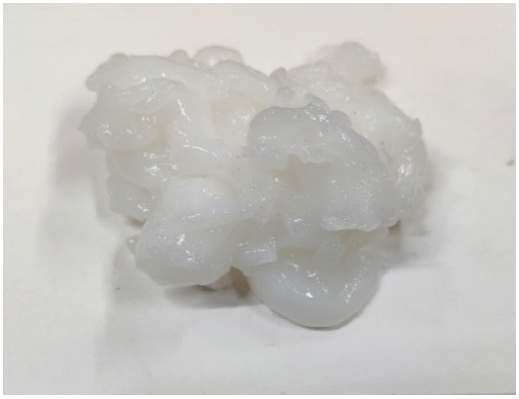

Figure 3: Clumping of 1.5% high acyl gellan gum

- EDTA in the percentages of 1%, 3%, and 5% were administered through 2.5% low acyl gellan gum and 0.75% high acyl gellan gum. In both the cases results were similar. 5% EDTA showed maximum level of cleaning after placing the gel for 20 minutes on the samples.
- Upon addition of 1% Triammonium citrate in 2.5% of low acyl gellan gum, the gel mixture coagulated. To test whether higher concentration of gellan gum would aid in gel formation, gellan gum concentration of 4% was used, however, the gel was not able to form. The possible reason for this could be that gellan gum is anionic in nature and triammonium citrate has the presence of cations. The mixing of the two results in a reaction, causing coagulation of the mixture without gelling. The gel was then first heated and just before gelling, traimmoinium citrate was added. The gel did not form.
- Upon addition of 1% Triammonium citrate in 0.75% of high acyl gellan gum, the gel partially coagulated but it did not form a gel. The mixture remained as a liquid. To test whether higher concentration of gellan gum would aid in gel formation, gellan gum concentration of 1% was used, however, the gel was not able to form. The possible reason for this could be that gellan gum is anionic in nature and triammonium citrate has the presence of cations. The mixing of the two results in a reaction, causing coagulation of the mixture without gelling. The gel was then first heated and just before gelling, triammonium citrate was added. The gel did not form (Figure 4).

Figure 4: Gel not forming with triammonium citrate

- Low acyl gellan gum forms a clear rigid gel, and high acyl gellan gum forms an opaque flexible gel. A combination of optimum level of low acyl gellan gum of 2.5% and high acyl gellan gum of 0.75% was combined and 5% EDTA was administered to the gel to test the efficacy. The gel formed was flexible than 2.5% low acyl gellan gum and more stable than 0.75% high acyl gellan gum. The opacity was less than 0.75% high acyl gellan gum but more than 2.5% low acyl gellan gum. EDTA could be administered and showed tangible cleaning results.

CONCLUSION

- High and low acyl gellan gum were successful in administering EDTA for warak printed samples.
- High and low acyl gellan gum were unsuccessful in administering Triammonium citrate for warak printed samples.
- Formation of combination gel of optimum concentration of low acyl and high acyl gellan gum was successful. The gel had the desirable properties of greater flexibility of high acyl gellan gum and lower opacity of low acyl gellan gum. Administration of EDTA through combination gel was successful.
- On comparison with agarose gel, gellan gum required less quantity for gelling and administering the chelating agent. It was advantageous with respect to quantity usage and clarity of gel when compared to low acyl gellan gum. It posed limitations in administering triammonium citrate as a chelating agent. The combination gel of low and high acyl gellan gum produced opacity visually similar to that of agarose gel, thus gellan gum can be preferred to administer EDTA over agarose gel. However, since gellan gum was unsuccessful to administer triammonium citrate, thus agarose would be suitable to administer triammonium citrate.

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Research Article

Textiles and Ethnic Cultural Identity: The Tais of Northeast India

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ABSTRACT

The Tais of North-East India, a diverse group of indigenous communities, have a rich tradition of textiles that plays a profound role in the manifestation of cultural identity, reflecting the traditions, beliefs, and values of a community. This abstract explores the intricate relationship between textiles and ethnic cultural identity, with a particular focus on the Tais of north-east India. The present study has been conducted on the Tai Phake people living in Namphake village, situated in Dibrugarh district, Assam, India, with the objectives 1. Issues of cultural assimilation among Tais 2. A specific aim is to focus on the textile tradition of Tai Phake in light of ethnic socio-cultural identity projection. The descriptive method and simple random sampling have been adopted for the research work. The study reveals how textiles serve as a medium through which the Tais transmit their cultural heritage, affirm their identities, and adapt to changing socio-cultural contexts. The textiles produced by the Tais are not mere products; they are a repository of tradition, stories, and symbols. This research provides a comprehensive analysis of the weaving techniques, motifs, and materials that define Tai textiles. It traces the historical and contemporary significance of these art forms within the context of globalization and rapid socio-economic changes in the region. In conclusion, textiles, especially Tais, serve as powerful symbols of the Tai people's ethnic cultural identity in north-east India. They encapsulate a rich history and continue to evolve in response to the changing world, ensuring that the legacy of Tai textile traditions endures. Understanding the intricate relationship between textiles and cultural identity is crucial not only for preserving the heritage of the Tai people but also for appreciating the broader significance of textiles in our diverse world cultures.

Keywords: Ethnicity, Socio-cultural identity, Traditional textiles, Tais

INTRODUCTION

Throughout Asian history, ethnic politics has inevitably brought forth images of conflicts between indigenous peoples and larger migrant groups. One such dominant migrant ethnic group, which is found across South and Southeast Asia and China, is the Tais. All Tais in Assam refer to themselves simply as "Tai." The names Ahom, Khamti, Phake, Aiton, and Khamyang are used by other people to distinguish those Tai groups from one another. The names, however, are accepted by each and every group of the Tai themselves. The Tai is a generic name denoting a great branch of the Mongoloid population of Asia. The Tai people are now mainly concentrated on the Indo-Chinese peninsula. The present habitat of the Tai people extends from Assam in the west to Kwangsi and Hainan in the east and from the interior of Yunnan in the north to the southern-most extremity of Thailand (Siam) in the south.

The Tai-Phakes entered Assam in 1775 A.D. during the reign of the Ahom king Lakshmi Sinha (1769–1780 A.D.) and settled at Nangtao in present-day Arunachal Pradesh. They belong to the great Tai race. Ethnically, they belong to the Mongoloid tribe, and linguistically, they belong to the Tibeto-Chinese families. They settled in Arunachal Pradesh for a few years, and during the British rule, they gradually entered Assam and started living in small groups in Dibrugarh

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and Tinsukia districts, where they are still found now. Presently, they live in nine villages in Dibrugarh and Tinsukia districts, which are as follows: Namphake and Tipamphake on the bank of the river Buridihing in the Naharkatiya area of Dibrugarh district; Mounglang, Man Mou, Bor Phake, Man Long or Long Phake; Ningam Phake or Ningam; Nonglai; and Phaneng in the Ledo-Margherita area of Tinsukia district. Throughout history, it has been the concern of all ethnic groups to maintain their ethnicity, irrespective of the globalisation that has affected each and every community. Irrespective of modernization peeping into each and every household, it has been observed that the Tai Phake community has been able to preserve its ethnicity. This paper aims to explore how ethnicity has been preserved by the Tai Phakes of this village with respect to their attire.

MATERIALS AND METHODS

The present study has been conducted on the Tai Phake people living in Namphake village, situated at a distance of about 3 km from the Naharkatiya town of Dibrugarh district, Assam, India. Considering the nature of the data collected, the descriptive method has been adopted in the present study. The population of this study, comprised of 100 respondents from Namphake village, has been selected as a sample for the study. Simple random sampling has been adopted for selecting the sample. For the purpose of this study, a well-organised, structured questionnaire schedule has been used for the collection of the data from the sample respondents. In order to collect the data, an interview schedule was prepared. Respondents were interviewed carefully on a number of questions and supplementary questions through face-to-face interactions, and their replies were noted down for the composition of the literature of the paper.

RESULTS AND DISCUSSIONS

At present, the Tais in India (living in the States of Assam and Arunachal Pradesh in the Northeast) may be divided into two groups: those who use Tai language in their daily lives and those who do not. The first group (those who are still speaking Tai) live in remote rural areas, making their living as rice farmers. They are known by various names, such as Phake Tai, Khamti Tai, Aiton Tai, Khamyang Tai, or simply one of the preceding names without the word "Tai." These Tais are Buddhists. They share many traditions, customs, and aspects of culture. They live in the same Tai-style houses, and they dress alike, especially the women. Minor differences in pattern and colour of clothing material are used to differentiate the groups, however. They also have their own writing system. Their spoken languages, though somewhat different, are mutually intelligible. They all share the same writing system. A Phake person who reads and writes Phake Tai writing can read Khamyang Tai texts without difficulty. An Aiton person described the difference between Phake and Aiton writings in terms of the place where the text was found. If a text was from a Phake village, it was called "Phake writing." The same text would be called "Aiton writing" if it was from an Aiton village.

The second group no longer speaks Tai. The best known of this group is "Ahom." They are said to be the descendants of the Ahom people, who were the rulers of the Ahom kingdom (now Assam) for about 600 years. According to Sir Edward Gait, the Ahom people came to the Brahmaputra valley in the year 1228 AD, about 400 years before the other groups. The Ahom were said to be non-Buddhists at this time. Despite the large amount of shared vocabulary, their writing is different from that of the other groups, and other Tais simply cannot read the Ahom writing.

There are historical records (and other evidence) that prove that the Khamti, Aiton, Phake, and Khamyang Tais were from Burma. They crossed the Patkai mountain range, from the Burmese side, into Assam. This is the same mountain range that the Ahom used to enter Assam about 400 years earlier. Cultural change is inevitable with changing ways of life and language shifts. Formerly, being Tai meant being rice farmers and Buddhists. Now Tais are living in cities and working as doctors, government officers, engineers, etc. Some marry Hindus and are no longer Buddhists. The 'bamboo culture' is changing fast. The culture of the Tais in Assam may be considered a 'bamboo culture' in the sense that they use a great deal of bamboo in their daily lives.

Unlike other Tais, most of the houses in Assam are built with bamboo—whole and split. Most receptacles used for storing rice, food, and clothes are made from bamboo. The well-known 'khaw-lam' is sticky rice cooked in bamboo tubes. Pickled bamboo

shoots are an essential part of marriage rituals and ceremonies. Other materials are now starting to replace bamboo. The younger generations no longer know all the different terms for different types of bamboo. Similarly, the words for different sizes and shapes for storage and measurement (especially of rice) are disappearing, despite the fact that Tai rice has been selling well amongst other ethnic groups.

Cultural similarities' among Tais: The Tais, a diverse ethnic group in Southeast Asia, share several cultural similarities that form the foundation of their collective heritage, despite the presence of distinct subgroups like the Thai, Lao, Shan, and others. These shared cultural elements contribute to a sense of interconnectedness among Tais.

Theravada buddhism: A predominant unifying factor among Tais is their adherence to Theravada Buddhism. Buddhism has deeply influenced their cultural practices, rituals, and art forms. Common religious practices create a shared spiritual foundation and a sense of unity across Tai communities.

Traditional clothing and textiles: Tais often share similarities in traditional clothing and textiles. Elaborate costumes, often vibrant and intricately woven, showcase shared design motifs and patterns that reflect the cultural richness of the Tai people. These garments are not merely clothing but expressions of identity and heritage.

Culinary traditions: Tai cuisines exhibit similarities in flavours, ingredients, and preparation methods. Staple ingredients such as rice, noodles, herbs, and spices are fundamental to Tai culinary traditions. Shared dishes and culinary techniques foster a sense of cultural continuity among Tais.

Festivals and celebrations: Tais celebrate a variety of festivals that, while varying in specific rituals and practices, often share common themes rooted in agricultural cycles, religious observances, and communal harmony. These festivals serve as occasions for cultural expression, reinforcing a shared sense of belonging.

Traditional arts and performances: Traditional arts, including dance, music, and theatre, often showcase similarities among Tais. Common themes, movements, and instruments resonate across Tai cultural expressions, emphasising a shared artistic heritage.

Respect for elders and ancestral practices: Tais generally hold deep respect for their elders and maintain ancestral practices. Filial piety and reverence for traditions are integral aspects of Tai cultural values, contributing to a sense of continuity and identity across generations.

Agricultural practices: Many Tais have historically engaged in agriculture, and this shared agrarian heritage influences their cultural practices. Rituals related to planting, harvesting, and agrarian festivities are common threads that bind Tai communities.

Recognising these cultural similarities among Tais is essential for fostering a sense of unity and appreciation for their shared heritage. Despite regional variations and unique local expressions, the common threads of religion, traditional arts, and cultural practices create a tapestry that highlights the richness and interconnectedness of the Tai ethnic group.

Issues of cultural assimilation among tais: Cultural assimilation among the Tais, a diverse ethnic group in Southeast Asia, presents a multifaceted challenge marked by several pressing issues. One prominent concern is the erosion of traditional customs and practices. Globalization, urbanisation, and the pervasive influence of mainstream cultures contribute to the diminishing relevance of age-old rituals, languages, and ways of life among Tais. Younger generations, influenced by contemporary values and external trends, may gradually distance themselves from their cultural roots. Generational conflicts emerge as a result, with elders often struggling to reconcile traditional beliefs with the changing attitudes of the youth. This intergenerational tension can lead to social disintegration within Tai communities, impacting the cohesive fabric that binds them together. Language, a cornerstone of cultural identity, faces a significant threat. The adoption of dominant languages in education, media, and daily communication marginalizes traditional Tai languages, jeopardizing their survival. This linguistic shift not only hampers effective intergenerational communication but also contributes to the gradual loss of cultural nuances embedded in native languages. Economic factors play a pivotal role in driving cultural assimilation. Opportunities for education and employment often align with the adoption of mainstream cultures, leading to disparities within Tai communities. Those who readily

assimilate may reap economic advantages, while others who adhere to traditional practices may find themselves economically marginalized. Efforts to address these assimilation challenges require a delicate balance. Initiatives promoting cultural education, language preservation, and community engagement are crucial. Fostering pride in Tai heritage and encouraging dialogue between generations can contribute to the resilience of traditional practices. Moreover, policies that strike a balance between modernization and cultural preservation are essential to ensuring that the rich tapestry of Tai cultures endures amid the currents of change. Recognizing and valuing the diversity within the Tai ethnic group is imperative for fostering cultural resilience and sustainable coexistence.

The textiles of Tai-Phakes

The textiles of Tai-Phakes (one of the small Buddhist groups of Tai linguistic stock) have distinctive ethnic characteristics. Tai-Phake textiles are not decorated with elaborate designs. The checks and stripes are arranged in a harmonious pattern to produce conspicuous designs. The checks and stripes that make up the designs in Tai-Phake textiles are very similar to tribal textiles prevalent in Upper Burma, the original homeland of the people. They still use their indigenous loin loom for weaving different textile items. As found among other communities, textiles are produced only for home consumption and not for sale. In the olden days, both cotton and muga yarns, used in their textile production, were produced at home. Those were also dyed with indigenous dyes. These days, home-spun cotton yarn is mostly replaced by mill-made yarns. Muga yarn, used rarely at present, is also bought from local shops and dyed partly with indigenous dyes. The major traditional textile items produced by the Tai-Phakes are summarized in Table 1.

Chin: Chin is the major item of a Phake women's dress. It is worn to cover the lower part of the body, from the waist down to the ankles. It is woven out of 2/80s cotton and occasionally with muga as weft. Three equal pieces of the size 0.75 x 0.50 meters with characteristic stripes are joined lengthwise. On top of this, a striped or chequered piece of 1.50 x 0.50 metres is attached to get the chin of the size 1.25 x 0.75 metres. green, white, or yellow; violet, blue, and black or muga

Table 1: Major textile items produced traditionally by the Tai-Phakes

Name of textile item	Approx. size (meter)	Use
Chin (Female garment for the lower part of the body, akin to mekhela)	1.25 x 0.75	To cover the lower part of the body from the waist down to the ankles
Nangwat (Breast cloth for married women)	2.70 x 1.00	To wrap over the chin, covering the breast
Pha-fek-hang (Breast cloth for grown up girls)	2.70 x 1.00	Same as Nangwat
Pha-fek-mai or Pha -mai (Wrapper)	2.75 x l.40	As a wrapper for men and women while entering the Vihar (Buddhist temple). Has important significance on socio-religious occasions.
Pha-nung (Lungi, an item of men's apparel)	1.20x1.00	To cover the lower part of the body from the waist down to the ankles
Thung (Shoulder bag)	0.30 x 0.25 to 0.35 x 0.30	As an indispensable part of Phake men's dress
Gamocha (Towel type cloth)	1.50 x0.70	As towel
Tong-khwan (Sacred hanging)	0.50x 0.15 to 1.50 x 0.40	As an important textile item to be offered in the Buddhist temples (Vihar).
Changkanfra (Symbolic sacred cloth)	Small symbolic cloth having seven squares	As symbolic sacred cloth. Has important significance as the most valuable item to be offered at Vihar.
Phachanglong (Sacred shoulder cloth)	2.70 x 0.70	As a decorative, sacred shoulder cloth at the time of converting oneself to a Buddhist monk
Pha-chet (Sacred handkerchief)	0.70 x 0.30	As a handkerchief at the time of converting oneself to a Buddhist monk

(golden brown); maroon, white, black, or blue are the colour schemes used popularly in chin. No separate ornamentation is used in this, but the harmonious arrangement of different colours in the stripes themselves produces a rich and pleasing effect.

Nangwat: It is a chequered cloth of the size 2.70 x 1.00 meters. Nangwatis are used by Phake women to wrap over Chin, covering the breast and leaving both ends hanging in front. It is generally used by women after marriage, but strictly not before puberty (Plate 1). These days, it is woven out of dyed cotton yarns, mostly 2/80s counts. But in the earlier days, it was also woven out of muga yarns, dyed in indigenous colours. Such nangwat is called nangwat-puchung. Using nangwat-puchung as a part of the wedding attire is still considered a mark of prosperity and high status. Two equal pieces of size 2.70 x 0.50 meters are woven separately and stitched lengthwise for nangwat. It is woven in checks and stripes of different colours with sparingly placed tiny flowers (called maklu) as butis. Nangwat with cross borders having creepers and floral motifs at both ends, followed by fringes, are also being woven these days.

Plate 1: Nangwat

Pha-fek-hang: It is an important item of dress for grown-up girls and is akin to nangwat in size and manner of use. Only the colour is traditionally white. Pha-fek-hang is woven out of 2/80s cotton. Floral designs in any colour are woven as cross borders at two ends.

Pha-fek-mai or Pha-mai: It is a shoulder cloth used by adults, irrespective of sex, in addition to their respective attire. It has an important cultural significance since it is invariably required to be put on when people go to Vihar (a temple) or participate in social gatherings. It is woven out of 2/80s cotton in white. The designs at two ends are woven mostly with muga yarn. The size of Pha-fek-mai or Pha-mai is 2.75 x 1.40 meters. For this, two equal pieces are woven separately and stitched lengthwise.

Pha-nung: It is a typical item of men's apparel among Tai-Phakes. It is tucked around the waist, covering the lower part of the body, like the lungi (Plate 2). Pha-nung is made up of two pieces of chequered cloth of the size 2.00 x 0.60 meters. Pha-nung (lungi): these two pieces are woven separately and stitched lengthwise. Further, a side seam is made to make the garment cylindrical.

Generally, 2/80s dyed cotton yarns of violet, blue, yellow, maroon, green, black, etc., are used to make this colourful cloth. No separate motifs or designs are found in Pha-nung. The main feature lies in the clever arrangement of colours with checks and stripes. However, very tiny flowers of geometrical shapes (called maklu) are woven sparingly as butis in the body of the cloth.

Muga silk yarns, dyed in indigenous colours, were also used in the past in weaving Pha-nung. This was named Pha-puchung. These days, it has become a rare specimen, and the few pieces available in the villages are being preserved only to be used on socio-religious occasions.

Plate 2: Pha-nung

Thung: The indigenous shoulder bag widely used by Tai-Phake men is available in sizes ranging from 0.30 x 0.25 meters to 0.35 x 0.30 meters with a strap (Plate 3). It has increasingly acquired a distinct cultural connotation among the people. The shoulder bag is considered a representative item of Tai-Phake culture. The Thung, as shown in is woven out of 2/20s or 2/40s cotton preferably in black, blue, or maroon colour. Motifs representing creepers, trees, butterflies, birds, flowers, and fruits are woven in a variety of colours, covering the body of the bag. The weaver's names and addresses are also woven along with the designs these days.

Plate 3: Thung

Pha Kong Kho (Towel type cloth): Although gamocha seems to be a new adoption by the Phakes, it is an important element of their textile production (Plate 4). It is woven out of 2/80s cotton, generally in a 1.50 x 0.70 meters size. Gamocha is woven white with side and cross borders in red. Floral designs are woven as cross-borders, generally at one end. The other end is finished with a plain cross border of the same colour.

Plate 4: Pha Kong Kho

Tong-khwan: Tong-khwan, the decorated sacred hanging, is offered to Vihar by Phake women on sacred days of the Buddhist calendar and at various other occasions. It is woven out of 2/40s or 2/80s cotton in different shades. The size of the tong-khwan varies from 0.50 x 0.15 metres to 1.50 x 0.40 meters. It is divided into 3, 5, or 7 divisions with fine bamboo sticks woven into the fabric. Colourful fringes are suspended from each of these bamboo sticks as an additional ornamentation. Various designs with motifs of flowers, trees, birds, butterflies, and animals, along with the weaver's name and address, are woven in tong-khwan. The two cross ends of the hanging are finished with fringes, on which beads are also interlaced. Offering cloth at the Vihar is regarded by the people as a pious act. One earns religious virtues from such acts.

Chankanfra: Chankanfra, a small symbolic cloth having seven squares, is essentially of religious significance (Plate 5). It is prepared during the annual festival called Poi-kithing observed on the full moon day of Kartika (October–November). It is the tradition that on the day before the festival, the womenfolk of the village assemble either in the Vihar compound or in the village headman's house and weave this symbolic cloth in the course of a single night. This cloth is offered at the Vihar in the early morning of the festival day. The Tai-Phakes have a strong conviction that chankanfra is the greatest of all gifts the villagers can offer at the Vihar, in the name of Lord Buddha, for the well-being of the village and its inhabitants.

Plate 5: Chankanfra

Phachanglong: It is a decorative cloth of the size 2.70 x 0.70 meters (Plate 6). It is usually woven out of 2/80s dyed cotton with elaborate arrangements of floral and geometrical designs as cross borders at both ends. The extreme ends are finished with colourful fringes. Phachanglong, with its socio-religious significance, is a highly valued item. It is never used as an element of casual dress. Only when a person adopts the life of a Buddhist monk is this decorative cloth

Plate 6: Phachanglong

used at the initiation ceremony. After this ceremony, called Charman, he has to use only the specified saffron dress of the monk.

Pha-Chet: Pha-chet, a richly decorated sacred cloth of the size 0.70 x 0.30 meter approximately, used as sacred handkerchief is also considered essential in the Charman ceremony of Phakes.

All the Tai Phake women are specialist in weaving. Every day, after completing their daily activities, they start weaving. The handloom is mostly on the platform of chaan ghar or below it. One of the important characteristics of Tai Phake culture is the colour of clothing and age relation. Ladies above the age of 50 are seen wearing deep green and deep purple. Men of the age group of above 50 wears Pure white phaa and saa. The design and colours vary according to the age. The younger the age, more the use of bright colours. The married women wear coloured naang wat and sidd till about the age of 45. Usually the Nang wats are yellow, purple, green and red in colour. Newly married women wear even more colourful dresses. Tai Phake people wear their traditional clothes at home as well as in social gatherings. Their traditional attire speaks about their pride and culture.

CONCLUSION

The Tai-Phakes of Upper Assam, also known as Phakials, are one of the ethnic groups of the Tai family. The Tai is a general name denoting a great branch of the Mongoloid population of Asia. The history of their origin and migration to Assam is still shrouded in obscurity. The river Burhidihing, the banks of which are the abode of the Tai-Phakes, originates in the Patkai Hills. After leaving the hills it flows along the southern border of Dibrugarh district and passes through Margherita, Jaipur, Naharkatia and Khowang. Accordingly, on reaching Assam, the Phakes started living on the banks of the river Burhidihing. Agriculture is the major occupation of the Tai-Phake people and they concentrate all their attention upon this economic activity. The Phakes are bilingual. Amongst them they speak the Tai language, but they use Assamese language with Assamese people among whom their villages are located. The Tai-Phakes although a lesser-known Buddhist population with its microcosmic existence, is still preserving the traditional traits of their socio-cultural life to a considerable extent.

They practice their own religion, which is Buddhism. Each Tai-Phake village has a Buddha Vihar (temple) constructed in a central place. All the religious beliefs and practices of the Phakes centre around the Buddha Vihar. Poi Chang Ken, i.e., the festival of bathing the images of Lord Buddha, and Poi-Kitting, the festival of offering a symbolic dress to the image of Lord Buddha, are the major festivals of Tai-Phakes. The textiles of Tai-Phakes also have distinctive ethnic characteristics and are produced at home. Tai Phake is a very less-known tribe from Assam with a small population. They have a glorious culture and tradition. Being such a small group, the tribe is trying hard to keep their legacy and rich culture alive. They reside in small villages in Dibrugarh district, with a major population staying in Namphake village in Dibrugarh. The village has 100 percent literacy, keeping alive their glorious tradition by still living in their traditional houses, dressing in their traditional attire, and also by the food they eat every day. So, it is important to know the tradition and culture of such a culturally rich tribe and also how this small community of people is struggling to preserve their culture in the present-day modern global cultural context.

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Research Article

Constraints in Livestock Production as Perceived by the Dairy Farmers of Kolaras Block of Shivpuri District M.P.

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ABSTRACT

Dairying is important occupation for the farmers of Shivpuri district of Madhya Pradesh But the present day dairying is faced with a number of challenges. Dairy farming has been an indispensable activity in history of human civilization which is not only important from economic point of view but it has nutritional importance too as an alternative food for ever growing human population. This activity was carried out in Kolaras block of Shivpuri district of Madhya Pradesh. To explore various constraints associated with dairy farming as perceived by the farmers. Later the identified constraints were ranked according to their significance. Results showed that increased Poor vaccination facilities in villages, distant location of veterinary health Centre, and High cost of disease treatment, Lack of knowledge to control and treat animal disease, Poor irrigation facilities for growing green fodder and so on.

Keywords: Dairy farming, Indispensable activity, Vaccination, Veterinary, Animal disease

INTRODUCTION

The rapid growth of milk production in India has been mainly because of the increase in the number of animals rather than that of improved productivity. India, low animal productivity results due to climatic, social and economic factors. India possesses enormous bovine wealth, but their per capita production is one of the lowest in the world due to reasons that the farmers do not adopt improved dairy management practices at the desired level. Keeping the above problems in view, the present study was taken up with the specific objectives to identify the constraints faced by the dairy farmers.

MATERIALS AND METHODS

In this study Descriptive research design was used. Descriptive research design is a type of research method that is used when one wants to get information on the current status of a person or an object. It is used to describe what is in existence in respect to conditions or variables that are found in a given situation. In the present study was conducted in Shivpuri district of Madhya Pradesh. Shivpuri district is selected purposively and simple random sampling is used. For the present study those farmers who possess five or more than five milch animals and are practicing dairy as primary or secondary livelihood option would be taken into consideration for the study.

Selection of blocks: There are 7 blocks in Shivpuri district out of which 3 blocks were selected randomly.

Selection of villages: Four villages from each block were selected among the total blocks. Thus a total of 12 villages will be selected for the present study.

Selection of respondents: Firstly we prepared a list of farmers who have milch animal. A Sample of 10

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Table 1: Constraints in livestock production as perceived by the dairy farmers (n=120)

S.No.	Category	Frequency	Rank
1	Poor vaccination facilities in villages	75(62.5)	I
2	Distant location of veterinary health centre	72(60)	II
3	High cost of disease treatment	70(58.33)	III
4	Lack of knowledge to control and treat animal disease	65(54.16)	IV
5	Poor irrigation facilities for growing green fodder	63(52.5)	V
6	Lack of knowledge about scientific dairy management	62(51.66)	VI
7	Inadequate Knowledge of breeding practices	60 (50)	VII
8	Lack of knowledge about preservation of feed and fodder	59(49.17)	VIII
9	High cost of animal shed construction	58(48.33)	IX
10	Lack of knowledge in weaning new born calves	57(47.5)	X
11	Lack of knowledge about balanced feeding	55(45.83)	XI
12	Perception of A.I. as unnatural method	53(44.16)	XII
13	Lack of knowledge about full hand milking	52(43.33)	XIII
14	High lost of cattle feed and feed supplement mineral mixture in villages	51(42.5)	XIV
15	High cost of superior quality bull/cross breed animals	50(41.67)	XV
16	Repeat breeding problem in animal	45(37.5)	XVI

dairy farmers of each village will be selected randomly. Hence the total sample of the study will be of 120 respondents.

RESULT AND DISCUSSION

The data regarding constraint in livestock production as perceived by the dairy farmers as presented in Table 1. Table 1 show that main constraints faced by farmers. The data indicated that the "Poor vaccination facilities in villages" is most important constraint perceived by dairy farmers with 75(62.5) frequency in livestock production and was given first rank. It was also observed that out of other fifteen aspects, "Distant location of veterinary health centre", "High cost of disease treatment"," Lack of knowledge to control and treat animal diseases", "Poor irrigation facilities for growing green fodder", "Lack of knowledge about scientific dairy management", "Inadequate Knowledge of breeding practices", "Lack of knowledge about preservation of feed and fodder", "High cost of animal shed construction", "Lack of knowledge in weaning new born calves", "Lack of knowledge about balanced feeding", "Perception of A.I. as unnatural method", "Lack of knowledge about full hand milking", "High lost of cattle feed and feed supplement mineral mixture in villages", "High cost of superior quality bull/cross breed animals" were perceived as constraints in livestock production in decreasing order. They were ranked second, third, fourth, fifth, sixth, seventh etc. respectively. However, "Repeat breeding problem in animal" was given the last rank by the dairy farmers in livestock production.

CONCLUSION

The study concluded that dairying was one of the major activity performed by farmers of the Kolaras block Shivpuri district of Madhya Pradesh. So, present study highlighted that people seek information more from personal localite than any other sources of information. Hence poor vaccination facilities in villages and distant location of veterinary health centre was the second most important constraints faced by dairy farmers.

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Research Article

Estimation of Existing Entrepreneurial Traits among Maize Growers

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ABSTRACT

The present empirical study investigates the existing entrepreneurial traits that govern their behavior concerning Adoption leadership, Innovativeness, Independency, Achievement motivation, Self-control, Risk bearing capacity, and competitiveness. Face to face interview with the 120 maize growers in Purnea region were conducted with the help of semi structured interview schedule. Data collected were analyzed with the help of R studio statistical package. Statistical tools were used viz. correlation, linear regression, frequency and percentage distribution of socio-economic profile as independent variables and Entrepreneurial traits as dependent variable of the respondents. The study revealed that 34.16 per cent of the respondents were found in the category of medium high degree, 30.0 per cent of the respondents were found in the category of high and only 5.83 per cent of the respondents were found in the very high category of entrepreneurial traits. It was also found that 43.33 per cent of the respondents have not received any type of training. Linear regression of socio-economic profile of the respondents with Entrepreneurial traits revealed that Education (x2), Land under maize cultivation (x6), Annual Income (x7), Holding size (x5), Irrigation index (x9) and Utilization of information source (x8) were the major contributor in predicting the Entrepreneurial traits of the respondents.

Keywords: Entrepreneurial traits, Farmers, Socio-economic, Achievement motivation, Adoption leadership, Self-control, Competitiveness

INTRODUCTION

Psychologically entrepreneurial behavior focusses on entrepreneurs' traits, i.e. achievement motivation, autonomy, self-confidence, self-motivation, risk taking, proactiveness, innovativeness, decision making, planning ability, coordinating ability and information seeking. Fayaz (2015) proposed that entrepreneurial skills influence successful smallholder farmers to perform better in the agribusiness environment which in turn contributes to economic growth and development of developing and developed economies. Entrepreneurs are individuals who recognizes opportunities in situations where others do not seem to notice anything beneficial and they start companies and create jobs (Kuratko, 2009). Kuratko in 2009 while setting the principal objectives such as innovation, profitability, and growth of Entrepreneurs argued that Entrepreneur is not only an innovator but also identifies and take opportunities and finally convert them into marketable ideas adds economic values, assumes the risk of the competitive market place to implement those ideas and realizes awards at the end. De Wolf and Schoorlemmer (2007) concluded that an entrepreneurial farmer is a person who is able to create and develop a profitable business in a changing business environment. Rohitha Rosario *et al.* (2016) found that

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entrepreneurial attitudes were more due to educational background and farming experience rather than age, gender, extent of farm land, type of farming and ownership of farmland. They also found that farming experience were positively related with innovation, opportunity seeking and risk taking whereas, farmers' educational background showed no significant association with innovation. Agbolosoo and Anaman (2021) found that majority of small holder farmers had a medium level of risk-taking ability, proactiveness behavior, innovativeness behavior, information seeking behavior, cosmopoliteness behavior and decision-making ability. They concluded that small holder potato farmers could not perceive potato farming as a profitable and sustainable agribusiness enterprise. According to Tamminana and Mishra (2017) contributes in the personal development of individual entrepreneurial farmers while making them competitive and innovative to survive and thrive in the farming business. Rodriguez *et al.* (2023) found that entrepreneurial ability ranged from – 1.54 to 10.11 logits while using. Rasch-Andrich rating scale which is a psychometric model that enables to obtain the measurement of entrepreneurial skill with a certain degree of precision. The present empirical study was undertaken to assess the entrepreneurial traits of maize growers of Purnea region of Bihar.

MATERIALS AND METHODS

Purnea region is the major maize growing area, therefore four districts under Purnea region viz. Purnea, Katihar, Araria, and Kishanganj were selected for the study. Thirty respondents from each district were selected simply randomly for the survey with the help of semi structured interview schedule. Independent variables were Age (x1), Education (x2), Family size (x3), Occupational perception (x4), Holding size (x5), Land holding under maize cultivation (x6), Annual income (x7), Utilization of information source (x8), Irrigation index (x9), Credit load (x10) whereas, dependent variable taken was Entrepreneurial Traits (Y). Data were collected face to face with 120 farmers. Data collected were compiled and analysed with the help of R-Studio. Coefficient of correlation and linear regression were the statistical tools used for assessing the existing Entrepreneurial traits among maize growers in Purnea region.

RESULTS AND DISCUSSION

Table 1 shows that Mean age (x1) was found 46.38 years with standard deviation (SD) 13.21 and coefficient

Table 1: Descriptive statistics of socio-economic characteristics of farmers of Purnea region (N=120)

Independent variables	Mean	Median	Mode	SD	CV %
Age (x1)	46.38	45.0	45	13.21	28.48
Education (x2)	9.44	9.00	8.0	3.56	37.71
Family size (x3)	5.45	5.00	5.0	1.84	33.76
Occupational perception (x4)	2.49	2.0	2.0	0.987	39.63
Holding size (x5)	3.01	2.41	3.0	3.08	102.32
Land holding under maize cultivation (x6)	2.80	2.00	2.0	2.65	94.64
Annual income (x7)	44218.33	90000	5000	161210.37	11.17
Utilization of information source (x8)	43.76	46.0	24.0	13.81	31.55
Irrigation index (x9)	139.15	115.55	200	60.20	43.26
Credit load (x10)	59075.00	20000	00	115861.27	196.12
Adoption leadership (x11)	6.34	6.33	8.0	1.20	18.92
Independence (x12)	7.05	7.33	7.33	1.42	20.14
Innovativeness (x13)	6.56	6.47	7.78	1.26	19.20
Risk bearing capacity (x14)	7.28	7.5	4.67	1.64	22.52
Achievement motivation (x15)	7.04	7.05	7.0	1.49	21.16
Self-control (x16)	6.94	7.11	6.56	1.40	20.17
Competitiveness (x17)	5.91	5.91	5.17	1.36	23.01
Entrepreneurial traits (Y)	6.70	6.88	6.92	1.07	15.97

of variation (CV %) was 28.48. Mean education (x2) was found 9.44 in formal education in years with SD 3.56 and CV % was 37.71. Mean size of the family (x3) was found 5.45 with SD 1.84 and CV % was 33.76. Mean of the occupation perception (x4) was found 2.49 with SD 0.987 and CV % was 39.63 which implies that maize growers of Purnea region apart from farming occupation goes of alternative occupation also for thriving and surviving in entrepreneurial environment. Mean of the holding size (x5) was found 3.1 acre with SD 3.08 and CV % was 102.32 implying that most of the maize growers in Purnea region are small farmers. Mean land holding under maize cultivation (x6) was found 2.80 acre with SD 2.65 and CV % was 94.64. Mean of the annual income (x7) was found 44218.33 with SD 161210.37 and CV % was 11.17. Mean of the Utilization of source of information (x8) was found 43.76 with SD 13.81 and CV % was 31.55. Mean of the Irrigation index (x9) was found 139.15 with SD 60.20 and CV % was 43.26. Mean of the Credit load (x10) was found 59075.00 with SD 115861.27 and CV % was 196.12. Mean of the Adoption leadership (x11) was found 6.34 with SD 1.20 and CV % was 18.92. Mean of the Independency (x12) was found 7.05 with SD 1.42 and CV % was 20.14. Mean of the Innovativeness (x13) was found 6.56 with SD 1.26 and CV % was 19.20. Mean of the Risk bearing capacity (x14) was found 7.28 with SD 1.64 and CV % was 22.52. Mean of the Achievement motivation (x15) was found 7.04 with SD 1.49 and CV % was 21.16. Mean of the Self-control(x16) was found 6.94 with SD 1.40 and CV % was 20.17. Mean of the Competitiveness (x17) was found 5.91 with SD 1.36 and CV % was 23.01. Mean of the Entrepreneurial traits (Y) was found 6.70 with SD 1.07 and CV % was 15.97.

Table 2 shows that Entrepreneurial traits among maize growers in Purnea region was found in the category of very low scoring 2.82-3.7 with 0.83 per cent, low scoring 3.7-4.58 with 2.5 per cent, low medium scoring 4.58-5.46 with 10.83 per cent, medium high scoring 5.46-6.34 with 15.83, medium scoring 6.34-7.22 with 34.16 per cent, high scoring 7.22-8.10 with 30.0 per cent and very high scoring 8.10-9.04 with 5.83 per cent. Majority of maize growers possessed medium entrepreneurial traits followed by high, medium high, low medium and low. Only 0.83 per cent of the farmers was found in the least entrepreneurial traits category.

Table 2: Frequency distribution of maize growers with entrepreneurial traits (Y) of Purnea region (N=120)

Entrepreneurial traits	Score	Frequency	Percentage
Very low	2.82 - 3.7	01	0.83
Low	3.7 - 4.58	03	2.5
Low medium	4.58 - 5.46	13	10.83
Medium high	5.46 - 6.34	19	15.83
Medium	6.34 - 7.22	41	34.16
High	7.22 - 8.10	36	30.00
Very high	8.10 - 9.04	07	5.83
Total		120	100

The perusal of Table 3 shows that the independent variables viz. Utilization of information source (x8), Irrigation index (x9), Holding size (x5), Annual income (x7), Landholding under maize cultivation (x6), and Education (x2) are highly significant at 0.01 level of significance and positively correlate with increasing strength of association with the dependent variable Entrepreneurial traits (Y). This means that as the strength of independent variables increases the Entrepreneurial traits of maize growers also increase with the same unit of strength.

The results imply that with the increase in the level of education, more holding size, more land holding under maize cultivation, more annual income, and

Table 3: Correlation of coefficient between entrepreneurial traits (Y) and independent variables of Purnea region (n=120)

Independent variables	r
Age (x1)	-0.091
Education (x2)	0.388**
Family size (x3)	-0.065
Occupational perception (x4)	0.033
Holding size (x5)	0.312**
Land holding under maize cultivation (x6)	0.377**
Annual income (x7)	0.355**
Utilization of information source (x8)	0.252**
Irrigation index (x9)	0.268**
Credit load (x10)	-0.047

** 0.01 level of significance

Table 4: Linear regression of entrepreneurial trait with independent variables of maize growers in Purnea region

S.No.	Independent variables	Estimate	Std error	t-value	Pr(>|t|)
	Intercept	5.422e+00	4.130e-01	13.129	<2e-16***
1	Education (x2)	9.333e-02	3.167e-02	2.947	0.0039
2	Holding size (x5)	6.288e-02	7.553e-02	0.833	0.4069
3	Land under maize cultivation (x6)	-7.154e-02	1.092e-01	-0.655	0.5138
4	Annual Income (x7)	-1.829e-07	8.766e-07	-0.209	0.8351
5	Irrigation index (x9)	4.473e-03	1.834e-03	2.439	0.0163
6	Utilization of Information source (x8)	-5.070e-03	8.919e-03	-0.568	0.509
Significance code	0.001‘ *** ’	0.01‘ ** ’	0.05‘ *’	0.1‘ • ’	1‘ ’
R2	**R2 Adjusted**	**F Statistics**	**DF**	**P value**	**Residual error**
0.1484	0.1032	3.283	113	0.005153	1.02

utilization of more sources of information, the entrepreneurial traits of maize growers also increase proportionately. With the increase in the availability of timely and adequate irrigation, maize growers' entrepreneurial traits also enhanced.

The perusal of Table 4 shows that the predictors Education (x2), Holding size (x5), Land under maize cultivation (x6), Land under maize cultivation (x6), Annual Income (x7), Irrigation index (x9), Utilization of information source (x8) were the major contributors in the response variable Entrepreneurial traits. The value of R^2 interprets that all the predictors cumulatively explained 14.84 per cent variance embedded in the response variable Entrepreneurial traits (Y).

CONCLUSION

The present study concludes that the small land holding size of maize growers of Purnea region can be categorized according to entrepreneurial traits such as very low, low, low medium, medium-high, medium, high, and very high. The majority of the respondents were under the medium category followed by the high category concerning entrepreneurial traits. Poorly educated maize growers having low income with low holding size not only give attention to producing more but also look for alternate sources of income such as business and independent sources of income. Low production from their farm enterprise did not oriented them to marketing. The study suggests that a suitable training module with more practical can be developed for the enhancement of entrepreneurship traits among maize growers. Training modules should be based on the felt need viz. prevention of postharvest loss, value addition of maize produce formation of maize growers' interest group to change their behavior from merely producer to an entrepreneur.

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Research Article

Nutritional and Sensory Evaluation of Drumstick Leaves Powder Supplemented Food Items

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ABSTRACT

Fresh leaves of drumstick contain nutrients in higher quantities and it is important to extend its shelf life for treating malnutrition and iron deficiency anaemia. In the view of extending the shelf life and to make nutritious food products from drumstick leaves, the current study was conducted with the objectives to prepare drumstick leaves powder, to study its nutritional characteristics by using standard methods, to incorporate drumstick leaves powder in daily food recipes like chapati (flat bread) (T1), dal (pulse) (T2) and potato vegetable (T3). Therefore, the aim of the study was to improve the dietary behavior and reduce iron deficiency anemia among adolescent girls of nutri-smart village of Morena district of Madhya Pradesh. This was done by evaluating the effect of supplementing DLP enriched food recipes in daily diet of adolescent girls for three months. The protein content of enriched food recipes were 13.58, 23.35 and 3.58 gram for T1, T2 and T3, respectively while the iron values for product T1, T2 and T3 were 7.09, 8.45 and 2.65 mg per serving. Despite the variations in the individual attribute scores, the overall composite score for T2 was highest at 8.17 ± 0.67. This score was followed by T1 at 7.97 ± 0.49 and T3 at 7.6 ± 0.70. Hence it is concluded that drumstick leaves powder can be effectively utilized for treatment of iron deficiency anaemia and in boosting overall health of adolescent girls in nutri-smart village of Morena district.

Keywords: Drumstick, Nutrients, Leaves, Adolescent girls, Anaemia

INTRODUCTION

Drumstick (*Moringa oleifera)*, a highly nutritious plant grown in tropical regions of developing countries, has the potential to combat nutritional deficiencies (Mutar *et al.*, 2021). In common language it's also known as "sahajan" (Malemnganbi and Singh, 2021). Due to its excellent ability to produce edible food, which includes a variety of vegetative structures, including leaves, pod shells, stems, flowers, fruits, and seeds, it is regarded as a very adaptable plant (Milla *et al.*, 2021). Its leaves, pods, seeds, gums, bark, and flowers are used in over 80 countries to treat mineral and vitamin deficiencies, support a healthy cardiovascular system, number of chronic diseases, such as inflammatory diseases, neuro-dysfunctional diseases, diabetes, and cancer (Kou *et al.*, 2018).

Moringa leaves contain high levels of fiber (11.23 g/100g), ash (4.56 g/100g), carbohydrates (56.33 g/100g), total proteins (9.38 g/100g), and lipids (7.76 g/100g). The plant is an excellent source of essential minerals (such as sodium, potassium, magnesium, phosphorus, iron, zinc, copper, calcium, and manganese). 17 amino acids were quantified, both essential and non-essential. The amino acids found in higher levels were leucine and lysine (94.36 and 69.13 mg/100g, respectively). Regarding vitamins, beta-carotene (vitamin A precursor), vitamins E, C, B1, B2, and B3 were identified (El Sohaimy *et al.*, 2015).

Nutrients present in drumstick are essential for vision, blood, bones and skin. Deficiency of such nutrients leads to anaemia, xerophthalmia and night blindness and scurvy. Since drumstick leaves are rich

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in antioxidants, it is used to boost our immune system (Sauveur *et al.*, 2015). Fresh leaves of drumstick contain nutrients in higher quantities and it is important to extend its shelf life (Sahay *et al.*, 2017). Prolonging in its fresh form through pre-packaging is important in extending the shelf life making it available to ready to use form (Ambrose *et al.*, 2017).

Drumstick leaves are also commonly used as a replacement for spinach in curries and vegetable dishes. The leaves can be dried, ground into a powder and stored without refrigeration conditions for many months and without loss of nutrients. The dried powder is completely edible and is used in soups and a variety of traditional foods. The leaves are quite versatile as they can be eaten fresh, cooked, or stored as dried powder. The powdered leaves are packed with nutritional properties as they are a rich source of protein (23.78 g/100g), fiber (11.8 g/100g), and potassium (1467 mg/100g) (Witt, 2013). Drumstick contains 7, 17, 10, 9, 25, 15 times the amount of vitamin C in oranges, calcium in milk, vitamin A in carrots, protein in yogurt, iron in spinach and potassium in bananas respectively (Rockwood, 2013). The leaves also perform various pharmacological activities in our system, such as analgesic, antihypertensive, antitumor activity, and anti-inflammatory effects (Prabhu *et al.*, 2011).

One of the most studied and published aspects involving the applicability of drumstick in food is its nutritional benefits, especially in populations with a diet low in essential nutrients. Thus, this plant has been used for formulations of supplements against malnutrition and as an additive or fortifier of the most varied foods (Leone *et al.*, 2018). So it is recommended to use these leaves in food products to enhance the nutritive value.

One of the best ways of utilization of drumstick leaves is to dry them first and then incorporate them into various food products. Leaves particularly when dried are easy to handle and store as they have a very good shelf life. Also, after drying, the nutrients are more concentrated, thereby making them even richer and more valuable (Pakade, 2013). Drying can be considered as the most commonly used method for preservation, packaging, transportation and distribution (Alakali *et al.,* 2015) of leafy vegetables. The principle of preservation by dehydration process is to remove the moisture content of a material to a level where microorganism may not be able to grow and spoil it (Titi *et al.*, 2012).

Present dietary scenario necessitates exploring the possibility of incorporating novel ingredients in commonly consumed foods rather than developing new food product (Kar *et al.*, 2013). In the view of extending the shelf life and to make nutritious food products from drumstick leaves, the current study was conducted with the objective to prepare drumstick leaves powder, to study the nutritional analysis of drumstick leaves powder (DLP) by using standard methods, to incorporate drumstick leaves powder in daily food recipes like chapatti (flat bread), dal (pulse) and vegetable. Therefore, the aim of the study was to improve the dietary behavior and reduce iron deficiency anemia among adolescent girls of nutri-smart village of Morena district of Madhya Pradesh. This was done by evaluating the effect of supplementing DLP enriched food recipes in daily diet of adolescent girls for three months.

MATERIALS AND METHODS

The study was conducted at RVSKVV-Krishi Vigyan Kendra, Morena and Nutri Smart Village of Morena district of Madhya Pradesh.

Drying of fresh drumstick leaves was carried out, with slight modifications, following the method reported by Joshi and Mehta (2010). Fresh drumstick leaves of variety PKM-1 with the stalks were taken from the plant. The thin branches of fresh, green, undamaged drumstick leaves were sorted and washed with clean water thoroughly three to four times with plenty of water to remove all the adhering dust, dirt particles. After washing the stems of the leaves were tied together in small bunches and was hung in an airy space to drain away extra water and air dried for some time. After air drying, all the stems and branches of the leaves were removed and only the leaves of drumstick were used for drying.

The air dried leaves were spread on cotton cloth for shadow drying and then covered with the muslin cloth to keep off dust and insects. These leaves turned occasionally to assure even drying. The leaves were brought indoor at nights as the temperature during night falls down. Sudden temperature change could

put moisture back into the leaves and lengthen the drying time. The leaves took four to five days to dry completely and become crisp and brittle to touch. The dried leaves were ground, sieved (80 mesh size), packaged in zip lock bags and stored. The dried leaves were grinded and stored in an air tight container.

Nutritive value of recipes enriched with drumstick leaves powder was done using standard methods. Sensory evaluation was carried out by standard method using nine point hedonic scale. All indexes were measured using a scale from 0 to 9, where a score of 9 represents excellent quality and a score of 0 represents the lowest quality level (Meilgaard and Civille, 1999). The storage period of three months for drumstick leaves powder was considered in view of the fact that such a shelf life should be adequate for a product packaged in small quantities and is consumed on a daily basis. The cost of drumstick leaves powder enriched nutritious recipes were calculated by adding the costs of ingredients used for the preparation of these food products.

All the subjects were randomly selected from the nutri -smart village of the district, to find out effect of drumstick leaves powder supplemented diet on their nutritional status along with haemoglobin level. The subjects were non-pregnant non-lactating young unmarried malnourished adolescent girls aged 10 to 16 years belonging to lower income group. All of them were de-wormed with Albendazole at the beginning of the study. Three recipes were selected which were consumed frequently by young adolescent girls, namely chapati (flat bread) (T1), dal (pulse) (T2) and potato vegetable (T3). The selected adolescent girls were administered dehydrated drumstick leaves powder added food items of 70 to 100 grams per day regularly for a period of three months. Anthropometry is the universally acceptable inexpensive and most sensitive parameter for assessing the nutritional status. Body weight is the most widely used and simplest reproducible anthropometric measurement for the evaluation of nutritional status of the population where as height is the principle measure of skeletal body tissue (Thirumani devi *et al.*, 2005).

Data on the anthropometric indices (weight and height) was collected. Every fifteenth day, the weight and height of adolescent girl was recorded. The weight and height of these adolescent girls at the start of the study were compared at the end of the study after three months. Body Mass Index (BMI) was calculated using the formula given by WHO 2004. All the subjects were observed for presence of clinical signs and symptoms of anemia that included fatigue, pallor, breathlessness and flat nails. The dietary intake of the subjects was assessed using food frequency method and 24 hour dietary recall. The food and nutrient intake was compared with the RDA given by ICMR and percent adequacy was calculated. The hematological indices were assessed before and after supplementation.

Impact analysis was exercised based on statistical calculations and general responses of the subject. Nutrition education was given to all the selected beneficiaries with the help of training, group discussion, posters, folders, etc.

RESULTS AND DISCUSSION

The nutritive value of the recipes supplemented with drumstick leaves is presented in Table 1. The value of protein, fat, fibre, calcium and ß carotene for product T3 were highest among all the three. The protein content of enriched food recipes were 13.58, 23.35 and 3.58 gram for T1, T2 and T3, respectively (Figure 1). Moringa leaves are rich in protein (Oduro *et al.*, 2008; Jongrungruangchok *et al.*, 2010; Omotesho *et al.*, 2013). The iron values for product T1, T2 and T3 were 7.09, 8.45 and 2.65 mg per serving, respectively (Figure 2).

Table 1: Nutritive value of DLP added food items per 100 g

Nutrient contents	DLP supplemented food items		
	T1	T2	T3
Protein (g)	13.58	23.35	3.58
Carbohydrate (g)	67.34	46.00	14.46
Fat (g)	2.33	2.63	0.90
Fibre (g)	2.84	9.81	2.73
Iron (mg)	7.09	8.45	2.65
Calcium (mg)	778.50	815.5	340.50
Phosphorus (mg)	59.00	50.15	21.80
β carotene (µg)	5942.27	9199.50	3960.00
Vitamin C (mg)	21.00	32.20	37.77

*Each value is the mean of three replications

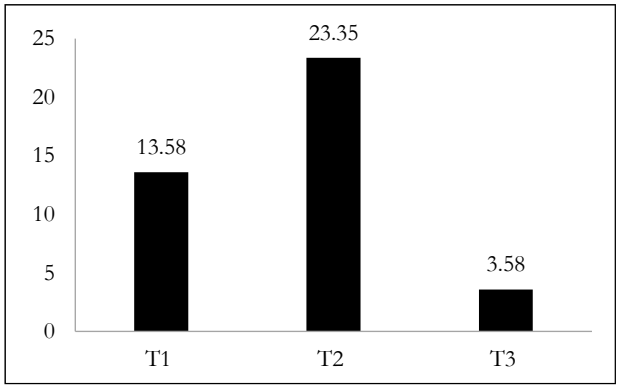

Figure 1: Protein content (g) of DLP added food items

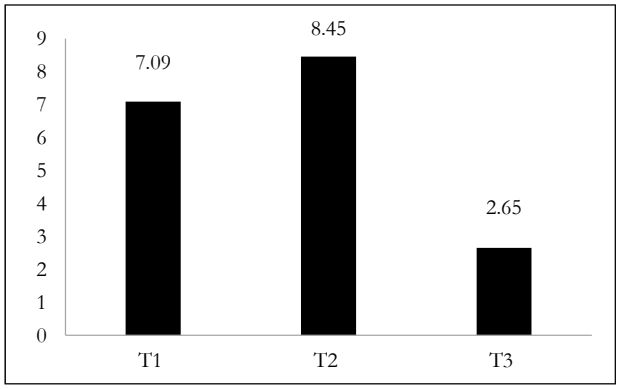

Figure 2: Iron content (mg) of DLP added food items

Product T2 exhibited highest vitamin C content (37.77 mg) per serving among all the three. The mineral content of T1, T2 and T3 products per serving for calcium and phosphorus were in the range of 340.5 to 815.5 and 21.8 to 59.0 mg, respectively. The calcium value of product T2 was significantly higher than T1 and T3 ($P<0.05$). These depicted results are in agreement with Sengev *et al.* (2013).

Thus the drumstick leaves powder incorporated recipes showed enhanced nutrient content. The recipes supplemented with drumstick leaves powder would be a good source of iron, vitamin C and other nutrients, which can be helpful in reducing anaemia among adolescent girls.

Organoleptic properties pertaining to colour, appearance, flavour, texture, taste and over all acceptability of drumstick leaves powder incorporated recipes are depicted in Figure 3. Despite the variations in the individual attribute scores, all of the recipes were rated as "good" by all the adolescent girls. The overall composite score for T2 was highest at 8.17 ± 0.67. This score was followed by T1 at 7.97 ± 0.49 and T3 at 7.6 ± 0.70. Scores for each of the individual attributes for the three tested recipes ranged from 7.4 to 8.35. A study on sensory and nutrition evaluation of value added products prepared with drumstick leaves was carried out by Dunkwal (2016).

By considering all the parameters, dal (pulse) supplemented with drumstick leaves powder was selected as the most preferred product which had the highest average ranks for all the sensory attributes and most preferred among the majority of the adolescent girls of nutri- smart village. Several investigators have reported the use of composite scores to evaluate foods products. Dehydrated drumstick leaves (DDL) powder incorporated into dhebra (shallow fried rotis, or flatbreads), muthia (steamed cereal pulse vegetable traditional snacks of Gujarat, Western India) and dal soup (boiled lentils) have been evaluated using composite scores (Clarkson and Thompson, 2000).

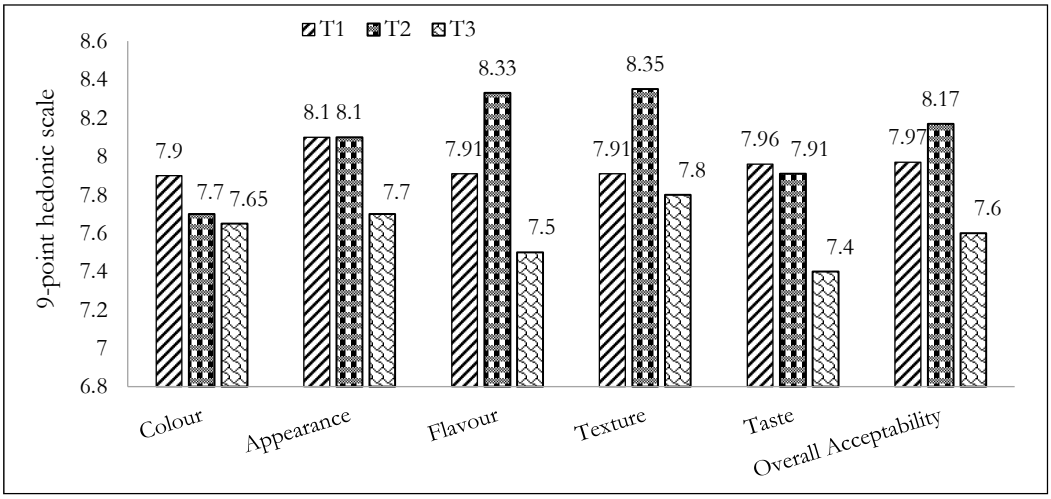

Figure 3: Sensory evaluation of DLP added food items

Table 2: Cost of nutritious products using drumstick leaves powder

Name of Recipe	Cost per 100g
T1-Chapati (flat bread)	Rs.3.0
T2-Dal (Pulse)	Rs.4.0
T3-Potato vegetable	Rs. 3.5

The drumstick leaves powder can be stored safely in air tight container or aluminum foil up to three months under ambient conditions without affecting the quality characteristics. The cost of DLP enriched nutritious recipes were calculated by adding the costs of ingredients used for the preparation of T1, T2 and T3 (Table 2). The cost of these recipes ranged between Rs 3.0 to 4.0 per 100 g. Hence the cost of these nutritious recipes is affordable in nutri-smart village.

The mean height and weight of the subjects at baseline were 148.8±5.3cm and 38.74±6.2 kg respectively. The ideal weight for height ranged from 54.4 to 58.1 kg thus indicating that the weight and height of the selected adolescent girls were below the standards given by ICMR, 1996. Clinical signs and symptoms of anaemia (weakness, flat nails, pale nails and skin, breathlessness) were obvious in both the group of girls. A total of 78 percent of the selected adolescent girls had flat and pale nails. Overall, breathlessness and pale skin was seen in 32 percent of the subjects. The prevalence of anaemia before supplementation was 78 percent in experimental group of adolescent girls. During the supplementation period, mean haemoglobin concentrations increased significantly ($p<0.001$).

Nutrition education was given to adolescent girls with the help of training, group discussion, posters, folders, etc. for nutritional benefits of drumstick. These girls were significantly well knowledgeable about health benefits of drumstick leaves after three months of nutrition education provided by Krishi Vigyan Kendra Morena. They also benefitted through practical experience of enriching daily food items with DLP. According to the results of this study, knowledge, attitudes and practices in improving dietary behaviour and reducing iron deficiency anaemia in adolescent girls can be improved through health education including nutritional benefits of drumstick leaves powder. To improve adolescent's condition it is important to provide them nutritional supplementation, food system and dietary intake interventions, integration along with appropriate information regarding nutrition (Pandey and Raghuvanshi, 2021). Excellent improvement was seen at post intervention in experimental groups as 100 per cent of selected adolescent girls improve their knowledge, attitude and practices scores to more than 80 per cent. Nutrition intervention had positive impact on nutritional knowledge of adolescent girls (Chaudhary *et al.*, 2019).

CONCLUSION

Drumstick leaves contains all the macro and micro nutrients. Products enriched from these leaves powder are also rich sources of nutrients. The major advantage of using drumstick leaves in this study is the fact that it is a locally available resource in nutri-smart village. These leaves are inexpensive and easily available. When considering nutritional and sensory characteristics of three recipes enriched with dehydrated drumstick leaves powder, dal (pulse) was the most preferred recipe. The utilization of drumstick leaves powder in enriching more local recipes can be increased through more awareness programmes. Nutritional intervention with drumstick leaves powder showed significant weight gain and increase in hemoglobin level among adolescent girls. Hence it is concluded that drumstick leaves powder can be effectively utilized for treatment of iron deficiency anaemia and in boosting overall health of adolescent girls in nutri-smart village of Morena district.

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Research Article

Constraints Faced and Suggestions Sought to Overcome Constraints in Utilization of ICT Tools in Transfer of Technology from the Respondents of North Kashmir, J&K State

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ABSTRACT

The study on constraints faced and suggestions provided to overcome constraints in utilization of ICT tools was carried out in all the three (03) districts of North Kashmir (Baramulla, Kupwara and Bandipora) in the state of J&K. Out of a list of 11855 farmers who were directly connected to Krishi Vigyan Kendras (KVKs), State Development Departments, SKUAST - Kashmir Agromet Field Unit and receiving updates via Farmer Portal, a sample of 350 farmers was selected through Stratified Random Sampling proportional to size from each district with the condition that the selected respondents had at least utilized two ICT tools during 2020. A well-structured interview schedule was prepared keeping in mind the objectives of the study. It was pretested in a non- sampled area and minor refinements were made to perfect the schedule. Personal interviews were used to gather data, which was analyzed using appropriate statistical tools/tests. Most significant constraints faced by the respondents in the utilization of ICT tools as per their rank/s were: high cost of ICT gadgets like smart phones, computers etc., due to unavoidable circumstances in J&K State mobile and internet facility is snapped frequently and lack of sufficient skills in usage of ICT tools. The suggestions provided by the respondents to overcome the constraints in utilization of ICT tools as per their rank were : cost of ICT tools to be reduced by providing subsidies frequent snapping of mobile and internet facility to be avoided and trainings on usage of ICT tools to be organised.

Keywords: ICT tools, Respondents, Extension personnel and Farmers

INTRODUCTION

ICT (Information and Communication Technology) is a broad term that encompasses all technologies for manipulating and communicating data, such as computers, mobile phones, hardware and software, satellite networks, radio, television and satellite technology; the internet, which includes email, instant messaging, video conferencing, social networking websites, artificial intelligence, robotics. One of the United Nation's Sustainable Development Goals is to "significantly increase access to information and communication technologies" and seek to provide free and open access to the internet in least developed countries by 2020 (SDG). This can be seen in computers, the internet, geographic information systems, mobile phones and traditional media such as radio and television (Stienen *et al.,* 2007). Rural India has an estimated 109 million mobile internet users, according to the Indian Market Research Bureau, though the vast majority of them use the internet mainly for social networking and email (Maghura Swaminathan *et al.,* 2018).

MATERIALS AND METHODS

The research was carried out in all the three (03) districts of North Kashmir (Baramulla, Kupwara and Bandipora) in the state of J&K. A list of 11855 farmers who were directly connected to KVKs, State

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Development Departments of North Kashmir, Agromet Field Unit of SKUAST-Kashmir and were receiving updates through the Farmer's Portal was collected. A sample of 350 respondents was drawn through Stratified Random Sampling proportional to size from each district with the condition that the selected respondent had utilized at least two ICT tools during 2020. A well-structured interview schedule was prepared and pretested, in a non-sampled area keeping in mind the objectives of study. The data was collected through personal interviews and every effort was made to clarify the questions posed to the respondents in their mother tongue.

RESULTS AND DISCUSSION

It is evident from the findings presented in Table 1 that most significant constraints faced by the respondents in the utilization of ICT tools was high cost of ICT gadgets like smart phones, computers etc. which was expressed by 31.71 per cent respondents (rank I). The second, third and fourth constraint in the utilization of ICT tools as expressed by the respondents was: Due to unavoidable circumstances in the state of J&K mobile and internet facility is snapped frequently (31.14%, rank II), lack of sufficient skills in the usage of ICT tools (29.14%, rank III) and lack of uninterrupted power supply (28.86%, rank IV). The other constraints in the utilization of ICT tools expressed by the respondents were: insufficient servicing centres of ICTs in villages (21.43%, rank V), facing difficulty in understanding the language of ICT gadgets (25.71%, rank VI), internet connectivity in villages is poor (23.71%, rank VII), lack of subsidies on ICT gadgets (22.86%, rank VIII), low level of

Table 1: Constraints faced by the farmers in utilization of ICT tools (N=350)

S.No.	Constraint*	Number of respondents	Percentage	Rank
1.	High cost of ICT gadgets like smart phones, computers etc	111	31.71	I
2.	Infrastructural facilities inadequate for maintenance of ICT tools	63	18.00	XIV
3.	Lack of sufficient skills in usage of ICT tools by rural communities	102	29.14	III
4.	Low level of education among the respondents	77	22.00	IX
5.	Inadequate internet facilities in rural areas	65	18.57	XIII
6.	Lack of uninterrupted power supply	101	28.86	IV
7.	Insufficient training and practical exposure towards ICTs	75	21.43	X
8.	Lack of awareness about benefits of ICTs	70	20.00	XII
9.	Insufficient servicing centres of ICTs in villages	92	26.29	V
10.	High cost of servicing charges of ICT gadgets (smart phones)	42	12.00	XIX
11.	Facing difficulty in understanding the language of ICT gadgets	90	25.71	VI
12.	Non-availability of ICT gadgets and spare parts in local markets	74	21.14	XI
13.	Internet connectivity in villages is poor	83	23.71	VII
14.	Economic condition of rural people is poor	61	17.43	XV
15.	Lack of subsidies on ICT gadgets	80	22.86	VIII
16.	Due to unavoidable circumstances in the state of J&K, mobile and internet facility is snapped frequently	109	31.14	II
17.	Recharge of mobile for internet facility is costly	55	15.71	XVIII
18.	In J&K, many places are still undeveloped and lack communication facilities like telephone, mobile,internet, etc.	59	16.86	XVII
19.	Communication towers in rural areas are lacking	60	17.14	XVI
20.	Broadband connections in rural areas are poor	29	08.28	XXI
21.	Short duration programmes for broadcast/ telecast	39	11.14	XX

* Multiple responses

education among the respondents (22.00%, rank IX), insufficient training and practical exposure towards ICTs (21.43%, rank X), non- availability of ICT gadgets and spare parts in local market (21.14%, rank XI), lack of awareness about benefits of ICTs (20.00% rank XII), inadequate internet facilities in rural areas (18.57%, rank XIII), infrastructure facilities inadequate for maintenance of ICT tools (18.00%, rank XIV), economic conditions of rural people is poor (17.43% rank XV), communication towers in rural areas are lacking (17.14%, rank XVI). Many places in J&K are still undeveloped and lack communication facilities like telephone, mobile, internet, etc. (16.86%, rank XVII), recharge of mobile for internet facility is costly (15.71%, rank XVIII). High cost of servicing charges of ICT gadgets (smart phones) (12.00%, rank XIX), short duration programmes for broadcast/telecast (11.14%, rank XX) and broadband connections in rural areas are poor (08.28%, rank XXI).

Based on the constraints, as expressed by the respondents in utilization of ICT tools for agricultural activities, the suggestions were sought from the respondents to overcome the constraints in utilization of ICT tools which are presented in Table 2.

Based on the constraints as expressed by the respondents in the utilization of ICT tools for agricultural activities the suggestions were sought from the respondents to overcome the constraints in the utilization of ICT tools which are presented in Table 4.13. The main suggestions put forth by the respondents were: cost of ICT tools be reduced by providing subsidies (33.14%, rank I), frequent snapping of mobile and internet facility to be avoided (31.14%, rank II), trainings on usage of ICT tools to be provided (29.71%, rank III) and continuous power supply to be provided (28.86%, rank IV). The other suggestions put forth by the respondents to overcome constraints in utilization of ICT tools for farm related activities were: agriculture related messages in local language to be provided (27.14%, rank V), service centres in villages to be established (26.29%, rank VI), servicing charges to be reduced (25.43, rank VII), awareness campaigns on benefits of ICT tools to be launched (22.57%, rank VIII), the internet connectivity to be strengthened

Table 2: Suggestions to overcome the constraints in utilization of ICTs (N=350)

S.No.	Suggestions*	Number of respondents	Percentage	Rank
1.	Cost of ICT tools be reduced by providing subsidies	116	33.14	I
2.	Infrastructure facilities to be provided	61	17.43	XI
3.	Continuous power supply to be provided	101	28.86	IV
4.	Trainings on usage of ICT tools to be provided	104	29.71	III
5.	Awareness campaigns on benefits of ICT tools to be launched	79	22.57	VIII
6.	Agriculture related messages in local language to be provided	95	27.14	V
7.	Servicing charges to be reduced	89	25.43	VII
8.	Services centres in villages to be established	92	26.29	VI
9.	Large markets of ICT gadgets to be established	66	18.86	X
10.	The internet connectivity to be strengthened	75	21.42	IX
11.	Frequent snapping of mobile and internet facility to be avoided	109	31.14	II
12.	Cost for mobile/ internet recharge to be reduced	55	15.71	XIV
13.	Communication facilities like telephone, mobile, internet, etc at village level to be developed	59	16.86	XIII
14.	Communication towers in rural areas to be developed	60	17.14	XII
15.	Broadband connections in rural areas to be expanded	29	08.28	XVII
16.	Duration of broadcasts/ telecasts to be enhanced	39	11.14	XVI
17.	Programmes on broadcast/ telecast to be repeated	48	13.71	XV

* Multiple responses

(21.42%, rank IX) and large markets of ICT gadgets to be established (18.86%, rank X). Moreover, the other suggestions put forth by the respondents to overcome constraints in utilization of ICT tools for farm related activities were: infrastructure facilities to be provided (17.43%, rank XI), communication towers in rural areas to be developed (17.14%, rank XII), communication facilities like telephone, mobile, internet etc at village level will be developed (16.86%, rank XIII), cost for mobile/internet recharge to be reduced (15.71%, rank XIV), programmes on broadcast/telecast to be repeated (13.71%, rank XV), duration of broadcast/ telecasts to be enhanced (11.14%, rank XVI) and broadband connections in rural areas to be expanded (08.28%, rank XVII).

CONCLUSION

The State Government of J&K should provide subsidies to farmers for purchase of Smart phones and other ICT tools, so that these are utilised for getting upto date farm related information from various Stake holders which they can put to use on their respective farms for increasing their income.

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Research Article

Improved Technology Intervention to Enhancing Productivity of Fennel Crop in Nagaur District of Western Rajasthan

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ABSTRACT

The frontline demonstrations (FLDs) on fennel crop were conducted by Krishi Vigyan Kendra, Nagaur-I during two consecutive years in *rabi* 2020-21 and 2021-22 with the objective to demonstrate the improved package of practices of fennel variety AF-1 in two adopted villages- Khajwana and Inana of Mundwa block. For the demonstration the recommended dose of fertilizers (RDF) at the rate of 80 kg nitrogen, 60 kg phosphorus, 40 kg potash and 20 kg zinc sulphate with 150 quintal FYM per hectare were used. There were two treatments in which one was local check and second was cultivation of improved variety of fennel (AF-1) with full package of practices. The higher yield was recorded in demonstration plots that is 19.80 q/ha and 18.50 q/ha as compared to local check in which 15.75 q/ha and 14.85 q/ha respectively, and per cent yield increase was 25.71 per cent and 24.57 per cent under demonstration. Net returns were also recorded comparatively higher in demonstration (Rs.166440 and 177900 ha^{-1}) than local check (Rs. 127475 and 135095 ha^{-1}) with BCR (5.43 and 5.64) over the local check (4.66 and 4.78, respectively). This will substantially increase the income as well as the livelihood of the farming community. The technology gap & extension gap ranged between 2.2 to 3.5 and 4.05 to 3.65 q/ha respectively, with the technology index of 10.0 to 15.9 per cent during the demonstration years.

Keywords: Fennel, Variety AF-1, Front line demonstration, Local check and yield

INTRODUCTION

Fennel (*Foeniculum vulgare* Mill) commonly known as *Saumph* is one of the most important medicinal and aromatic plant of Apiaceae family (Kandil, 2002). It has been used as an ethnic medicine for the cure of many infectious diseases (Agarwal *et al*., 2017). Besides, it is habitual in our country to eat fennel seeds after a meal and eating it after a mealtime is considered a healthy practice, primarily because of its ability to keep the digestive system healthy (Kanwat and Jat, 2022). Fennel plant is a rustic perennial plant which can survive in drought. In India it is popular seed spices and mainly grown in rabi season. Fennel seeds are highly nutritive as it contains volatile oils, flavonoids, phenolic glycosides, phytosterols, triterpenes and saponins (Ebeed *et al*., 2010). Fennel seed contain essential oil, carbohydrates, dietary fibre, protein, fat, potassium, phosphorus, and calcium (Table 1). Fennel is being cultivated over 83 thousand hectares with the production 137 million tonnes (2021-2022) in India. Among the states in Rajasthan state it is cultivated in 30.81 per cent area with the production of 33.56 mt (Anonymous, 2015). Rajasthan and Gujrat are major fennel producing state contributing nearly 96 per cent of national fennel producing area. In Rajasthan it is mainly cultivated in Nagaur, Sirohi, Jodhpur, Pali and Swai Madhopur district.

Now a day there is a shift or decrease in area of average spices crop like- fennel mainly due to lack of sufficient number of improved varieties which are suitable for different region with higher yield and resistant to different biotic and abiotic stresses. Fennel

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Table 1: Chemical composition of fennel grain/100g

Composition	Content (100 g)
Moisture	8.8 g
Protein	15.8g
Fat	14.9 g
Carbohydrate	36.6 g
Crude fibre	15.7 g
Calcium	1.2 g
Phosphorus	487 mg
Iron	19 mg
Sodium	88 mg
Potassium	1.7 g
Vitamin A	135 I.U.
Vitamin B-1	0.41 mg
Vitamin B-2	0.35 mg
Niacin	6.00 mg
Vitamin C	6.4 mg
Food energy	1440 kJ

Source: Malhotra *et al.* (2012)

is grown by broadcasting method using local cultivars without seed treatment and improper use of fertilizers as well as plant protection measures. Most of the farmers follow non judicious use of pesticides with higher doses which leads to reduction in grain quality and net return. Hence for enhancing the existing yield levels, it is necessary to popularize it's complete package of practices which include improved variety, seed treatment and plant protection measures in the region. The present study was carried out with the objective to study the economic evaluation of technology for promoting fennel production in Nagaur district of Rajasthan.

MATERIALS AND METHODS

The study was conducted during two consecutive years in *rabi* 2020-21 and 2021-22 under front line demonstration to evaluate the performance of AF-1 variety of fennel in village- Khajvana and Innana in block Mundwa of the district Nagaur. Nagaur district of Rajasthan comes under agro-climatic zone of Rajasthan IIa transitional plan inland drainage. Hence, generally in winter minimum temperature goes to 7ºC and in summer maximum temperature reaches upto 47ºC and average annual rainfall is 380 mm per year. The soils of frontline demonstration plots was sandy loam in texture, low in organic matter and available nitrogen is medium (Table 2). The frontline demonstrations, training, scientist visit, field day and *Kisan Gosthis* were organized at various stage of crop growth in the selected village and the feedback information from the farmers was also recorded for further improvement in research and extension programme. Sowing of fennel was done in the mid October to mid November, while harvesting in the month of April. Locally cultivated cultivars as practiced by the non-adopted farmers with their own management system was taken as local check. All the technological intervention was taken as per detail package of practices for improved variety of fennel crop (Table 3). The gap analysis, cost of cultivation, net return and additional return parameters were recorded. The yield data were collected from both the demonstration and farmers practiced plots. To estimate the technology gap, extension gap and technology index, the following formula were used after Samui *et al.* (2001) and Sagar and Chandra (2004).

Table 2: Soil properties of experimental field

Parameter	Result (Soil analysis)	Normal range
Soil pH	7.69	7.0 - 8.5
Electrical Conductivity (ds/m)	0.15	$\leq$1.5
Organic carbon (%)	0.17	0.5-0.75
Available N (kg/ha)	99	280-360
Available P_2O_5 (kg/ha)	35	23-56
Available K_2O	172	142-337

RESULTS AND DISCUSSION

The potential and field performance of the fennel variety along with the local check were evaluated and data are presented in Table 4 and 5. Performance of fennel variety AF-1 was found substantially higher under the demonstration plots over the farmers practices. Data furnished in Table 2 shown that farming situation was same under demonstration as well as under farmer's practices. For the frontline demonstration of fennel, variety AF-1 was taken due to its better yield performance and seed quality. Before sowing of crop seed and soil treatment was done. The balanced use of manures and fertilizers, weed management and need based plant protection was done to ensure optimum production potential.

Table 3. Details of gap analysis for fennel crop cultivation

Technology intervention	Farmers practices	Recommended practices
Variety	RF-35	AF-1, AF-2 & RF-125
Soil treatment	No application	*Trichoderma viride* @ 2.5 mixed with 100 kg FYM
Seed treatment	Carbendazim 50 WP @ 2.0 g/ kg	Carbendazim 50 WP @ 2.0 g/ kg & NPK liquid consortia @ 5ml/kg
Spacing	Asymmetrical plant population	40x30 cm^2 (Plant x Plant & Row to Row)
Manures & fertilizers	Imbalance use of manures & fertilizers	Soil testing based balance use of manures and fertilizers FYM 150-200q/ha and 80 kg N, 60 kg P_2O_5, 40 kg K_2O and 20 kg $ZnSO_4$ /ha
Weed management	Hand weeding	Use of pendimethalin 1.0 litre/ha before of sowing

Grain yield: It was observed that frontline demonstration of improved technology increased productivity over farmer's practices (Local check). The yield of fennel AF-1 under demonstration was substantially higher 19.80 q/ ha and 18.50 q/ ha over the local check (15.75 q/ha and 14.85 q/ha) during *rabi* 2020-21 and 2021-22, respectively (Figure 1). There was 25.71% and 24.57% yield increase was obtained under demonstrated plots over the farmers practices during both years, respectively.

Technology gap, extension gap and technology index: The technology gap 2.2 & 3.5 q/ha and extension gap 4.05 & 3.65 q/ha was observed during *rabi* 2020-21 and 2021-22, respectively. The technology gap observed might be due to variation in the weather conditions, soil fertility and implementation of management practices. Extension gap indicated that there is a need to educate the farmers, to train them for adoption of improved production technology. The data (Table 4) showed that maximum technology index i.e., 10.0 and 15.9 per cent was recorded in demonstration plot during *Rabi* 2020-21 & 2021-22, respectively. The findings are close conformity with the findings of Lal *et al.* (2017) and Meena *et al.* (2018).

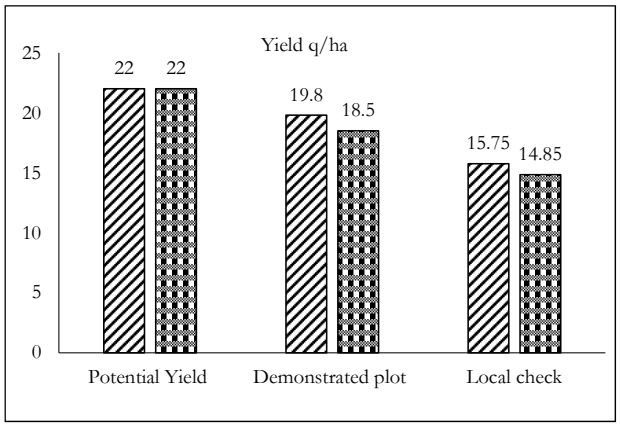

Figure 1: Yield of fennel during two consecutive years (*rabi* 2020-21 and *rabi* 2021-22)

Table 4: Percent yield increase, technology gap, extension gap and technology index

FLD conducted Year	Crop	Variety	No. of Demonstration	Area (ha)	% increased yield over local check	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
2020-21	Fennel	AF-1	10	2	25.71	2.2	4.05	10.0
2021-22	Fennel	AF-1	10	2	24.57	3.5	3.65	15.9

Table 5: Economic analysis of frontline demonstration of fennel

Conducted year	Cost of cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		B:C Ratio	
	Demonstrated plot	Local check plot	Demonstrated plot	Local check plot	Demonstrated plot	Local check plot	Demonstrated plot	Local check plot
2020-21	37500	34750	203940	162225	166440	127475	5.43	4.66
2021-22	38300	35680	216200	170775	177900	135095	5.66	4.78

Economics of fennel: Economics of fennel production under frontline demonstration and local check was evaluated and the data presented in Table 5. The net return of demonstration plot was recorded Rs. 166440/ha and Rs. 177900/ha and B.C Ratio 5.43 and 5.64 as compared to the local check in which farmers got net return Rs. 127475 and Rs. 135095 /ha and B:C Ratio 4.66 and 4.78, respectively during the *rabi* 2020-21 and 2021-22t. The findings are confirmed with the findings of Khan *et al.* (2010) and Singh *et al.* (2011).

CONCLUSION

The result revealed that the frontline demonstration had good impact over the farming community of Nagaur district. The percent yield increase of fennel to the extent of 25.71 per cent and 24.57 per cent over the farmers practices due to timely organization of training programmes, field visits, diagnostic visit and timely plant protection methods. Frontline demonstration have shown the use of improved variety, seed & soil treatment, timely sowing, balance use of fertilizers, weed management & plant protection may result in higher yield of fennel crop. Improved technology enhancing the yield of fennel and found economically remunerative with high B:C Ratio. Thus, it may be concluded that situation extension intervention may be designated to get benefit from improved technology.

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Research Article

On Construction of Sliced Latin Hypercube Designs

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ABSTRACT

Sliced Latin hypercube designs (SLHDs) are considered ideal when planning computer experiments for collectively assessing related computer models. SLHDs represent a specific subset of Latin hypercube designs (LHDs), and they can be further subdivided into various slices, each acting as a batch of smaller Latin hypercube designs. In particular, SLHDs with unequal batch sizes find valuable application in designing of computer experiments involving models with varying attributes such as relative cost and accuracy. In this article, we present a simple method for constructing Sliced Latin hypercube designs with unequal batch sizes.

Keywords: Computer experiments, Latin hypercube designs, Sliced Latin hypercube designs

INTRODUCTION

Computer experiments have gained widespread popularity in situations where conducting physical experiments proves to be prohibitively expensive, time-consuming, or even unfeasible due to various constraints. They have emerged as a valuable tool for comprehending the intricacies of complex physical processes across a wide range of fields, including aircraft design, computational fluid dynamics, post-harvest engineering, and cosmology, among others.

Among the classes of designs that serve this purpose effectively are those that facilitate the use of various modelling methods and do not require the replication of input combinations. These designs are commonly known as space-filling designs. Latin Hypercube designs, introduced by McKay *et al.* (1979) are the most frequently utilized space-filling designs. These designs are considered to possess the one-dimensional space-filling property when the design points are projected onto each dimension (McKay *et al.,* 1979).

A Latin hypercube design LHD (n,q), is a n × q matrix whose columns are permutations of the vector (1,2,...,n)'. Latin hypercube designs are not suitable when the objective is to conduct a computer experiment that involves the joint assessment of related computer models, as pointed out by Williams *et al.* (2003). To illustrate this limitation, let's consider an example involving the designing of a controlled atmospheric storage system for horticultural or agricultural products.

Example: Creating a controlled atmospheric storage system for diverse horticultural and agricultural products, ranging from climacteric and non-climacteric fruits, leafy and bulb vegetables, as well as cereals and pulses, demands tailored storage conditions for short-term and long-term preservation. To effectively design storage systems for each product variant, individual computer models, let's say A_1, A_2, B_1, B_2 and C_1, C_2 are utilized to predict their expected outputs. Employing different Latin Hypercube Designs (LHDs) to estimate these outputs becomes cumbersome when aiming for a combined linear estimation of all six models and their outputs. To streamline this process, there's a

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preference to implement a novel approach: employing a new type of design that facilitates running computer models in batches, with each batch representing a slice of the overall design space. This method aims to maintain Latin hypercube properties within each slice while enabling the analysis of data from different batches separately.

In 2012, Qian introduced a novel variant of Latin hypercube design (LHD) called the sliced Latin hypercube design (SLHD), aiming to simplify the process of designing experiments in complex situations as described above. An SLHD is a special subtype of Latin hypercube design that can be subdivided into smaller Latin hypercube designs known as "slices." SLHDs offer two appealing characteristics: firstly, each individual slice within the design achieves the maximum level of uniformity when examined in any one-dimensional projection. Secondly, when all the slices are combined, the entire SLHD exhibits the maximum degree of stratification in any one-dimensional projection, as highlighted by Wang *et al.* (2017).

An n run SLHD is a special type of LHD that can be partitioned into t slices (blocks), each of which is also an LHD of n/t runs, after collapsing the n levels to n/t levels. For integers n_1 and t, an SLHD with $n= n_1*t$ runs, n_1 runs in each slice, t slices and q factors, denoted by SLHD (n_1, t, q). Similarly sliced Latin hypercube designs are defined wherein slices are having different run sizes. In such situation, sliced Latin hypercube design is denoted as SLHD ((n_i), t,q). Here, total number of runs $n = \Sigma^{t}_{i=1} n_i$. An n run SLHD (n_i), t,q) is a new type of LHD that can be partitioned into t different slices where each of which is also having the property of LHD with n_i runs, after collapsing the n levels to n_i levels of each batch appropriately. For more details, one may refer Yuan *et al.* (2021).

Consider, $n_1 = 3$, t=3, and q=3, with n = 9. A 9 × 3 Latin hypercube design or an SLHD (3,3,3) with three slices is given below.

$$D = \begin{pmatrix} \begin{pmatrix} 1 & 2 & 3 \\ 7 & 5 & 9 \\ 4 & 8 & 6 \end{pmatrix} \\ \begin{pmatrix} 8 & 6 & 1 \\ 2 & 9 & 4 \\ 5 & 3 & 7 \end{pmatrix} \\ \begin{pmatrix} 3 & 4 & 2 \\ 9 & 1 & 8 \\ 6 & 7 & 5 \end{pmatrix} \end{pmatrix}$$

The above given design is an SLHD (3,3,3), which is a special type of LHD (9,3) and the whole design can be partitioned into 3 slices or batches of run size 3. For more details, one may refer to Xie *et al.* (2014); Shan *et al.* (2015); Xu *et al.* (2019); Zhang *et al.* (2019); Kumar (2020) etc.

The main purpose of this paper is to develop suitable method of construction of designs to carryout computer experiments with multiple complex computer models to estimate expected output of each of the computer model at varied cost, accuracy and complexity etc. as well as a linear combination of the expected output of the multiple computer models. In this article a very simple method of construction of SLHD's of unequal batch size is given. The proposed method of construction is general in nature in reference to number of runs, number of factors and number of slices.

MATERIALS AND METHODS

SLHD of equal batch size

In this section, we propose a simple method of construction to obtain SLHDs with unequal run slices. The given Algorithm is easy to implement and general in nature with respect to number of runs, factors and slices.

Algorithm: Consider the following steps to construct an SLHD (n_i),t,q).

For, $n=\Sigma^{t}_{i=1} n_i$. Let Z_n = {1,2,…,n

Step 1: Divide the elements of Z_n into *t* blocks of size n_i (i=1,2,..,t), elements of the block will be obtained as following: Let, *m* and *t* be any two positive integers ≥2 such that n=(m*t)+1.

Blocks	Elements of the Block
1st block	(1,1+t,1+2t,…,1+mt)
2nd block	(2,2+t,2+2t,…,2+(m-1)t)
3rd block	(3,3+t,3+2t,…,3+(m-1)t)
:	:
(t-1)th block	((t-1),(t-1)+t,(t-1)+2t,…,(t-1)+(m-1)t)
tth block	(t,2t,3t,…,mt)

Step2: Obtained blocks are juxtaposed to form the first factor of an SLHD. Subsequent factors can be derived by uniformly permuting the elements of the

blocks in the initial factor, ensuring that the combinations of factors remain distinct and do not repeat.

Example 1: Let m=3 and t=4 to construct an SLHD ((4,3,3,3),4,2). Where, n_1=4, n_2=3, n_3=3 and n_4=3, t=3, q=2 and n=$\Sigma^{t}_{i=1} n_i$ is 13.

Z_n = {1,2,..,13}

First block is (1,1+t,…,1+mt) therefore, first block with its elements is given as(1,5,9,13). Similarly, we get elements of the remaining blocks, 2nd block (2, 6 ,10) 3rd block (3 7 11) and 4th block (4,8,12). Now first column/factor of the SLHD will be obtained after juxtaposing of the blocks i.e. ((1 5 9 13) (2 6 10) (3 7 11) (4 8 12))^T

Now, remaining columns (factors) are obtained by the uniform permutation of elements in each block. Thus, we can obtain required SLHD ((4,3,3,3),4,2). It can also be observed that each slice will be a LHD (4,2), LHD (3,2), LHD (3,2) and LHD (3,2) respectively after collapsing the 13 levels appropriately.

$$D = \begin{pmatrix} \begin{pmatrix} 1 & 5 \\ 5 & 9 \\ 9 & 13 \\ 13 & 1 \end{pmatrix} \\ \begin{pmatrix} 2 & 6 \\ 6 & 10 \\ 10 & 2 \end{pmatrix} \\ \begin{pmatrix} 3 & 7 \\ 7 & 11 \\ 11 & 3 \end{pmatrix} \\ \begin{pmatrix} 4 & 8 \\ 8 & 12 \\ 12 & 4 \end{pmatrix} \end{pmatrix}$$

Let each of the slice be denoted as t_i=(a_{jk}), where a_{jk} is j^{th} row and k^{th} column element of t_i. i=1,2,…,t, j=1,2,…,n_i and k=1,2,…,q. Now, $\forall\ a_{jk} \in t_i$, let, a_{jk}/t = [a_{jk}]. Where [a_{jk}] is greatest integer no less than a_{jk} then, t'=([a_{jk}]) is an LHD (n_i, q). Therefore, in the above example of SLHD ((4,3,3,3),4,2), slice t_1 is an LHD (4,2). t_1=$=\begin{bmatrix} 1 & 5 \\ 5 & 9 \\ 9 & 13 \\ 13 & 1 \end{bmatrix}$ dividing each element of t_1 by 4, {t_1=(a_{jk}/t)}gives $\begin{bmatrix} 0.25 & 1.25 \\ 1.25 & 2.25 \\ 2.25 & 3.25 \\ 3.25 & 0.25 \end{bmatrix}$ and the resulting t_i'=([a_{jk}]) will be, t_i'= $\begin{bmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \\ 4 & 1 \end{bmatrix}$ which is an HD (4,2). Similarly, t_2, t_3, and t_4 will be LHD (3,2), LHD (3,2) and LHD (3,2) respectively.

DISCUSSION

SLHDs prove to be exceptionally valuable for various types of computer experiments in the field of agriculture, particularly in areas such as post-harvest engineering and the design of advanced nurseries etc. Given the significance of these designs, there exists a necessity to formulate construction methods to obtain them. In this article, we have put forth a flexible approach for obtaining Sliced Latin hypercube designs with unequal batch sizes. The proposed method is general in nature for any number of slices and are capable of accommodating flexible number of runs and factors in each slice.

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Research Article

Augmentation of Livelihood Security of Scheduled Caste farmers in Mandya district of Southern Karnataka

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ABSTRACT

The study was conducted in purposively selected Mandya district with a sample of 240. Data was collected by using pretested structured interview schedule and analyzed by using appropriate statistical tools. The results revealed that, livelihood security improved from less satisfied (41.82%) to satisfied (38.18%) level and overall livelihood security increased by 48.17 per cent after implementation of project. Further, the characteristics such as land holding, cropping pattern, livestock possession, innovativeness, mass media exposure, management orientation, level of aspiration, training undergone, participation in development programme, access to extension personnel and access to resources exhibited positive and significant relationship with farmers' livelihood security. Hence, he positive and significantly related characteristics need to be considered while selecting the farmers for the extension educational programmes to enhance their livelihood security.

Keywords: Integrated farming system, Schedule Caste and livelihood security

INTRODUCTION

India is a developing nation and one of the most important agricultural countries of South East Asia which blessed with diverse agro-ecological conditions. Small land holdings along with low to medium productivity and injudicious use of natural resources as well as other crop inputs are main the features of Indian agriculture. Beside these, Indian agriculture has also been facing severe problems, such as reduction in crop productivity, increase in inputs price, shortage of electricity, water crises, environmental deterioration, land degradation in terms of accelerate soil and water erosion. Furthermore, majority of the farmers are small and marginal farmers, which has accounted for around 87 per cent of the operational holdings are less than two hectares (Kumar *et al.,* 2020). Increasing land fragmentation, diminishing natural assets, high costs for external farm inputs, indebtedness and pesticide-related health issues have threatened the livelihoods of many farm families. About 58 per cent of rural Indians depend on agriculture for their livelihood and this sector contributes 18.80 per cent to the country's GDP (Anon, 2023). The smaller share of agriculture in national GDP is getting distributed among a larger number of people who depend on agriculture for their livelihood and even credit. Integration of farm enterprises provides better livelihood in terms of increased food production, higher net income and improved health, habitat, educational and social status. Therefore introduction of appropriate farming systems is going to be one of the important approaches to achieve better growth in agriculture and securing livelihoods of major segment of society. Through Integrated Farming System (IFS) it is possible to reach the high level of productivity in more sustainable way with proportionately less input. The University of Agricultural Sciences (UAS), Bangalore has implemented the project entitled "Livelihood

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Improvement of Scheduled Caste (SC) Farm Families through Integrated Farming System (IFS)" with the financial support from the Government of Karnataka under Scheduled Caste Sub Plan (SCSP).The project aims at sustainable development of agriculture among the SC farm families by bringing them to mainstream and also efficient management of soil, water, crop and Integrated Pest Management practices in crop husbandry. Further, it integrate dairy, poultry, sheep, piggery, fishery, sericulture, agro-forestry and other related enterprises with crop husbandry which increases the overall net income.

In Karnataka, the Scheduled Caste (SC) population comprised of 17.15 per cent and majority of them belongs to small & marginal farmers and agricultural labourers (Anon, 2018). They are directly or indirectly depend on agriculture for their livelihood. The per capita land holding of SC farmers is 1.3 ha as against state average of 1.74 ha. with fragile resource base, the agricultural production systems of these farmers largely dependent on monsoon, coupled with fragmentation of land resulted in low production and productivity. They are more exposed to the constant threat of poverty, illiteracy, hunger, starvation, malnutrition and migration to urban areas. Having understood the SC farmers have the potentiality to perform the diversified operations / practices of production systems, integration of appropriate possible number of farming system components out of the available alternatives (crop production, dairy, sheep, piggery, poultry, fisheries sericulture, apiculture, mushroom production, horticulture, agro-forestry, post-harvest and value additions etc.) with due considerations to improve their livelihood is the way out for betterment of SC farmers. With this background, the present study is conceptualized with following objectives:

1. To know the personal, social, economic and psychological characteristics of respondents
2. To measure the livelihood security of SC farmers practicing Integrated Farming System
3. To ascertain the relationship between personal and socio-psychological characteristics of respondents with their livelihood security
4. To know the economic analysis of Integrated Farming System on development of SC farmers.

MATERIALS AND METHODS

The study was conducted in purposively selected Mandya district of Karnataka based on the implementation of the project entitled "Livelihood Improvement of Scheduled Caste (SC) Farm Families through Integrated Farming System (IFS)" by University of Agricultural Sciences, Bangalore during 2014-15 to 2018-19. A Total sample of 240 respondents were purposively selected for the study based on maximum number of SC farm families. All the farm families having land holding 1 to 5 acres of dry land were considered as beneficiaries (respondents) under the project. Data was collected using structured interview schedule and analysed using mean, percentage, standard deviation and correlation coefficient.

The results given in the Table 1 revealed that majority of the respondents found to have marginal land holding and belonged to low level of education, livestock possession level of aspiration, training undergone and willingness in agriculture followed by high level of land holding, extension participation, social participation and low level of mass media exposure, cropping pattern, innovativeness and risk orientation. The possible reason for low category of above mentioned variables could be due to poverty and other social stigma in the rural areas and the land holding distribution is matching with the general trends in the country that more than 80 per cent of the land holding in the country are marginal and small holding and another supporting reason that could be attributed to this trend might be due to fragmentation of land holding. The ancestral lands were broken into smaller units, due to increase in family size year by year. With respect to low level of mass media exposure and cosmopoliteness, the accessibility to the mass media such as television, radio, newspapers and farm magazines was found to be less. Farmers rarely had the habit of reading newspaper and farm magazines because majority of them had low education level and lack of time and interest in travelling to cities and exposing to mass media as well. They don't listen to radio programmes and watch television for agricultural programmes due to irregular and less power supply in rural areas. The results of the present study are in conformity with the findings of Mamathalakshmi (2013); Harshitha *et al.* (2018) and Venkatareddy (2021).

Table 1: Distribution of respondents according to personal, social, economic and psychological characteristics (n=240)

Variables	Category	No.	%age
Education level	Low	105	43.75
	Medium	58	24.17
	High	77	32.08
Land holding	Marginal	100	41.66
	Small	90	37.50
	Big	50	20.84
Cropping pattern	Low	77	32.08
	Medium	82	34.16
	High	81	33.76
Livestock possession	Low	86	35.83
	Medium	81	33.75
	High	73	30.42
Cosmopoliteness	Low	89	37.08
	Medium	70	29.17
	High	81	33.75
Innovativeness	Low	62	25.83
	Medium	104	43.33
	High	74	30.84
Mass media exposure	Low	75	31.25
	Medium	77	32.08
	High	88	36.67
Extension Participation	Low	73	30.41
	Medium	75	31.25
	High	92	38.34
Social participation	Low	69	28.75
	Medium	80	33.34
	High	91	37.91
Level of aspiration	Low	93	38.75
	Medium	58	24.17
	High	89	37.08
Risk orientation	Low	57	23.75
	Medium	141	58.75
	High	42	17.50
Training undergone	Low	98	40.83
	Medium	51	21.25
	High	91	37.92
Willingness in agriculture	Low	101	42.08
	Medium	41	17.08
	High	98	40.84

The findings presented in Table 2 indicated that, Livelihood Security of respondents in 'highly satisfied category' increased to 30.33 per cent from 26.067 per cent after implementation of the project. The findings seek support from the studies of Sujay Kumar (2018) and Shwetha and Shivalingiah (2019).

The results depicted in Table 3 indicated that, there is an improvement in different dimensions of livelihood security after the implementation of the project in Mandya district. Out of seven dimensions, maximum increase was noticed in employment security (48.14%) followed by living amenities (46.36%), coping strategies against stress (42.54%), assets (37.40%), ecological security (33.55 %), social equitability (27.34%) and economic efficiency (24.87%). Overall livelihood security was increased by 38.37 per cent after implementation of the IFS project.

The findings in the Table 4 implied that, 10 out of 13 characteristics found to have significant relationship with livelihood security. The personal, socio-economic and psychological characteristics such as land holding, cropping pattern, livestock possession, cosmopoliteness, innovativeness, mass media exposure, extension participation, level of aspiration, training undergone and willingness in agriculture had positive and significant relationship with livelihood security. The possible reasons for the positive and significant relationship between land holding and livelihood security might be due to land holding is the major asset which provides economic security to the respondents thereby it leads secured livelihood. Inputs such as seeds and livestock components were provided free of cost to respondents under the project which leads them to get engaged in rearing of livestock as subsidiary occupation and gets additional income by selling milk and meat apart from crop production. Cropping pattern have positive and significant relationship with livelihood security, as farmers mainly depends on farming, increased in cropping pattern and adopting the new technologies advocated by the scientists and project personnel led to higher productivity, profitability fetching higher income and generated employment. Higher level of mass media exposure would have facilitated the members to develop habits of gathering more information about the improved IFS activities. Level of aspiration and training undergone had positive and significant relationship with livelihood

Table 2: Distribution of respondents according to their livelihood security in Mandya district (n=240)

Category	Before		After		Change in
	Number	Percentage	Number	Percentage	Percentage
Less satisfied	122	40.67	103	34.33	-6.34
Satisfied	98	32.67	106	35.33	2.66
Highly Satisfied	80	26.67	91	30.33	3.66
Total	300	100.00	300	100.00	

Table 3: Dimension-wise impact analysis of livelihood security among respondents in Mandya district (n=240)

Dimension	Mean Value		Percentage
	Before	After	in increase
Assets	1008	1385	37.40
Living amenities	921	1348	46.36
Economic efficiency	567	708	24.87
Ecological security	617	824	33.55
Social equitability	684	871	27.34
Coping strategies against stress	623	888	42.54
Employment security	941	1394	48.14
Overall Livelihood Security	5361	7418	38.37

Table 4: Relationship between know the personal, social, economic and psychological characteristics of respondents with their livelihood security (n=240)

Independent variables	Correlation co-efficient (r)
Education level	-0.004 NS
Land holding	0.107**
Cropping pattern	0.193**
Livestock possession	0.411**
Cosmopoliteness	0.196**
Innovativeness	0.405**
Mass media exposure	0.418**
Extension participation	0.377**
Social participation	0.083 NS
Level of aspiration	0.143*
Risk orientation	-0.057 NS
Training undergone	0.291**
Willingness in agriculture	0.373**

NS: Non-Significant; *: Significant at 5% level; **: Significant at 1% level.

security the possible reason for such result might be due to the reason, respondents spent greater amount of time in IFS to fulfil their aspirations such as multiple cropping, diary, piggery, sheep rearing and poultry etc. The participation in training programmes enhanced the knowledge about IFS due to exposure to different components of IFS in each of the training programmes, respondents directly influenced by the training undergone. Regular contact with the project personnel, agriculture officers, scientists of agriculture university and hence the respondents might have developed inclination towards IFS. Being an IFS farmer, effective utilization of available resources leads to higher productivity, profitability, employment

Table 5: Multiple regression analysis personal, social, economic and psychological characteristics of respondents with their livelihood security (n=240)

Variables	Regression coefficient (b)	Std. error of regression co-efficient (SE_b)	't' value
Education level	-0.523	0.314	-0.690 NS
Land holding	2.114	0.675	3.133**
Cropping pattern	0.117	0.037	3.159**
Livestock possession	0.131	0.125	0.423 NS
Cosmopoliteness	-0.026	0.200	-0.129 NS
Innovativeness	0.936	0.325	2.883**
Mass media exposure	-1.555	0.401	-3.875 NS
Extension participation	1.206	0.323	3.736**
Social participation	0.159	0.107	1.485 NS
Level of aspiration	0.320	0.131	1.993*
Risk orientation	-0.093	0.135	-1.667 NS
Training undergone	0.546	0.274	2.450*
Willingness in agriculture	0.057	0.135	1.055 NS

R^2= 0.6440, F =15.26**; NS: Non-Significant; *: Significant at 5% level; **: Significant at 1% level

generation and farm income. The findings are in conformity with the results obtained by Mamathalakshmi (2013); Harshitha *et al.* (2018) and Venkatareddy (2021).

The contribution of independent variables to the livelihood security of the respondents was assessed and illustrated in the Table 5. The findings conveyed that six independent variables such as land holding, cropping pattern, innovativeness, extension participation, level of aspiration, training undergone had contributed significantly towards livelihood security. The R^2 value indicated that all the 13 independent variables had contributed to the tune of 64.40 per cent of variation in livelihood security of the respondents. The possible reason with regard to the extent of contribution of independent variables is due to land holding, cropping pattern, innovativeness, extension participation, level of aspiration, training undergone characteristics of respondents were the factors going to influence directly on livelihood security of the respondents. Independent variables have synergic effects to one another, helping each other to have a major contribution towards the livelihood security. The findings seek support from the studies of Harshitha *et al.* (2018) and Shwetha and Shivalingiah (2019).

The results pertaining to economic analysis of IFS components were presented in the Table 6 indicated that, Livestock and Crop component generated 509.17 Mandays of employment per annum and Rs. 108977.85 net income to beneficiary farmers. The average gross income of Rs. 155540.00 from both crop and livestock enterprises of IFS against Rs. 18837.00 before implementation of the project. As such, for every one rupee investment under IFS they are getting Rs. 3.34 rupee income where in BC ratio has been increased to 3.63 from 2.77 in crop component and with respect livestock component BC ratio was found to be enhanced to 3.34 from 2.77. The probable reason for the observed trend is that, Integrated Farming system provides an opportunity to utilize the resources productively. Crop diversification, integration of different farming systems provides regular income through the sale of milk, butter / ghee, egg and manure. Use of off-farm inputs, maximum on-farm inputs and wastes recycling helps to increase and sustain the profitability of farm.

Table 6: Economic analysis of Integrated Farming System (IFS) components before and after implementation of project in Mandya district (n=240)

Crop Component	Avg.	Before							After										
	Land Holding (Acre.)	Avg. Yield (Ql./ac.)	Avg. yield of Beneficiary farmers (Ql./ac.)	Price (Rs./Ql.)	Prod. Cost/ac. (Rs.)	Prod. Cost of Beneficiary farmers (Rs.)	Gross Income (Rs./ac.)	Net Income (Rs./ac.)	BC Ratio	Avg. Yield (Ql./ac.)	Avg. yield of Beneficiary farmers (Ql./ac.)	Price (Rs./Ql.)	Prod. Cost/ac. (Rs.)	Prod. Cost of Beneficiary farmers (Rs.)	Gross Income (Rs./ac.)	Net Income (Rs./ac.)	BC Ratio	Change in yield (%)	Change in income (%)	Emply. Gene. in (Mandays/ ac.)	Emply. Gene. of Beneficiary farmers (Mandays)
Paddy	0.69	21.00	14.49	1300.00	9856.00	6800.64	18837.00	12036.36	2.77	24.00	16.56	1550.00	10235.00	7062.15	25668.00	18605.85	3.63	14.29	36.26	93.00	64.17
Total						6800.64	18837.00	12036.36	2.77					7062.15	25668.00	18605.85	3.63		36.26		64.17
Livestock Component	**Body live wt. or Ltrs/ sheep or poultry or pig or cow**		**Price/kg or Ltr**		**Cost**		**Gross Income (Rs.)**	**Net Income (Rs.)**	**BC Ratio**	**Body live wt. or Ltrs/ sheep or poultry or pig or cow**		**Price/kg or Ltr**		**Cost**	**Gross Income (Rs)**	**Net Income (Rs.)**	**BC Ratio**	**Change in yield (%)**	**Change in income (%)**	**Emply. Gene. (Mandays)**	**Emply. Gene. of Beneficiary farmers (Mandays)**
Cow (n1=190)										1574.00		28.00		16500.00	44072.00	27572.00	2.67				210.00
Sheep (n2=86)										90.00		400.00		9000.00	36000.00	27000.00	4.00				95.00
Poultry (n3=60)										12.00		150.00			1800.00	1800.00					
Piggery (n4=24)										400.00		120.00		14000.00	48000.00	34000.00	3.43				140.00
Total														39500.00	129872.00	90372.00	3.29				445.00
Grand total						6800.64	18837.00	12036.36	2.77					46562.15	155540.00	108977.85	3.34		36.26		509.17

*Inter crop

CONCLUSION

Based on the findings it can be concluded that, the results revealed that, the livelihood security of respondents in 'highly satisfied category' increased to 30.33 per cent from 26.067 per cent, out of seven dimensions maximum increase was noticed in employment security (48.14%).The characteristics such as land holding, cropping pattern, livestock possession, cosmopoliteness, innovativeness, mass media exposure, extension participation, level of aspiration, training undergone and willingness in agriculture had positive and significant relationship with livelihood security. The R^2 value indicated that all the 13 independent variables had contributed to the tune of 64.40 per cent of variation in livelihood security of the respondents. The findings conveyed that, six independent variables such as land holding, cropping pattern, innovativeness, extension participation, level of aspiration, training undergone had contributed significantly towards livelihood security. The R^2 value indicated that, all the 13 independent variables had contributed to the tune of 64.40 per cent of variation in livelihood security of the respondents. Hence, the concerned development departments should promote and strengthen the IFS activities to enhance the livelihood security of resource poor farmers. The positive and significantly related characteristics need to be given a priority while selecting the farmers for IFS programs to enhance their livelihood security.

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Research Article

Phytochemical Screening of Tray Dried *Amaranthus viridis* L. (Chirryaku) and *Alternanthera sessilis* (Ponnaganti koora aaku) Methanol Extracts

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ABSTRACT

Amaranthus viridis L. (chirryaku) and *Alternanthera sessilis* (ponnaganti koora leaves) were traditional medicinal plants from the Amaranthaceae family. These were found in tropical and subtropical regions and used for their analgesic, anti-pyretic, anti-inflammatory, diuretic, antiproliferative, antifungal and antiviral properties. This study aimed to investigate the phytochemical composition of these plants. The leaves were processed to extract their bioactive compounds using cold maceration in methanol. Preliminary phytochemical screenings revealed the presence of carbohydrates, alkaloids, proteins, amino acids, flavonoids, terpenoids, cardiac glycosides, steroids, saponins, tannins, phlobatinins, phenols, and quinones, while fixed oils and fats were absent. The results underscore the potential of *Amaranthus viridis* and *Alternanthera sessilis* as valuable sources of bioactive compounds for pharmacological and pharmaceutical applications which further needed to be explored.

Keywords: *Amaranthus viridis*, Chirryaku, *Alternanthera sessilis*, Ponganti koora aaku, Phytochemical screening, Bioactive components

INTRODUCTION

Amaranthus viridis L. of Amaranthaceae was a cosmopolitan weed commonly called chirryaku in Telugu found in tropical and subtropical regions, occasionally in temperate regions like Europe and North America. It was a native to Asia, common in equatorial Africa and occasionally cultivated in countries like Nigeria, Gabon and Congo (Brenan, 1981). This herb grew up to 1.0 m tall with slender, angular stems and alternate leaves that were 10.0 cm long. It has green and unisexual flowers that produced small and glossy black seeds (Ferdous *et al*., 2015; Panda *et al*., 2015).

Traditionally, chirryaku was used for its analgesic and anti-pyretic properties to treat pain and fever. Its leaves were applied on various skin conditions like eczema, psoriasis and rashes (Kiritikar and Basu, 1987). The plant was also used for its anti-inflammatory properties, along with being used as diuretic for treatment of urinary tract issues, venereal diseases, rheumatism, ulcers, respiratory problems, eye problems and asthma. It has antiproliferative, antifungal and antiviral properties (Agra *et al*., 2007).

Sessile joyweed (*Alternanthera sessilis*), a leafy vegetable from the Amaranthaceae family, commonly called ponnaganti koora leaves in Telugu has two varieties which were green (ASG) and red (ASR) in colour ASG offered several health benefits including anti-inflammatory effect, cytotoxicity against pancreatic cancer cells and free radical scavenging (George *et al*., 2010; Subhashini *et al*., 2010; Borah *et al*., 2011). Traditionally, it was used in India for treating eye

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problems, headaches, fever and gastrointestinal issues and in Indonesia was used for stomach disorders, diarrhea and dysentery. ASR showed protective effects against hyperglycemia and triglyceridemia in diabetic rats (Othman *et al*., 2016).

Green leafy vegetables (GLVs) were a vital source of nutrition and provided health benefits from ancient times, especially in developing countries. They provided essential nutrients, micronutrients and phytochemicals like iron, vitamin C, lutein, zeaxanthin, tocopherols, and polyphenols which aided in glycemic control, immuno-stimulation, antioxidant activity and eye health. Despite their high nutritional value and affordability, knowledge about their benefits was limited among the general public, leading to their lower consumption. The documentation of traditional knowledge about GLVs particularly in South India underscored their importance in nutrition and health that highlighted their role in combating micro nutrient deficiencies and promoting overall well-being (Kumar *et al*., 2013; Azam *et al*., 2014; Misra and Misra 2014).

Phytochemicals with nutraceutical properties are bioactive constituents obtained as non-nutritive plant derivatives that are produced by plants for their self defense against pests and insects as well as contributed to human wellbeing. The isolated substances were used as nutritional supplements and in functional diets to produce genetically engineered designer foods, herbal goods and cold drinks. Phytochemicals were broadly categorised as polyphenolics, flavonoids, isoflavonoids, anthocyanidins, phytoestrogens, terpenoids, carotenoids, phytosterols, glucosinolates and fibres (Sharma *et al*., 2014).

The other phytochemicals namely alkaloids, reducing sugars and flavonoids were found only in methanol and aqueous extracts, whereas tannins and terpenoids were present in all solvent extract of whole grains and their bran fractions. The methanol extracts of whole flour and its bran fraction showed a significantly high radical scavenge activity of 44.62 and 51.80 percent respectively by DPPH system with reducing power of 0.38 and 0.46 respectively (Suma and Urooj, 2012).

MATERIALS AND METHODS

Amaranthus viridis (chirryaku) was procured from Krishi Vigyan Kendra, Wyra and *Alternanthera sessilis* (ponnaganti koora aaku) was purchased from local markets of Hyderabad. The glassware and equipment were from Department of Foods & Nutrition, PGRC, PJTSAU, Rajendranagar, Hyderabad.

Preparation of *Amaranthus viridis* (chirryaku) and *Alternanthera sessilis* (ponnaganti koora aaku) methanol extracts: Firstly, fresh leaves were blanched for 2 min, excess water removed, tray dried for 6 hours at 60°C, cooled, powdered and stored in air tight container. From this 2.0 g of leaf powders were used to extract by cold steeping in 100.0 ml of methanol for 24 hrs, centrifugated at 3000 rpm for 10 min and filtered with Whatman No. 41 filter paper to obtain clear extracts. The clear filtrates were pooled, combined and stored at 4°C until further use.

Preliminary phytochemical screening of chirryaku and ponnaganti koora aaku methanol extracts: The preliminary tests of carbohydrate, alkaloids, proteins, amino acids, flavonoids, fixed oils, terpenoids, cardiac glycosides, steroids, tannins, phlobatins, phenols and quinones were carried out as per procedure given by Harborne (1993).

Test for carbohydrates: To 2.0 ml of sample extracts, two drops of Molisch reagent was added and shaken vigorously. To this 2.0 ml of concentrated H_2SO_4 was added from the walls of the test tube. A reddish violet ring formed at the juncture of two layers immediately which indicated the presence of carbohydrates.

Test for alkaloids: The presence or absence of alkaloids was carried out using Mayer's, Wagner's and Hager's tests.

Mayer's test: A portion of extract was added with 1.0% HCl and 6 drops of Mayer's reagent (1.36 g of mercuric chloride and 5.0 g of potassium iodide in 100.0 ml of water). The organic precipitate indicated the presence of alkaloids in the samples.

Wagner's test: A fraction of extract was treated with Wagner's reagent which has 0.28 g of iodine and 0.20 g of potassium iodide in 10.0 ml water. The formation of cream-colored precipitate indicated the presence of alkaloids.

Hager's test: The extract sample was treated with Hager's reagent containing saturated aqueous solution of picric acid and the formation of a prominent

yellow coloured precipitate indicated the presence of alkaloids.

Test for proteins: To 2.0 ml of sample extract, 1.0 ml of 40.0% sodium hydroxide and 1 to 2 drops of 1.0% copper sulphate solution were added. The formation of violet color indicated the presence of peptide linkages found in proteins of leaf samples.

Test for amino acids: To 2.0 ml of sample extract, 2.0 ml of ninhydrin reagent was added and kept in a water bath at 60°C for 20 minutes. The appearance of purple color indicated the presence of amino acids in the sample.

Test for flavonoids: Each fraction of sample extracts was added with 5.0 ml ammonia followed by few drops of concentrated H_2SO_4. The development of a yellow colour confirmed the presence of flavonoids which disappeared on standing for a few minutes.

Test for fixed oils and fats: A few drops of 0.5 N alcoholic KOH and a drop of phenolphthalein indicator were added to the extract fractions. The mixtures were heated at 60°C in a water bath for 1½ – 2 hrs. The formation of soap or partial neutralization of alkali indicated the presence of fixed oils and fats.

Test for terpenoids: To 5.0 ml of each extract, 2.0 ml of chloroform and 3.0 ml of concentrated sulphuric acid were added and formation of single layer of reddish-brown colour at the juncture was due to the presence of terpenoids.

Test for cardiac glycosides: About 5.0 ml of each extract was added with 2.0 ml of glacial acetic acid containing one drop of $FeCl_3$ solution and 1.0 ml of concentrated sulphuric acid. The formation of brown ring at the interface indicated the deoxy sugar which was distinctive for cardenolides. A violet ring can appear below the brown ring in the acetic acid layer whereas a green layer can also form just gradually into a thin layer.

Test for steroids (Liebermann - Burchard test): 2.0 ml each of acetic anhydride and concentrated sulphuric acid were added to 0.5 ml of leaf extracts in triplicates. The appearance of blue or green colour from initial violet colour indicated the presence of steroids.

Test for saponins: The extracts were added with 20.0 ml of distilled water and agitated vigorously in a graduated cylinder for 15 min. The formation of centimetre layer of foam indicated the presence of saponins.

Test for tannins: A few drops of 1.0% lead acetate was added 5.0 ml of extracts and the formation of yellow precipitate indicated the presence of tannins.

Test for phlobatinins: Each extract was boiled with a few drops of 1.0% hydrochloric acid and the deposition of red precipitate indicated the presence of phlobatins.

Test for phenols: Ferric chloride and Liebermann's tests were used to determine the presence or absence of phenols in chirryaku and ponnaganti koora aaku methanol extracts.

Ferric chloride test: A fraction of each of the extracts was added with a few drops of 5.0% Ferric chloride and the formation of deep blue or black colour indicated the presence of phenols.

Liebermann's test: The extracts were heated with sodium nitrite and concentrated sulphuric acid solution, diluted in water, cooled and added with excess of dilute sodium hydroxide. The formation of deep red or green or blue colours indicated the presence of phenols.

Test for quinones: A small amount of each extract was treated with concentrated HCl and appearance of yellow coloured precipitate indicated the presence of quinones. The absence of yellow coloured precipitate showed that the extracts have not undergone any form of oxidation.

RESULTS AND DISCUSSION

The naturally occurring phytochemicals or phytonutrients in plants were found to be beneficial for human health and showed antioxidant activity. These phytochemicals displayed antioxidant and anti-inflammatory properties. They play a important role in purging of human body by removal of harmful and deleterious chemicals which otherwise lead to the formation of free radicals (Praveena and Estherlydia, 2014).

The phytochemicals tests were carried out using standard methods of analysis for carbohydrates, alkaloids, proteins, amino acids, flavonoids, fixed oils and fats, terpenoids, cardiac glycosides steroids,

Table 1: Phytochemical screening of *Amaranthus viridis* (chirryaku) and *Alternanthera sessilis* (ponnaganti koora aaku) methanol extracts

S.No.	Phytochemicals	Test	Chirryaku	Ponnaganti koora aaku
1.	Carbohydrates	Molisch test	++	++
2.	Alkaloids	Mayer's test	++	++
		Wagner's test	++	++
		Hager's test	++	++
3.	Proteins	NaOH and $CuSO_4$	++	++
4.	Amino acids	Ninhydrin solution test	++	++
5.	Flavonoids	With ammonia solution	++	++
6.	Fixed oils and fats	Foam test	-	-
7.	Terpenoids	Chloroform and Sulphuric acid	+	+
8.	Cardiac glycosides	Glacial acetic acid and $FeCl_3$ solution	++	++
9.	Steroids	Liebermann's – Burchard test	+	+
10.	Saponins	Foam test	+	+
11.	Tannins	$FeCl_3$ test	++	++
12.	Phlobatinins	With HCl	+	+
13.	Phenols	$FeCl_3$ test Liebermann's test	++++	++++
14.	Quinones	With concentrated HCl	-	-

Note: As the tests were carried out in triplicates.

saponins, tannins, phlobatinins, phenols and quinones. The results of phytochemical screening were presented in Table 1. The present study showed that carbohydrates, alkaloids, proteins, amino acids, flavonoids, cardiac glycosides, tannins and phenols were strongly detected. Terpenoids, steroids, saponins, phlobatinins and quinones were also identified. The fixed oils and fats were not detected in both *Amaranthus viridis* and *Alternanthera sessilis* leaves.

Few research studies examined the phyto-constituents in methanol and hexane extracts of drum stick and ponnaganti koora leaves. The methanol extracts showed alkaloids, flavonoids, carbohydrates, terpenoids, polyphenols, glycosides and coumarins. The drum stick leaves methanol extract showed cytotoxicity to brine shrimp nauplii but not the hexane extract. The methanol extract of both leaves showed strong radical scavenging activity with 50.00 of 65.77 μg/mL where as ponnaganti leaves showed high antioxidant activity with 50.00 of 71.10 μg/mL than its hexane extracts (Umate and Marathe, 2017; Pathak *et al.,* 2020; Gayathri *et al*., 2021).

The phytochemical composition of fresh ponnaganti leaves using aqueous, acetone, methanol and ethanol extracts showed the presence of alkaloids, carbohydrates, cardiac-glycosides, flavonoids, phenols, saponins, tannins, terpenoids, quinones and coumarins. These phytochemicals had significant uses to pharmacological and pharmaceutical industries due to their diverse bioactive principles (Sunday *et al*., 2021; Nikam and Namdas, 2022; Popoola, 2022).

CONCLUSION

In conclusion screening of phytochemicals was an easy way to find out the presence or absence of components there by understanding the composition to help design special functional foods. The antioxidants are in high demand as they played a very significant role in neutralizing free radicals which were formed due to stress, environmental pollution, ageing, food habits and environment conditions.

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