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MAHARASHTRA SOCIETY OF EXTENSION EDUCATION

C/O, Head, Department of Extension Education,
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Maharashtra, India

Editorial

Maharashtra Society of Extension Education (MSEE) registered in 1982, has the foremost objective to publish the research journal. Accordingly, the society was publishing the journal entitled Maharashtra Journal of Extension Education. Since the year 2004 this journal has been renamed as Asian Journal of Extension Education.

The journal includes research articles from the researchers and extension workers in the field of extension education from various faculties of various institutes in the country. Extension education plays an important role not only in transfer of innovative technologies but also in developing appropriate methodology in the field of extension more suited for field application. The innovative research methods can be very well communicated for its application and use in further research by the extension fraternity. This can be achieved by publishing research articles.

Asian Journal of Extension Education is a very humble attempt to provide platform towards this goal of networking with the all extension professionals who could kindle the minds of their peers and young scientists through their research articles.

I have immense pleasure to present this 41st issue of Asian Journal of Extension Education for the year 2023. The Journal has received an encouraging response from all corners of the country. We have made an effort to encompass the best articles for the issue. Thanks are due to all the authors who have contributed for this issue.

I extend sincere thanks to Capt. Dr. L. B. Kalantri, Hon'ble President, Dr. D. M. Mankar, Vice President and Respected Member of Executive Body Dr. N. R. Koshti, Dr. N. V. Kumbhare for their constant inspiration, valuable guidance and concrete suggestions to maintain the quality of the journal.

I appreciate the tireless contribution of my colleagues and Joint-Secretary Dr. M. K. Rathod and Dr. S. D. More for their endless efforts in publishing this issue. I am confident that this issue of the Journal will be appreciated by the extension scientists, researchers, students and readers for its usefulness and contents. I solicit their suggestions for further enhancement of quality of the Journal.

Akola

Date: April, 2024

P. K. Wakle

Chief Editor

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RESEARCH ARTICLE**Assessment and improvement of the undergraduate agricultural extension curriculum in Sri Lanka****Murari Suvedi¹ P.V.K. Sasidhar² and Maheshwari S Elapata³**

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ABSTRACT

Changing job environment calls for process skills and competencies of agricultural extension professionals. This study assessed the agricultural extension professionals' skills and competencies. They were also asked about the barriers and also to recommend ways to acquire these skills and competencies. Focus group discussions and online survey were conducted to solicit perspectives of extension professionals. There is a significant gap between extension worker's job skills and how well these skills are covered in the undergraduate agricultural extension curriculum. The major barriers to effective implementation of extension curricula include budget to support practical learning, quality faculty to teach extension courses, student motivation in practical work, and teacher motivation. The findings suggest areas for developing competency-based extension curriculum.

INTRODUCTION

The agriculture sector in Sri Lanka acts as a major economic strength to the national economy. The agriculture sector employs over 27% of the labor force (Central Intelligence Agency, 2022). Agriculture, along with its related sectors, is the most important source of employment in the country. Sri Lanka is mainly dominated by the small-scale agriculture. Small-scale agriculture, however, has been facing complex challenges such as the spread of commercial farming, trade liberalization, feminization in agricultural labor, and technological advancement, which have created both opportunities and threats for smallholder livelihoods (Rivera & Alex, 2008; Suvedi & Ghimire, 2015; Suvedi & Kaplowitz, 2016). These challenges are of no exception to Sri Lanka. Agricultural extension is perceived to be one of the most important keys in advancing innovation and development in rural areas by

effective dissemination of right information (Davis, 2015; Maulu et al., 2021). Thus, agricultural extension and advisory services (AEASs) play a key role in addressing the challenges of the small holders and helping them to capitalize the market opportunities.

The scope of AEASs has been widening, and the need to adapt to changing contexts is also growing. The AEASs should work in sustainable agricultural development and play coordinating and leadership roles among agricultural stakeholders (Rajalahti, 2012; Swanson, 2008). The challenges include offering new services, ensuring the quality of services, and strengthening collaboration and synergy among extension service providers (Davis & Sulaiman, 2012). Furthermore, extension services should become more participatory, demand-driven, and pluralistic (Rivera et al., 2009). This means that, to thrive, extension must understand and adjust to rapid changes and

emerging challenges (Extension Committee on Organization and Policy, 2002). This calls for organizational changes and new tasks that indicate the need for multi-skilled human resources in AEASs (Cochran et al., 2012). Because capable human resources help make efficient and sustainable use of other resources, the effectiveness of AEASs depends greatly on the preparedness and competencies of extension professionals. Extension professionals with current knowledge who can make informed decisions about agricultural systems and who have skills needed for adaptation and facilitation can make significant contributions to extension services and thus to agricultural development (Hoffman, 2014; Qamar, 2006).

Agricultural extension services in Sri Lanka had failed to adequately respond to the information needs of farmers and rural communities (Wijekoon & Emitiyagoda, 2009; Wanigasundera & Attapathu, 2019; Elapata et al., 2023). Wanigasundera & Attapathu (2020) also revealed that the agricultural services in Sri Lanka lagged in adjusting to the changing roles of agricultural extension. Thus, it appears that there is a serious gap between the current competencies of the extension professionals and the desired level of extension competencies.

Agricultural training institutions in Sri Lanka were created during 1960s and 1970s.

Training content, or the subject matter, was mainly borrowed from British universities, and learning methods and materials were often outdated and inadequate. Further, there is a dearth of studies done to assess the core competencies of agricultural extension professionals in Sri Lanka. Such an assessment of core competency skill gaps would help develop competency-based curriculum and curricular revitalization in the agricultural training institutions Sri Lanka.

Thus, the goal of this study is to assess the agricultural extension curricula currently followed in Sri Lanka at the undergraduate level and recommend revisions and reforms. The specific objectives include:

1. Identify critical process skills or core competencies of agricultural extension professionals, process skills gaps, and areas of potential curricular reform.
2. Identify the major barriers to effective implementation of extension curricula.

Theoretical Background

The agricultural extension has a long history in Sri Lanka. Some forms of extension services began after the arrival of Europeans in Sri Lanka (Marambe & Athauda, 2017). The evolution of the Sri Lankan extension system is summarized in the Table 1

Table 1: Evolution of the agricultural extension system in Sri Lanka

17th century	Extension programs in the agriculture sector of Sri Lanka were initiated during the Dutch period in the 17 th century.	(Marambe & Athauda, 2017)
	These programs were conducted with the aim of expanding cinnamon crops and targeting the export market.	
	During British colonial era, plantations were managed under superintendents of plantations who transferred their knowledge to the plantation workers.	(Shanmugaratnam, 1981)
	Hierarchy of staff included field officers, field assistants, supervisors (<i>kankanam</i>) and laborers	(Shanmugaratnam, 1981)
1904	The Ceylon Agriculture Society (CAS) was established in 1904 to revive farming. The CAS promoted experimental	(Arasasingham, 1981; Wijeratne, 1988)

	work and operated an agricultural extension service with the objective of researching native cultivators and passing on the agricultural knowledge and experience gained by the research staff.	
1912	Establishment of the Department of Agriculture (DOA)	(Wanigasundera & Atapattu, 2019)
1920	Establishment of an agricultural extension arm within the DOA. Tea, rubber, and coconut research institutes were established.	(Wanigasundera & Atapattu, 2019; Wijeratne, 1988).
1923	The entire country was divided into 3 divisions and divisional agricultural officers were appointed to head them.	(Wijeratne, 1988)
1938	Six agricultural divisions were established, and each division was led by an agricultural officer who maintained direct contact with the farmers.	(Wijeratne, 1988)
1939	74 agriculture diploma holders were appointed to the post of agricultural instructor (AI). Agricultural officer supported by 37 AIs were appointed for each 9 provinces of Sri Lanka.	(Sivayoganathan, 2020)
1940	Sri Lanka agriculture association was established, and food production officers (FPO) were attached to this association.	(Sivayoganathan, 2020)
1951	In year 1951 the Maha-Illuppallama, the dry zone research station was reopened.	(Sivayoganathan, 2020)
1952	Ministry of agriculture formed a separate department of food production, and the department was disbanded in 1957 and its workers incorporated into the DOA. About 500 FPOs came into the DOA. Later the name of FPO was renamed as Krushikarma Vyaptha Sevaka (KVS) with individuals	(Wijeratne, 1988).
1957	completing a year of training in practical farm schools. District agriculture extension officers were appointed, and	(Wijeratne, 1988).
1963	provincial level extension system was decentralized by DOA. Agriculture extension was recognized as separate division under DOA, and deputy director of agriculture (extension) was appointed.	(Sivayoganathan, 2020)
1967	The central rice breeding station was established at Batalagoda and was renamed as the rice research and development institute in 1994.	(Wijeratne, 1988).
1970	Establishment of agrarian development centers to provide services such as banking/agri-credits, agriculture inputs, and extension services under one roof	(Marambe & Athauda, 2017)
1979	The Mahaweli river development scheme in accordance with the Mahaweli authority act No. 23 of 1979 was initiated to promote agricultural development through a network crops and livestock knowledge system to serve the farmers in the Mahaweli Area.	(Marambe & Athauda, 2017)
1979/80	Training and visit system of agricultural extension was introduced for coordination of Extension, Research and Training Institutes.	(Sivayoganathan, 2020)
1989	Under the 13 th amendment to the constitution, the extension function of the DOA and department of animal production and health (DAPH) was largely devolved to the provinces.	(Sivayoganathan, 2020)

	After the promulgation of the council act, the provincial department of agriculture restructured its workforce. Its field-level extension workers were designated as <i>Grama Seva Niladaries</i> (GSNs) to focus on administrative functions.	(Sivayoganathan, 2020)
2004	As an ICT initiative, cyber agricultural extension mechanism was implemented as an appropriate information delivery mechanism.	(Wanigasundera & Atapattu, 2019)
2015	A new cadre of technical assistants (TAs) was created in the DOA and diploma holders in agriculture were recruited for this cadre. These TAs carry out their duties under the direct supervision of AIs of the respective divisions.	(Sivayoganathan, 2020)

Today, Sri Lanka has a pluralistic extension service providers representing both the public and the private sectors. But still the extension system of Sri Lanka is more of a top-down, supply- and technology-driven and this no longer appears to be an appropriate model. Today, a demand driven approach of extension service has been the buzz word that extension service should tailor to the expressed demands of the ultimate clients of the service: not just to their "needs" as identified by various stakeholders (government, corporations, scientists, extension professionals), but also to address the wants (Alex & Rivera, 2004). Franzel et al (2020) had pointed out that a demand-driven extension and advisory services have an imperative role to play in bridging gaps in know-how and networking that would enable large numbers of youth and businesses to successfully engage with one another in agriculture and supporting markets, especially in rural areas of developing countries. Swanson (2008) argues that, to make these institutional changes, public extension systems must become more decentralized, farmer-led, and market-driven. Thus, there is an urging need of a transition from a supply-driven and top-down technology transfer system to a demand-driven and bottom-up participatory approach, work in partnership with many public, not-for-profit, and private sector organization and to be flexible to meet the educational and informational needs of new clientele groups

(Axinn, 1988; Chambers, 1997; Swanson, 2008). These changes in the role of the extension system demand different skills and competencies from extension professionals (Cooper & Graham, 2001).

Agricultural universities and vocational/technical training institutions are responsible for producing agricultural development professionals who can shoulder the responsibilities of enhancing sustainable agricultural systems (Dubois et al., 2004; Baker, 2015). Thus, the curriculum of these agricultural universities and vocational training institutions is a crucial component in educating and producing competent agricultural development professionals. According to the earliest definition by Beauchamp (1982), curriculum theory is a set of related statements, or propositions, that gives meaning to the phenomena related to the concept of a curriculum, its development, its use, and its evaluation. At the development of a curriculum, a curriculum framework is used. The curriculum framework, including the expected learning outcomes, communicates what teachers and learners should know and do (UNESCO, 2023). Expected learning outcomes encompass the full range of information, knowledge, understanding, attitudes, values, skills, competencies, or behaviors that a learner should acquire upon successfully completing the curriculum" (UNESCO, 2023). Thus, to develop a

competence-based curriculum, it is crucial to assess the competences (Mulder, 2017). All jobs require specific competencies, and these could be categorized as technical competencies. Technical competencies are job specific, and whereas core competencies are relevant in all jobs within the organization, although their importance may vary by job (Mulder, 2017). Establishing rapport with farming communities, networking with local organizations, facilitating group formation, resolving conflict, and engaging stakeholders in program planning, implementation, and evaluation are examples of process skills or functional competencies (Extension Committee on Organization and Policy, 2002; Harder et al., 2010; Ghimire, 2016). Ghimire et al. (2016) identified eight areas of job expectations for an agricultural extension professional: program planning, program implementation, communication skills, educational and informational technology, program evaluation, personal and [professional development](#), diversity, and technical subject matter expertise.

METHODOLOGY

This study was undertaken in Sri Lanka during 2020. An online survey and focus group discussions were conducted to solicit opinions and perspectives of extension professionals about the context of extension services, required skills and competencies of extension workers in a changing context, and the coverage of skills and competencies in the undergraduate level extension curriculum.

An online survey questionnaire was developed after careful review of literature and past survey instruments. The survey was formatted using Qualtrics software and pretested with 12 faculty members from the School of Extension and Development Studies and School of Agriculture at Indira Gandhi National Open University, New Delhi, India (Suvedi & Sasidhar, 2020). Faculty members from India reviewed the instrument for validity, and they also participated in the survey pretest. The pretest

data were used to determine survey instrument's reliability. A Cronbach's alpha for scales in various sections of the survey instrument showed an alpha value at 0.70 or higher indicating satisfactory level of reliability. His same instrument was used for online data collection in Sri Lanka.

An email list of Sri Lankan agricultural extension professionals was compiled by scanning the websites and directories of research institutions, agricultural, veterinary, and fisheries universities, state government departments, NGOs, and private sector companies. The emails of the professionals were also obtained from the Sri Lanka Network of Agricultural Extension and Advisory Services (NAEASL). All persons in the list were invited to participate voluntarily in the online survey which was administered through Qualtrics software. Three email reminders were sent to increase the response rate. However, a total of 119 respondents participated in the online survey. Hence, the study adopted a convenience sampling technique, which posed as a limitation to the study. The survey questionnaire included questions regarding the process skills and core competencies and barriers. The process skills and core competencies in the present study were operationalized as the basic sets of knowledge, skills, abilities, and behaviors that agricultural extension professionals require to perform their tasks well in the following eight areas: 1) program planning, 2) program implementation, 3) communication and public relations, 4) information and communication technologies (ICTs), 5) program evaluation, 6) personal and professional development, 7) diversity and gender, and 8) Technical subject matter expertise. Keeping in mind their experience in agricultural extension work, respondents were asked to rate the above eight process skills and competencies on the following.

- a. How important is this skill or competency? Respondents rated items on 1 to 5 scales with 1 being not important; 2 = somewhat important; 3 = average; 4 =

important; and 5 = essential.

- b. How well does our UG extension curriculum address this competency? Respondents rated the statements on 1 to 5 scales with 1 = not at all covered; 2 = minimally covered; 3 = moderately well covered; 4 = very well covered; and 5 = extremely well covered.

The survey consisted of mostly closed-ended questions. A few open-ended questions were also included. Participants were also asked to list three major barriers to effective implementation of the extension curriculum. The filled in questionnaires were checked for completion, and incomplete surveys were excluded from the analysis. The quantitative data were analyzed using the SPSS software, and descriptive statistics, and paired sample t-test were applied to analyze the data. The important barriers perceived by most of the respondents were tabulated using frequencies and percentages.

Further, five focus group discussions were conducted to gather qualitative data to get in-depth information on the study. Focus group discussions were carried out in Sabaragamuwa University of Sri Lanka – four faculty members and six field extension functionaries participated in the discussion; Agriculture Extension Department, Peradeniya University, Kandy – eight faculty members and the dean participated in the discussion; Faculty of Veterinary Medicine, Peradeniya University, Kandy – 10 faculty members and the dean participated in the discussion; Department of Agriculture Extension and Training, Kandy – five senior officials participated in the discussion; Department of Animal Production and Health, Kandy – 14 senior officials participated in the discussion. The focus groups were guided by a moderator using a guided questionnaire. One member of the project team served as facilitator; another member documented the discussion. Each focus group lasted about two hours. Confidentiality of the data and anonymity of the participants' identity

were maintained throughout the session. The FGD participants were encouraged to brainstorm ideas for explaining the current issues in agricultural extension, critical skills and competencies required by agricultural extension personnel, gaps in the agricultural extension curricula, barriers to training the undergraduates, and finally, recommendations to improve the agricultural extension curricula. The facilitator guided the sessions, offering procedural clarifications where necessary. Then, each participant independently generated a set of ideas to address the questions, after which all the individual responses were collected, and identical ones were grouped by the documenter. Thematic analysis was conducted to analyze the focus group data.

RESULTS AND DISCUSSION

The results revealed that many Sri Lankan extension professionals (31%) were in the age group of 26-35 years, followed by 46-55 years (30%) and 36-45 years (26%). Of the respondents, 38.1% had master's qualification in agricultural extension and allied subjects, followed by bachelor's (36.3%) and Ph.D. (15%) educational backgrounds. The results revealed an equal distribution of gender and time on the job-- 60% of agricultural extension professionals had less than 10 years of experience. The results on current positions of respondents showed that 55.4% of them were serving under the Ministry of Agriculture, DOA, or DAPH. About 34.8 percent of the respondents were serving as extension faculty members at universities (Table 2).

Table 2: Demographics of Agricultural Extension Professionals in Sri Lanka

Category	Frequency (%)
(a) Age (N= 111)	
<25 years	1 (0.91)
26-35 years	34 (30.6)
36-45 years	29 (26.1)

46-55 years	33 (29.7)
>55 years	14 (12.6)
(b) Education background (N= 113)	
Associate Degree / Diploma	12 (10.6)
Bachelor's Degree in Agriculture / Allied Subjects	41 (36.3)
Masters in Agricultural/Veterinary/ Home Science Extension	43 (38.1)
Ph.D. in Agricultural/Veterinary/ Home Science Extension	17 (15.0)
(c) Gender (N= 111)	
Male	56 (50.4)
Female	55 (49.5)
(d) Work experience (N=104)	
<10 years	62 (60.0)
11-20 years	30 (29.0)
21-30 years	12 (11.0)
(e) Primary employer (N= 112)	
Ministry of Agriculture / Department of Agriculture / Animal Health and Production	62 (55.4)
NGOs / Private Sector	8 (7.0)
Universities	39 (34.8)
Others	3 (2.8)

Process Skills and Competencies among Agricultural Extension Professionals in Sri Lanka

Extension worker skills and core competencies were grouped into eight areas. The mean scores on the level of importance indicated that all the agricultural extension professionals in Sri Lanka perceived all process skills and competencies as important (Table 3). Program planning skills included that agricultural extension professional must be able to plan meticulously by expanding participation and evaluating a program, an extension workers should be familiar with the vision, mission, and goals of policies; able to engage stakeholders to conduct needs assessment and prioritize local needs; able to acquire resources to address priority needs; able to engage local development partners such as NGOs, women's groups, and

cooperatives in extension programs; and familiar with government administrative and financial rules and regulations.

Program implementation includes implementation of various programs and activities through collaboration and teamwork, engaging women and members of minority groups and grassroots organizations. Similarly, listening and negotiation skills were identified as important skills for conflict resolution. Communication and public relations skills including use of various communication channels to disseminate information, listening and public speaking skills are important for extension workers. Information and communication technologies such as mastery of Microsoft Word, PowerPoint, and Excel software, and use of e-mail, Internet and web pages, mass media like radio/TV and social media are emerging skills. Designing process and impact evaluations, developing data collection instruments, conducting focus groups and in-depth interviews, analyzing data and preparing reports are essential skills for program evaluation. Diversity and gender skills included engaging women farmers, small holder farmers, and members of ethnic minority, local organizations and business groups. Finally, technical subject matter expertise in plant and animal production, food processing and marketing were considered essential for successful extension work.

The above results were further confirmed by the focus group discussions. They key competencies that need to be improved in the Sri Lankan agricultural extension curricula are summarized as follow: program planning (participatory need assessment, priority-setting methods, facilitation skills); program implementation (stakeholder engagement); communication and interpersonal; program evaluation (data entry, analysis and interpretation, develop data collection instrument, write evaluation reports); personal

and professional development (practice principles of good governance) and; technical (essential knowledge in the basic discipline, comprehend the new technology being promoted, disaster management).

These competencies have been identified as basic extension skills that are needed and useful for any extension professionals at individual level by many researchers (Cooper & Graham, 2001; Scheer et al., 2006; Davis & Sulaiman, 2012; Davis & Sulaiman, 2014; Davis, 2015; Prasad et al., 2015; CRISP, 2015; Suvedi & Kaplowitz, 2016; Sasidhar & Suvedi, 2016).

Further, the mean score of the coverage in the undergraduate curriculum indicated that all the above process skills are moderately covered in the undergraduate curriculum. However, the depth of coverage and amount of curriculum transaction seems weak or missing. The results were supported by the focus group findings. The response to the FGD question on coverage of job skills and core

competencies in the UG curriculum are summarized as: yes, but theoretically covered; partially covered; in adequate hands-on training; and not much covered.

The mean scores on the level of importance of all eight process skills and core competencies were higher than the corresponding mean scores on their level of coverage in UG courses, with significant t-values ($p < 0.01$) (Table 3). The findings revealed significant differences between the level of importance and the level of coverage in undergraduate courses in all the eight process skills and core competencies of agricultural extension professionals in Sri Lanka-- i.e., program planning, implementation, and evaluation; communication and public relations; ICTs; personal and professional development; diversity and gender skills; and technical subject matter expertise. and competencies in UG extension curricula, among others.

Table 3: Summary of process skills and core competencies among agricultural extension professionals in Sri Lanka

Extension process skills and competencies (with examples)	Level of importance	Level of coverage in UG courses	Mean diff. (SD)	t-value
	Mean (SD)	Mean (SD)		
Program planning	4.34 (0.52)	3.05 (0.86)	1.29 (1.01)	13.18**
Program implementation	4.38 (0.46)	3.01 (0.73)	1.37 (0.85)	16.83**
Communication and public relations	4.50 (0.40)	3.21 (0.69)	1.29 (0.77)	17.40**
Information and communication technology	4.30 (0.56)	3.48 (1.10)	0.82 (1.08)	7.87**
Program evaluation	4.38 (0.54)	3.09 (0.84)	1.30 (0.90)	14.85**
Personal and professional development	4.33 (0.60)	2.96 (0.87)	1.37 (0.97)	14.90**
Diversity and gender skills	4.32 (0.59)	3.01 (0.82)	1.32 (0.84)	16.19**
Technical subject matter expertise	4.37 (0.53)	3.19 (0.83)	1.18 (0.86)	14.16**

** $P < 0.01$.

Note: Scale for importance: 1 = Not important, 2 = Somewhat important, 3 = Average, 4 = Important, 5 = Essential.

Appropriate Ways to Acquire the Core Competencies

A list of various strategies to enhance the undergraduate level extension curriculum was

developed. Revising and/or updating the curricula, requiring internship at various work environments (i.e., public institutions, NGOs, private companies, etc.) during the bachelor's degree program,

degree program, offering basic induction training (job orientation training at the beginning of job), offering in-service training during extension job, and providing opportunities to attend trainings, seminars, workshops, webinars, etc. Respondents were asked to rate the appropriate ways to acquire core competencies on a four-point Likert-type scale, i.e., inappropriate, somewhat appropriate, appropriate, and very appropriate, with scores of 1, 2, 3, and 4 respectively.

Perera (2013) stated that there is appreciable revision of the curricula of the Sri Lankan universities and higher education institutes involved in agricultural education. However, the findings in Table 4 reveal that a revised or updated undergraduate extension curricula is essential in Sri Lanka. Further, focus group findings and analysis of existing undergraduate extension curricula point to the conclusion that Sri Lanka is continuing to teach the traditional broad course contents adopted in the 1960s from U.S. and U.K. universities. Though, some of those contents are relevant to some extent in the field of agricultural extension, curriculum reforms are important to accommodate new technological advances and need for demand-driven, participatory, and pluralistic extension and advisory services. While formulating the curriculum, the minimum competencies must be defined so that these outcomes can be assessed during examinations.

The study also revealed the importance of internship at various work environments (i.e., public institutions, NGOs, private companies, etc.) during the bachelor's degree programs. Internships that extend beyond the classroom can enhance students' understanding of their coursework and allow them to apply their knowledge in real-world work environments (Heinert & Roberts 2016; Mott et al., 2021).

Basic induction training or job orientation training at the beginning of a job is also essential to acquire the core competencies. Providing agricultural students, extension faculty members, and the extension profession with explicit statements on the day-one competencies required enables all stakeholders to work toward the common goal of ensuring that these skills are delivered through the preservice training (Davis, 2015).

Further, in-service training (training offered during the employment period) should also be carried out periodically. In Sri Lanka, refresher or in-service training is the main and, in most cases, the only form of staff capacity development. Though several agencies are involved in in-service training of extension workers, most of their focus has been on technical issues such as crop varieties and agronomical practices, plant protection, and animal health management that too is offered in classroom setting. Extension officers should be given opportunities to attend trainings, seminars, workshops, webinars.

Table 4: Appropriate ways to acquire the core competencies

Appropriate ways to acquire core competencies	N	Mean	SD
Using revised or updated UG curricula.	112	3.07	0.77
Requiring internship at various work environments (i.e., public institutions, NGOs, private companies, etc.) during the bachelor's degree (UG) programs.	114	3.29	0.67
Through basic induction training (job orientation training at the beginning of job).	114	3.38	0.64
Through in-service training (training offered during the employment period).	113	3.49	0.60
Through opportunities to attend trainings, seminars, workshops, webinars, etc.	112	3.44	0.67

Major barriers to effective implementation of extension curricula

An open-ended question asked respondents to list major barriers to effective implementation of extension curriculum. Findings in Table 5 show that “Budget to support practical learning experience” was perceived as the barrier by 32.77% of respondents. Inadequate classroom and demonstration facilities,” (18.49%) and lack of quality textbooks and/or manuals,” (15.97%) were also regarded as barriers. The government annual budget allocation for the higher education sector in Sri Lanka is somewhat less than 3% of the GDP (Gross Domestic Production) (Ranwala et al., 2020). Hence, inadequate funding from the government leads to weak tertiary educational institutions which can’t

develop and offer robust and cutting-edge educational programs (Ranwala et al., 2020). These institutions simply lack financial resources to support faculty development programs and offer practical hands-on learning facilities.

“Less student motivation in practical extension work” (27.73%) was also regarded as a barrier. This can also be seen as a trend within the youth in Sri Lanka. Withanage & Damayanthi (2019) stated that there is a declining interest of youngsters to work and engage in agriculture. Agriculture has a negative image as a career choice among the youth. Inadequate quality faculty to teach extension courses” (20.16%) and lack of teacher motivation to teach required process skills and competencies” (15.97%) also posed as a barrier.

Table 5 : Major Barriers to Effective Implementation of Extension Curricula

Major Barriers	Frequency	Percent
Budget to support practical learning experience	39	32.77
Student motivation in practical extension work	33	27.73
Quality faculty to teach extension courses	24	20.16
Classroom and demonstration facilities	22	18.49
Quality textbooks and/or manuals	19	15.97
Teacher motivation to teach required process skills and competencies	19	15.97
Other	7	5.88

CONCLUSION AND RECOMMENDATION

A nation’s development is not sustainable unless it is supported by a well-trained workforce of its own people. This is equally true for agricultural extension. Extension cannot sustain itself unless it has technically and professionally competent people from the grassroots to the national leadership level. The competencies of the faculty, field functionaries, farmer organizations, and non-governmental

organizations need to be improved greatly to address the challenges of agricultural extension.

Program planning, program implementation, communication and public relations, information and communication technologies, program evaluation, personal and professional development, diversity and gender, technical subject matter expertise are incorporated in the curriculum, but their content is minimally covered, and the level of required curriculum transaction and preservice training at the undergraduate level is inadequate. To provide

integrated support services efficiently to their clients, agricultural extension professionals need to have or acquire the above skills and competencies in letter and spirit. The results point to the conclusion that agricultural extension professionals are fully aware of the importance of these job skills or competencies required to perform their extension jobs effectively. They are also fully aware that the present curriculum insufficiently addresses these skills and competencies. Therefore, the core issue of concern is recognition that the implementation of the curriculum is weak and does not prepare students with the required skills and competencies for quality extension work. The analysis also informs us that capacity of the faculty needs improvement, and the course content should specify the skills or competencies to be achieved, suggest pedagogy for facilitating process skills development, and support practical training and fieldwork.

Therefore, we recommend that the agricultural universities in Sri Lanka focus on enhancing the curriculum transaction process. The proponents of new curricula in agricultural extension must realize and recognize the changing nature of agriculture, inability of the public sector extension system in effectively addressing the differential service needs of the smallholder families and emergence of demand-led and market-oriented advisory systems as the drivers for these changes. Further, students should be encouraged to become problem solvers through immersion in the world of work theory internships and pedagogical innovations in college teaching and learning.

The authors also recommend developing a campaign mentality to reinforce the importance of core competencies to extension employees and to the organization. The necessary and important aspects of a core competency campaign are a) A clear and visible organizational message from the national leadership; b) A well-articulated plan for fully implementing the core competency system

and integrating it with employment, evaluation, and professional development systems; and c) A dynamic system that meets differing need within the organization.

The results on major barriers to effective implementation of extension curricula revealed in budgetary constraints, quality of extension faculty, and textbooks, etc. To address these barriers and improve agricultural extension training, we recommend that colleges and universities provide budgetary support for extension practical teaching-learning experiences, recruit quality faculty members qualified to teach required extension courses, provide opportunities for the faculty development to teach required process skills and competencies, provide good classroom and demonstration facilities, and make available quality textbooks and/or manuals.

REFERENCES

- Alex, G., & Rivera, W. (2004). *Demand-driven approaches to agriculture extension: Case studies of international initiatives*. Discussion Paper 10. World Bank, Washington, USA
- Arasasingham, S. R. (1981). Agricultural extension in Sri Lanka. *Tropical Agriculturist*, (137), 41-54.
- Axinn, G.H. (1988). *Guide on alternative extension approaches*. United Nations, Food & Agriculture Organization. Rome, Italy.
<https://agris.fao.org/search/en/providers/122621/records/6471ce6877fd37171a6fc023>
- Baker, M. (2015). *Developing the capacity of middle-level tertiary education in preparing and nurturing young entrepreneurs in sub-Saharan Africa. Innovation for Agricultural Training and Education (Innovate)*. USAID.
<https://innovate.cired.vt.edu/wp-content/uploads/2015/09/BakerEntrepreneurFINAL.pdf>
- Beauchamp, G. A. (1982). Curriculum theory: Meaning, development, and use. *Theory into practice*, 21(1), 23-27.
<https://doi.org/10.1080/00405848209542976>

- Central Intelligence Agency. (2022) *The world factbook*. <https://www.cia.gov/the-world-factbook/>
- Chambers, R. (1997). *Whose reality counts: Putting the first last*. Intermediate Technology Publications, London, UK.
- Cochran, G.R., Ferrari, T.M., & Chen, C.Y. T. (2012). Trends affecting Ohio State University extension in the 21st century and the implications for human capital. *Journal of Agricultural Education*, 53(2), 43-57. <https://doi.org/10.5032/jae.2012.02043>
- Cooper, A.W., & Graham, D.L. (2001). Competencies needed to be successful county agents and county supervisors. *Journal of Extension*, 39(1), 1-11. <https://tigerprints.clemson.edu/joe/vol39/iss1/10>
- CRISP (Centre for Research on Innovation and Science Policy). (2015). *Report on the capacity needs assessment of extension and advisory service (EAS) providers in India*. Hyderabad, India: CRISP.
- Davis, K. (2015). *The new extensionist: Core competencies for individuals*. (GFRAS Brief No 3). Lindau, Switzerland: Global Forum for Rural Advisory Services (GFRAS).
- Davis, K., & Sulaiman, R.V (2014). The new extensionist: Roles and capacities to strengthen extension and advisory services. *Journal of International Agriculture and Extension Education*, 21(3). 341-355. <http://doi:10.5191/jiaee.2014.21301>.
- Davis, K., & Sulaiman, R.V. (2012). The new extensionist: Roles, strategies, and capacities to strengthen extension and advisory services. *Journal of International Agriculture and Extension Education* 21 (3) , 6 - 18 . <http://dx.doi.org/10.5191/jiaee.2014.21301>
- Dubois, D.D., Rothwell, W.J., Stern, D.J., & Kemp, L.K. (2004). *Competency-based human resource management*. Palo Alto, CA: Davies-Black Publishing.
- Elapata, M., Mahaliyanaarachchi, R., Sivashankar, P., & Hettiarachchi, I. (2023). Role of field level extension officers in development interventions: Evidence from Sabaragamuwa Province in Sri Lanka. *Journal of Agriculture and Environment for International Development (JAEID)*, 117(2), 143-160. <https://doi.org/10.36253/jaeid-12063>
- Extension Committee on Organization and Policy. (2002). *The extension system: A vision for the 21st century*. http://dasnr2.dasnr.okstate.edu/documents/commtee_report.pdf
- Franzel, S., Lowicki-Zucca, J., Miiro, R., & Uwitonze, N. (2020). Demand-driven extension and advisory services—catalysing opportunities for youth in agriculture. *Rural 21: International Journal for Rural Development*, 54(2), 23-25.
- Ghimire, R.P. (2016). Assessment of core competencies of agricultural extension professionals in Nepal Publication No 10144609 [Doctoral Dissertation, Michigan State University], ProQuest Dissertations & Theses Global.
- Harder, A., Place, N. T., and Scheer, S. D. (2010). Towards a competency-based extension education curriculum: A Delphi study. *Journal of Agricultural Education*, 51(3), 44-52. doi:10.5032/jae.2010.03044.
- Heinert, S. B., & Roberts, T. G. (2016). Globalizing the undergraduate experience in agricultural leadership, education, extension, and communication. *Journal of Agricultural Education*, 57(1), 42-55. doi: 10.5032/jae.2016.01042
- Hoffmann, V. (2014). Governmental extension services, their generic problems, and potential solutions. *Innovations in extension and advisory services: International conference proceeding Nairobi*, 15-18.
- Marambe, B., Silva, P., Athauda, S. (2017). Agriculture and Rural Development Under Central Government and Provincial Council Setup in Sri Lanka . In: N. Cooray & S. Abeyratne (Eds.), *Decentralization and Development of Sri Lanka Within a Unitary State*. Springer, Singapore. https://doi.org/10.1007/978-981-10-4259-1_6
- Maulu, S., Hasimuna, O. J., Mutale, B., Mphande, J., & Siankwilimba, E. (2021). Enhancing the role of rural agricultural extension programs

- in poverty alleviation: A review. *Cogent Food & Agriculture*, 7(1). <https://doi.org/10.1080/23311932.2021.1886663>
- Mott, R., Lorenz, T., & Britt-Rankin, J. (2021). Preparing Undergraduates for Agriculture and Food Research Careers: An Internship Paradigm. *The Journal of Extension*, 59(2), 7. <https://doi.org/10.34068/joe.59.02.07>
- Mulder, M. (2017). Competence theory and research: A synthesis. *Competence-based vocational and professional education: Bridging the worlds of work and education*, 1071-1106. https://doi.org/10.1007/978-3-319-41713-4_50
- Perera, M. P. (2013). Country Report on National Agriculture Education System in Sri Lanka. In T.R Gurung & A.K Azad (Eds.), *National agricultural education system in SAARC countries: Comparative analysis* (pp. 283-326). SAARC Agriculture Centre (SAC)
- Prasad, R.M., Sulaiman, R.V., & Mittal, N. 2015. *Assessing Capacity Development Needs of Extension and Advisory Services (EAS): A Review*. (Working Paper 001). <https://www.aesanetwork.org/crisp-aesa-working-paper>
- Qamar, M.K. (2006). Agricultural extension in Asia and the Pacific: Time for revisit and reform. In V.P. Sharma (Ed.), *Enhancement of extension system in agriculture*. (pp.20-33). Tokyo, Japan: Asian Productivity Organization.
- Rajalahti, R. (2012). *Agricultural innovation systems: An investment handbook*. World Bank, Washington, D C . <https://doi.org/10.1596/978-0-8213-8684-2>
- Ranwala, L., Siriwardena, S., Kurukulaarachchi, V., & Edirisinghe, L. (2020). Determinants of university choice for the academic disciplines in the tertiary education in Sri Lanka. *GARI International Journal of Multidisciplinary Research*, 6(6), 78-95
- Rivera, W.M., & Alex, G.E. (2008). Human resource development for modernizing the agricultural workforce. *Human Resource Development Review*, 7(4), 374-386. <https://doi.org/10.1177/1534484308324633>
- Rivera, W., Blum, M., & Suleiman, R. (2009). *Agricultural extension in transition worldwide: Policies and strategies for reforms*. FAO, Rome Italy. www.fao.org/nr/res/course1/file/intro/intro.html
- Sasidhar, P.V.K., and Suvedi, M. (2016). Assessment of Core Competencies of Livestock Extension Professionals in India. Modernizing Extension and Advisory Services Project. <https://meas.illinois.edu/wp-content/uploads/2016/11/MEAS-EVAL-2016-Core-Competencies-Livestock-Extension-Suvedi-and-Sasidhar-July-2015.pdf>
- Scheer, S.D., Ferrari, T.M., Earnest, G.W., & Connors, J.J. 2006. Preparing extension professionals: The Ohio State University's model of extension education. *Journal of Extension*, 44(4), 1-12. <https://tigerprints.clemson.edu/joe/vol44/iss4/3>
- Shanmugaratnam, N. (1981). *Impact of plantation economy and colonial policy on Sri Lanka peasantry*. Economic and Political Weekly, 69-80. <https://www.jstor.org/stable/4369436>
- Sivayoganathan, C. (2020). Evolution of Agricultural Extension System in Sri Lanka. In: Marambe, B., Weerahewa, J., Dandeniya, W. (eds) *Agricultural Research for Sustainable Food Systems in Sri Lanka*. Springer, Singapore. https://doi.org/10.1007/978-981-15-2152-2_15
- Suvedi, M., & Ghimire, R. (2015). How competent are agricultural extension agents and extension educators in Nepal. *Innovation for Agricultural Training and Education, Feed the Future, USAID, Michigan State University*.
- Suvedi, M., & Kaplowitz, M.D. (2016). What Every Extension Worker Should Know: Core Competency Handbook. Urbana-Champaign, IL: Modernizing Extension and Advisory Services Project. <https://meas.illinois.edu/wp-content/uploads/2015/04/MEAS-2016-Extension-Handbook-Suvedi-Kaplowitz.pdf>
- Suvedi, M., & Sasidhar, P.V.K. (2020). Strengthening agricultural extension training in South Asia (India, Sri Lanka and Nepal) – Process skills

- and competencies gaps in undergraduate agricultural extension curriculum. *Fulbright Program Research Report*. East Lansing, MI: Department of Community Sustainability, Michigan State University.
- Swanson, B. (2008). *Global review of good agricultural extension and advisory service practices*. Rome, Italy: Research and Extension Division, Food and Agriculture Organization of the United Nations.
- UNESCO (2023, March 22). Curriculum and expected learning outcomes. <https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-expected-learning-outcomes>
- Wanigasundera, W. A. D. P., and Atapattu, N. (2019). "Extension reforms in Sri Lanka: lessons and policy options." *In Agricultural Extension Reforms in South Asia*, S.C. Babu, P.K. Joshi (Eds.), Agricultural Extension Reforms in South Asia, Academic Press
- Wijekoon, R. O. H. A. N., Emitiyagoda, S., Rizwan, M. F. M., Rathnayaka, R. M. M. S., & Rajapaksha, H. A. (2009). Cyber extension: An information and communication technology initiative for agriculture and rural development in Sri Lanka. *Srilanka: http://www.fao.org/fileadmin/user_upload/kce/Doc_for_Technical_Consult/SRI_LANKA_CYBER_EXTENSION.pdf*.
- Wijeratne, M. (1988). *Farmer, extension and research in Sri Lanka: An empirical study of the agricultural knowledge system with special reference to Matara district* (Publication No. 28227864). [Doctoral Dissertation, Wageningen University and Research]. ProQuest Dissertations & Theses Global.
- Withanage, D. P., & Damayanthi, B. W. R. (2019). Factors influencing the youths' interest in agricultural entrepreneurship in Sri Lanka. *Developing Country Studies*, 12(9), 32-40. <https://doi.org/10.7176/DCS/9-12-05>

RESEARCH ARTICLE

Traditional grain storage practices in district Moga, Punjab: documentation and relevance for sustainable agriculture

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ABSTRACT

The study was conducted to document and analyze indigenous grain storage practices and the socio-personal characteristics influencing their adoption among farming households in District Moga, Punjab. A total of 120 respondents from six representative villages were selected using purposive sampling. The socio-personal profile revealed that 65% of farmers were above 45 years of age, with primary to matric-level education being most common. Low social participation (93.33%) and limited mass media exposure were observed, though moderate extension contact (64.17%) indicated some institutional engagement. Ten indigenous storage practices were documented, including sun drying and *chhajh* winnowing (92%), mud bin storage (78%), ash layering (70%), neem leaves incorporation (60%), turmeric application (37%), and red *kandi* soil coating (48%). These methods deeply rooted in Indigenous Technical Knowledge (ITK), offer cost-effective, eco-friendly solutions for managing post-harvest grain pests and minimizing storage losses. Despite minimal reliance on modern inputs, their persistence highlights cultural relevance and practical efficacy. The findings underscore the importance of preserving and scientifically validating these practices while integrating them into formal extension strategies to promote sustainable, farmer-led storage solutions.

Keywords : grain storage, Indigenous technical knowledge, Punjab, socio-personal profile, stored grains

INTRODUCTION

Punjab, often hailed as the “Granary of India,” plays a pivotal role in ensuring national food security through its substantial contributions to wheat and rice production. The district of Moga, situated in the heart of Punjab’s fertile plains, exemplifies the region’s agricultural productivity, with a predominant rice–wheat cropping system that sustains millions of livelihoods. Despite remarkable yield achievements, smallholder farmers in this area face persistent challenges related to grain preservation during the post-harvest period. These challenges include insufficient storage infrastructure, vulnerability to insect pests and rodents, and climatic fluctuations that accelerate spoilage and reduce grain quality (Bhardwaj and Sharma, 2020).

In rural Moga, modern scientific grain storage facilities are often inaccessible or economically unviable for small-scale farmers. Consequently, reliance on traditional storage practices, underpinned by indigenous technical knowledge (ITK), remains widespread. These practices have been refined over centuries and utilize locally available, cost-effective, and environmentally friendly materials to mitigate post-harvest losses (Thakur and Damitaand, 2011). For instance, farmers employ earthen structures such as *bukhari* and *bharola* for grain storage, which provide natural temperature and humidity regulation. Other time-tested techniques include sun drying combined with winnowing, layering pulses with ash or sand, incorporating neem (*Azadirachta indica*) leaves for their bio-insecticidal properties, and

smearing mustard oil on seeds to deter storage pests. Moreover, fodder preservation through *kupp* structures made from wheat straw helps prevent fungal contamination during monsoon months (Dhaliwal & Singh, 2010).

Research in other parts of India and South Asia has documented the efficacy of these indigenous storage methods in controlling insect infestation and maintaining grain quality without the adverse environmental effects of chemical fumigants (Kumar et al., 2015). Despite their proven benefits, such traditional practices face the risk of erosion due to rapid agricultural modernization, urban migration, and the uncritical adoption of synthetic chemicals (Hiremath et al., 2021). The lack of systematic documentation and scientific validation further threatens the transmission of this indigenous knowledge to future generations.

Given the increasing emphasis on sustainable agriculture and integrated pest management (IPM), the preservation and scientific study of indigenous grain storage techniques are critical (FAO, 2019). These methods offer eco-friendly alternatives that align with environmental conservation goals and the economic realities of smallholder farmers. By documenting and validating these practices, researchers and policymakers can facilitate their integration with modern technologies, thereby enhancing food security and farmer resilience.

The present study aims to systematically document the traditional grain storage practices prevalent in District Moga, Punjab, assess their adoption among farmers, and highlight their relevance for sustainable agriculture.

MATERIALS AND METHODS

Study Area : The study was conducted in District Moga, located in the central plains of Punjab, India. Moga lies within the heart of Punjab's rice-wheat cropping system and is characterized by fertile alluvial soils and a predominantly agrarian economy. The district has a large

proportion of small and marginal farmers who continue to rely on traditional post-harvest storage methods. Six representative villages - Thathi Bhai, Jai Singh Wala (Bagha Purana Tehsil), Bir Raoke, Lohara (Nihal Singh Wala Tehsil), Fatehgarh Korotana, and Kishanpura Kalan (Dharamkot Sub-Tehsil) were purposively selected for the study based on their agricultural significance, accessibility, and reported diversity of indigenous storage practices.

Study Design and Sampling: An exploratory survey design was adopted to document and assess indigenous grain and fodder storage practices. The target population consisted of farming households engaged in storing food grains and fodder using traditional methods. Out of approximately 250 households in the selected villages, 150 households were approached with a structured questionnaire to ensure comprehensive documentation of practices. A total of 120 fully completed responses were obtained, yielding a response rate of 80%.

Data Collection: Primary data were collected using a structured questionnaire, which included sections on demographic details, types of grains and fodder stored, storage structures and methods used, and the rationale behind each practice. The questionnaire was developed in Punjabi for ease of understanding and was pre-tested with 10 households in a non-sample village to ensure clarity and relevance. Minor modifications were incorporated based on pre-testing feedback. In addition to the questionnaire, informal discussions and field observations were conducted to validate the reported practices and to document locally used terminologies and storage equipment.

Socio-Personal Profile Assessment: In parallel with documenting storage methods, detailed information on the socio-personal characteristics of respondents was collected to understand factors influencing the adoption and continuity of indigenous practices. Variables measured

included age, education, social participation, mass media exposure, extension contact, socio-economic status, innovativeness, risk orientation, scientific orientation, rational orientation, and farming experience. These were categorized based on established agrarian research frameworks to allow meaningful analysis. The socio-personal data provided insights into demographic and psychological factors shaping farmers' reliance on traditional grain storage techniques.

Data Analysis: All collected data were analyzed descriptively using frequencies and percentages. Adoption rates for individual traditional storage practices were calculated as proportions of the total sample ($n = 120$). Socio-personal profile data were also analyzed descriptively to present the demographic and behavioral attributes of the respondent farmers. The results were tabulated and interpreted to highlight the most widely adopted methods and to assess the socio-personal context influencing their use within District Moga.

RESULTS AND DISCUSSION

Socio-Personal Factors Influencing Practice Adoption

The socio-personal profile of 120 farmers from six villages in District Moga was analyzed to understand the demographic and psychological characteristics influencing the adoption of indigenous grain storage practices (Table 1). The findings reveal a demographic pattern that holds significant implications for the conservation and dissemination of traditional knowledge systems.

The majority of respondents (65%) were above 45 years of age, while the remaining 35% belonged to the 35–45 age groups. This skew toward older farmers suggests that the knowledge of indigenous storage methods is predominantly concentrated among the senior farming community. Such an age-based concentration presents a potential vulnerability: as younger

generations increasingly migrate to urban areas or embrace modern technologies, there is a risk of gradual erosion of these time-tested practices. Similar observations have been reported in studies on traditional ecological knowledge (TEK), where intergenerational transmission is often interrupted due to changing socio-economic aspirations (FAO, 2019). Without proactive documentation and promotion, valuable experiential knowledge may be lost within a generation. Educational attainment among the respondents was moderate, with 40% having completed primary education, 31.67% matriculation, and 20% education above matriculation. Only 8.33% of farmers were illiterate. This relatively high literacy level in the study area suggests an encouraging potential for extension interventions and capacity-building programs. Farmers with basic education can comprehend agricultural advisories and are more likely to adopt improved versions of traditional practices when provided with scientific validation. The integration of indigenous wisdom with formal training programs can enhance adoption rates while preserving cultural acceptability. Social participation among respondents was strikingly low, with 93.33% reporting limited involvement in community-based organizations or farmer groups. Similarly, mass media exposure was also restricted; 59.17% of respondents had low media access, and only 30.83% reported medium exposure to channels such as radio, television, or newspapers. These findings indicate that the primary mode of knowledge transfer remains informal, relying heavily on familial interactions and local elders as custodians of knowledge. Community-based learning models and peer-to-peer farmer networks could therefore be pivotal in sustaining and revitalizing these practices (FAO, 2019). Strengthening such informal systems would be particularly valuable in areas where institutional outreach remains inadequate.

Extension contact among respondents, however, was relatively encouraging: 39.17%

reported medium engagement, and 25% had high contact with agricultural extension services. This moderate institutional interface presents an opportunity to document, validate, and disseminate indigenous practices through structured programs. Incorporating traditional knowledge into formal extension curricula could enhance the acceptability and relevance of storage innovations. Psychological traits revealed further insights into farmers' adoption behavior. Innovativeness was generally low, with 48.33% of respondents exhibiting reluctance to adopt new or unfamiliar methods. Conversely, risk orientation (65.83%), scientific orientation (53.33%), and rational orientation (62.5%) were largely moderate. These tendencies suggest that while farmers may hesitate to abandon traditional approaches, they are open to adopting evidence-based innovations that align with cultural norms and do not introduce high levels of perceived

risk.

Socio-economic status was mostly medium (56.67%) or high (35%), showing that the use of indigenous storage methods transcends income categories. This challenges the common perception that traditional practices are only used by resource-poor households. Rather, their continued relevance even among wealthier farmers underscores their cost-effectiveness, ecological suitability, and cultural embeddedness. Farming experience was evenly distributed, with respondents categorized as having low (<27 years), medium (27–44 years), and high (>44 years) experience. Older and more experienced farmers were often observed to be the primary custodians of indigenous knowledge. However, the lack of formal documentation and reliance on oral transmission raises concerns about knowledge continuity, particularly as younger farmers may prioritize mechanized solutions.

Table 1: Socio-personal distribution of adopters of ITKs in district Moga

Variable	Category	Frequency (f)	Percentage (%)
Age Middle (35–45)	42	35.00	
	Old (>45)	78	65.00
Variable	Category	Frequency (f)	Percentage (%)
Education	Illiterate	10	8.33
	Upto Primary	48	40.00
	Upto Matric	38	31.67
	Above Matric	24	20.00
Social Participation	Low	112	93.33
	Medium	8	6.67
Mass Media Exposure	Low(<3)	71	59.17
	Medium (3–6)	37	30.83
	High (>6)	12	10.00
Extension Contact	Low (<2)	43	35.83
	Medium (2–3)	47	39.17
	High (>3)	30	25.00

Socio-Economic Status	Low (<12)	10	8.33
	Medium (12–14)	68	56.67
	High (>14)	42	35.00
Risk Orientation	Low (<16)	22	18.33
	Medium (16–21)	79	65.83
	High (>21)	19	15.83
Scientific Orientation	Low (<16)	35	29.17
	Medium (16–21)	64	53.33
	High (>21)	21	17.50
Rational Orientation	Low (Score 1)	45	37.50
	Medium (Score 2)	75	62.50
Farming Experience	Low (<27 years)	41	34.17
	Medium (27–44 years)	45	37.50
	High (>44 years)	34	28.33

Indigenous Grain Storage Practices: Efficacy and Context

Ten key indigenous grain storage practices were documented among the respondents, with adoption rates ranging from 24% to 92% (Table 2). These practices represent a repository of traditional knowledge, fine-tuned over generations to suit the local agro-climatic and socio-economic contexts. They reflect farmers' adaptive strategies for protecting stored grains against insect pests, fungal contamination, and moisture-related losses in the absence of modern storage infrastructure.

The most widely adopted practice was sun drying and *chhajh* winnowing, reported by 92% of farmers. Sun drying involved exposing grains to direct sunlight for 3–5 days, ensuring moisture content was reduced to below 12%, thereby minimizing the chances of mold development and insect infestation. *Chhajh*, a traditional sieve, was used for winnowing to remove chaff, insect fragments, and other impurities. This pre-storage treatment is critical for pest prevention and aligns with earlier studies in rural Punjab that highlight sun drying as the

cornerstone of household-level grain management (Dhaliwal & Singh, 2010). Mud storage bins, including *bukhari* for bulk storage (5–10 quintals) and *bharola* for smaller household quantities (40–80 kg), were used by 78% of respondents. These structures are plastered with a mixture of mud and cow dung, creating a microclimate that is cool and dry, unfavorable to storage pests (Taye et al. 2018). The use of these eco-friendly, low-cost bins resonates with the findings of (Dhaliwal and Singh, 2010), who highlighted their thermal insulation properties and cultural acceptability in rural areas. Ash layering was adopted by 70% of respondents, particularly for pulses such as moong (*Vigna radiata*) and moth bean (*Vigna aconitifolia*). Ash acts as a physical barrier that suffocates insects and creates a desiccating environment that deters *Callosobruchus* spp. (pulse beetles). Otitodun et al. (2017) validated the insecticidal and abrasive qualities of ash, further supporting its widespread use.

Neem leaves incorporation was reported by 60% of farmers. Dried neem (*Azadirachta indica*) leaves were either mixed directly with

stored grains or rubbed on the inner walls of storage bins. Neem's bioactive compounds, particularly azadirachtin, have proven insecticidal and antifungal properties (Sarkar et al., 2014), explaining the preference for this practice as a natural, non-toxic alternative to synthetic chemicals. Red *kandi* soil coating (48%) and sand layering (42%) were prevalent in semi-arid villages. The fine particles of *kandi* soil form a protective layer over stored pulses, acting as a pest deterrent and helping regulate moisture. Sand, when used as a base layer in storage bins, serves as both a moisture absorber and a physical barrier to crawling insects. These regionally adapted practices align with Gopala Swamy et al. (2018), who noted their effectiveness under specific soil and humidity conditions. Moderately adopted methods included mustard oil smearing (38%), where farmers coated pulses with a thin layer of mustard oil. This method makes the grain surface slippery and unpalatable to ovipositing insects, reducing infestation rates. Arya (2019) validated effective use of oil for storage of pulse grains against insect-pests. . Significantly, turmeric application, reported by 37% of respondents, emerged as a noteworthy indigenous practice. Farmers sprinkled turmeric

powder (*Curcuma longa*) on rice grains during storage. Turmeric contains curcumin, a bioactive compound with documented antifungal and insect-repellent properties. Its use inhibits mold growth and deters rice pests, such as weevils. However, turmeric adoption was lower compared to neem and ash, potentially due to concerns about discoloration of rice grains, cost implications, or lack of widespread awareness about its scientific efficacy. Nevertheless, this practice represents an eco-friendly, easily available, and culturally acceptable alternative to synthetic grain protectants, deserving further scientific validation.

Other less widely adopted but innovative practices included the use of camphor, dried chilli additives (24%) and matchsticks in storage bins (30%). Camphor and chillies release volatile compounds that act as natural repellents, while sulfur in match heads is believed to deter pests, echoing traditional fumigation methods (Prakash et al., 2016). Though these methods are less studied scientifically, their persistence in local practice underscores the ingenuity of farmers in utilizing readily available materials for pest management.

Table 2: Traditional methods of storage documented in Moga district of Punjab.

No.	Practice	Prevalence in Moga (%)	Description
1.	Sun drying + sifting (Chhajh winnowing)	92%	Grains are sun-dried to reduce moisture to safe levels (<12%) and cleaned using <i>chhajh</i> sifters before storage. Essential to prevent fungal growth and pest infestation.
2.	Mud bins (<i>bukhari</i> , <i>bharola</i>)	78%	Earthen storage bins plastered with mud and cow dung. <i>Bukhari</i> for bulk storage (5–10 quintals); <i>bharola</i> for household use (40–80 kg). Widely used in rural areas.
3.	Ash layering for pulses	70%	Pulses (moong, moth bean) stored in earthen pots with a 2–3 cm layer of ash to deter insects like <i>Callosobruchus</i> spp.
4.	Neem leaves incorporation	60%	Neem leaves mixed with stored grains or rubbed on bin walls. Farmers rely on neem for its insecticidal and anti-fungal properties.

No.	Practice	Prevalence in Moga (%)	Description
5.	Red (kandi) soil coating	48%	Pulses rubbed with red soil before storage to create a protective barrier. Particularly common in kandi (semi-arid) villages.
6.	Sand bedding/layering in bins	42%	Coarse sand used at the bottom of bins as a moisture absorber and physical barrier against crawling insects.
7.	Mustard oil smearing on pulses	38%	Moong and moth bean seeds lightly coated with mustard oil to make their surface slippery and repel insects.
8.	Use of Turmeric in preserving Rice	37%	Lightly coat rice grains with a very small amount of turmeric powder (about 1 teaspoon per 5 kg rice). It can inhibit fungal contamination and insect infestation in stored grains.
9.	Camphor/chilli/turmeric additives	24%	Camphor tablets, dried chillies, or turmeric powder placed in bins as insect deterrents for 3–6 month storage periods.
10.	Matchsticks in storage bins	30%	Farmers place matchsticks inside grain storage bins; sulfur in match heads repels or kills storage pests.

Drivers of Adoption of Indigenous Technical Knowledge (ITK)

The adoption of indigenous grain storage practices among farmers in District Moga is influenced by a range of socio-cultural, economic, and ecological factors. These drivers explain the persistence of traditional methods in the face of modern technological alternatives.

1. Cost-effectiveness was identified as a key driver. Most ITKs documented in the study, such as mud bin storage (78%), ash layering (70%), neem leaves incorporation (60%), and turmeric application (37%), rely on locally available materials. Farmers highlighted that these methods require minimal or no financial investment, making them highly suitable for smallholder households with limited disposable income for post-harvest management.
2. Cultural familiarity plays an equally important role. Practices like sun drying and *chhajh* winnowing (92%) are not merely technical operations but are deeply ingrained in the cultural fabric of rural Punjab. These methods are passed down through generations, forming part of household routines during harvest seasons. Farmers trust these practices because of their long-standing use and the experiential knowledge shared by elders in their families and communities.
3. The accessibility of resources further strengthens reliance on ITKs. Materials such as neem leaves, ash, turmeric, mustard oil, and *kandi* soil are easily available in rural households or can be sourced locally, eliminating dependence on external markets or purchased chemicals. This accessibility is especially crucial in villages where modern storage materials are scarce.
4. The simplicity of methods documented in the study is another contributing factor. Farmers reported that techniques such as neem leaf mixing and mustard oil smearing are easy to apply and do not require any specialized tools or technical

- expertise. This contrasts with modern hermetic storage or chemical fumigation, which often demand higher knowledge, capital, and sometimes external assistance.
5. Eco-friendliness of ITKs was also valued by respondents. The avoidance of synthetic chemical pesticides aligns with growing concerns about food safety, household health, and environmental sustainability. Methods such as turmeric powder and neem leaves release natural bioactive compounds that repel insects and prevent fungal growth without harmful residues.
 6. Farmers cited proven effectiveness as a strong reason for continued use. Practices like ash layering and mustard oil smearing have shown consistent success over the years in controlling bruchid beetles and maintaining grain quality, validating their practical utility even in the absence of formal scientific trials.
 7. The perception of low risk further encourages adoption. Respondents felt confident using ITKs because they do not cause adverse effects on stored grains, human health, or livestock. In contrast, many were wary of modern chemical pesticides due to concerns over toxicity and contamination.
 8. In certain areas, limited access to modern inputs like hermetic bags or fumigants has made ITKs a practical alternative. Farmers without reliable access to markets or extension services fall back on these time-tested methods for post-harvest protection.
 9. Finally, the resilience of ITKs to local agro-climatic conditions emerged as a critical factor. These practices have been developed over decades to suit the temperature, humidity, and pest pressures of the region, making them robust and reliable even under variable

environmental conditions.

The interplay of these factors highlights why ITKs remain central to post-harvest grain management in the study area. These findings support earlier research (Ravi et al., 2016; FAO, 2019), emphasizing the importance of indigenous practices in enhancing food security, particularly for smallholder farmers.

Toward Integration and Policy Relevance

The findings from this study underscore the significance of Indigenous Technical Knowledge (ITK) in ensuring safe and sustainable grain storage among farming households in District Moga. Despite their proven cost-effectiveness, accessibility, and adaptability, these practices remain largely undocumented and are at risk of being lost as younger generations shift toward modern technologies or non-farm livelihoods. Integrating ITKs into formal agricultural extension systems is crucial to preserve this rich knowledge base while enhancing its scientific validation and broader applicability. Capacity-building programs that blend traditional wisdom with modern innovations can help farmers make informed choices about storage methods. For example, practices such as neem leaf incorporation (60%) and turmeric application (37%) could be refined and promoted through demonstration trials to improve efficacy and farmer confidence.

Policy interventions are also needed to support community-level documentation of ITKs and incentivize their continued use. Establishing farmer-led knowledge-sharing platforms, training rural youth in sustainable storage methods, and recognizing ITK practitioners through awards or certification can encourage intergenerational transfer. Furthermore, including ITK modules in training curricula for extension workers would ensure culturally sensitive dissemination of post-harvest technologies. At the research level, rigorous scientific evaluation of these methods such as the

insecticidal properties of turmeric and mustard oil can strengthen evidence-based recommendations. Policies that support smallholder access to improved storage structures could also incorporate ITK principles to create hybrid systems combining traditional materials with modern designs. The integration of ITKs into mainstream agricultural policies aligns with national goals for sustainable food systems and post-harvest loss reduction. Leveraging the strengths of these practices through research-extension-policy linkages will ensure their continued relevance and resilience in a changing agricultural landscape.

CONCLUSION

The study underscores the significance of Indigenous Technical Knowledge (ITK) in ensuring safe and sustainable grain storage among farming communities. These traditional practices, rooted in cultural experience and adapted to local conditions, offer cost-effective and eco-friendly solutions for managing post-harvest pests. However, with knowledge concentrated among older farmers and limited inter generational transfer, there is a risk of its gradual erosion. To preserve and enhance the relevance of ITK, systematic documentation, scientific validation, and integration into formal extension frameworks are essential. Policy and research efforts that promote farmer-led innovations and community-based learning can bridge the gap between tradition and modernity, ensuring sustainable grain storage systems for the future.

REFERENCES

- Arya, S. (2019). Scientific validation of ITK oil to protect pulses from storage pests. *International Journal of Fauna and Biological Studies*, 6(3), 51–54.
- Bhardwaj S. and Sharma R. (2020) *The challenges of grain storage: A review. International Journal of Farm Sciences*. 10(2): 18–22. <https://doi.org/10.5958/2250-0499.2020.00028.2>
- Dhaliwal R. and Singh G. (2010). Traditional food grain storage practices in Punjab. *Indian Journal of Traditional Knowledge*, 9 (3): 526–530.
- FAO (2019). *The state of food and agriculture: Moving forward on food loss and waste reduction*. Food and Agriculture Organization of the United Nations, Rome.
- Gopala Swamy, S. V. S., Wesley, B. J., Raja, D. S., & Vishnuvardhan, S. (2018). Feasibility of sand layer technique for small scale storage of pulses seed. *Journal of Entomology and Zoology Studies*, 6(6), 428–431.
- Hiremath, U., Gowda, B., Lokesh, G. Y., & Ganiger, B. S. (2021). Indigenous traditional knowledge (ITK) on seeds for agriculture sustainability in Kalyana, Karnataka region of India. *Ecology, Environment and Conservation*, 27(November Suppl. Issue), S210–S217. ISSN 0971–765X.
- Kumar, N., Patel, A. K., & Mishra, S. P. (2015). *Indigenous technology to protect the storage life of seed. International Journal of Innovative Science, Engineering & Technology*. 2(6): [h p://www.ijiset.com](http://www.ijiset.com)
- Otiotodun, G. O., Opit, G. P., Nwaubani, S. I., & Okonkwo, E. U. (2017). Efficacy of rice husk ash against rice weevil and lesser grain borer on stored wheat. *African Crop Science Journal*, 25 (2), 145–155. [h ps://doi.org/10.4314/acsj.v25i2.2](https://doi.org/10.4314/acsj.v25i2.2)
- Prakash, B. G., Raghavendra, K. V., Gowthami, R., & Shashank, R. (2016). Indigenous practices for eco-friendly storage of food grains and seeds. *Advances in Plants & Agriculture Research*, 3(4), 101–107.
- Sarkar, S., Singh, R. P., & Bhattacharya, G. (2021). Exploring the role of *Azadirachta indica* (neem) and its active compounds in the regulation of biological pathways: An update on molecular approach. 3 *Biotech*, 11(4), 178. [h ps://doi.org/10.1007/s13205-021-02745-4](https://doi.org/10.1007/s13205-021-02745-4)
- Taye, W., Ayalew, A., Dejene, M., & Chala, A. (2018). Fungal invasion and mycotoxin contamination of stored sorghum grain as influenced by threshing methods. *International Journal of Pest Management*, 64(1), 66–76. [h ps://doi.org/10.1080/09670874.2017.1327681](https://doi.org/10.1080/09670874.2017.1327681)
- Thakur D.R. and Damitaand P. (2011) Stored grain pests and traditional techniques of their control measures A case study on Chopal, Shimla (H.P.). *International Journal of Plant Protection*. 4(1): 220-226

RESEARCH ARTICLE

Adoption of integrated weed management practices by soybean growers

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ABSTRACT

The study entitled “*Adoption of Integrated Weed Management Practices by Soybean Growers*” was conducted in Renapur and Shirur Anantpal Panchayat Samitis of Latur district in the Marathwada region of Maharashtra. Six villages were randomly selected based on the maximum area under soybean cultivation. Employing an exploratory research design, data were collected from soybean growers using a structured interview schedule. The findings revealed that the majority of respondents exhibited medium levels of adoption of integrated weed management (IWM) practices. The correlation analysis showed that education, occupation, sources of information, extension contact, economic motivation, scientific orientation, and knowledge were positively and significantly associated with the adoption of IWM practices at the 0.01 level of probability. Additionally, landholding, annual income, area under soybean, and innovativeness were positively and significantly correlated at the 0.05 level. These variables were identified as key contributors to the adoption of IWM practices.

Key Words: Adoption, Integrated Weed Management, Soybean, Farmer

INTRODUCTION

Soybean (*Glycine max*), often referred to as the “Golden Bean”, “Queen of Pulses”, or “Agricultural Cinderella”, is a vital leguminous crop originally domesticated in Southeast Asia, with records of cultivation dating back to around 1100 BC by Chinese farmers. Its significance expanded globally when, in 1904, renowned American chemist George Washington Carver highlighted its value as a rich source of protein and oil.

India, the fourth largest oilseed-producing country in the world, introduced soybean in the 1960s primarily as an oilseed crop to address the need for edible oil self-sufficiency due to its high yield potential. Over the years, soybean has emerged as an important cash crop

in India, with major cultivation in Madhya Pradesh, Maharashtra, Rajasthan, and Karnataka. Apart from its agronomic and economic significance, soybean plays a crucial role in international trade, earning valuable foreign exchange through the export of soya-based products such as soya powder, which has a growing demand in global markets.

Soybean is often regarded as a “miracle crop of the 20th century” due to its nutritional richness and industrial versatility. It contains approximately 40% protein and 20% cholesterol-free oil, along with 21% carbohydrates, 11.5% iron, and 4% mineral salts including calcium and phosphate, alongside important vitamins. Compared to other legumes and oilseeds, soybean offers 2–3 times more protein per unit

yield, making it instrumental in improving nutritional security. Furthermore, soybean enhances soil fertility, contributes to sustainable agricultural practices, and mitigates the negative effects of chemical agriculture, thereby supporting environmental health (FAO, 1998; Shola & Stacey, 2001).

Despite its benefits, one of the major limiting factors affecting soybean productivity in India is inadequate weed control. Weeds compete aggressively with soybean for essential resources such as water, light, and nutrients, particularly during the early stages of crop growth. This competition can result in yield losses of up to 80%, and in severe cases, may even interfere with harvesting operations.

The evolution of weed control technologies parallels the history of agricultural development itself. Early methods involved manual weeding, which were later replaced by mechanical tools such as cultivators and rotary weeders. From the 1940s onward, chemical herbicides became the primary weed control method in developed countries, with their adoption spreading to developing nations like India from the 1970s.

In soybean cultivation, weed control can be achieved through various approaches—preventive, mechanical, chemical, biological, and cultural. However, the most sustainable and effective method is Integrated Weed Management (IWM). IWM is defined as a system-based approach that harmonizes all feasible weed control methods into a single, coordinated strategy aimed at keeping weed populations below economically damaging levels. This approach involves a tactical combination of tools including herbicides, crop rotation, mechanical interventions, biological agents, and cultural practices to optimize weed control outcomes while preserving ecological balance. The competitiveness of weeds in soybean fields varies, primarily due to differences in growth habits. Therefore, effective IWM in soybean emphasizes early-season weed

management, which is critical for minimizing competition and maximizing crop yield.

METHODOLOGY

The present study was conducted in Renapur and Shirur Anantpal Panchayat Samitis of Latur district, located in the Marathwada region of Maharashtra State. Latur district spans an area of approximately 7,157 square kilometers and is one of the major soybean-growing districts in the region. Given the prominence of soybean cultivation in these two Panchayat Samitis, they were purposively selected for the investigation. The study focused on assessing the adoption of Integrated Weed Management (IWM) practices among soybean growers. A multi-stage purposive sampling method was employed to select the study area and respondents, ensuring the relevance and reliability of the data collected. The sampling procedure consisted of the following stages:

1. Selection of Panchayat Samitis: Two Panchayat Samitis—Renapur and Shirur Anantpal—in Latur district were purposively selected based on the predominance of soybean cultivation in these areas.
2. Selection of Villages: From each selected Panchayat Samiti, six villages were purposively chosen, resulting in a total of twelve villages included in the study. The villages were selected based on the extent of area under soybean cultivation.
3. Selection of Respondents: From each selected village, ten soybean growers were purposively selected based on the criterion of having a minimum of three years of continuous experience in soybean cultivation. Thus a total final sample size of 120 respondents was for present study.

Adoption in present study was defined as actual use of integrated weed management practices by the respondents in soybean crop.

For measurement of adoption level of IWM practices a list of IWM practices was prepared in consultation with subject matter specialist of Department of Agronomy of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola for getting their advice regarding selection of practices to be included in the adoption test.

Adoption was measured on three-point continuum as complete adaption, partial adoption and no adoption by assigning the score 2, 1 and 0 respectively. The raw adoption score obtained by an individual respondent was converted adoption index it was calculated by using following formula.

$$\text{Adoption Index} = \frac{\text{Actually obtained adoption score}}{\text{Maximum obtainable adoption score}} \times 100$$

On the basis of obtained adoption index score, respondents were categorized in low, medium obtainable and high categories with the help of equal interval method, as follows.

Sr. No.	Category	Adoption Index range
1.	Low	Up to 33.33
2.	Medium	33.34 to 66.66
3.	High	66.67 and Above

1. Level of Adoption:

Adoption of Integrated Weed Management (IWM) practices by soybean growers is becoming increasingly important due to herbicide resistance, environmental concerns, and the need for sustainable agriculture. The adoption level of IWM practices among respondents was studied, and the category-wise distribution is presented in Table 1.

RESULTS AND DISCUSSION:

Table 1: Distribution of the respondents according to their level of adoption of IWM practices

Sr. No.	Adoption index	Respondents (n=120)	
		Frequency	Percentage
1.	Low (Up to 33.33)	24	20.00
2.	Medium (33.34 to 66.66)	83	70.00
3.	High (Above 66.66)	13	10.00
	Total	120	100.00

The data indicate that a majority of respondents (70.00%) exhibited a medium level of adoption of IWM practices in soybean cultivation. This was followed by 20.00% of respondents with a low level of adoption, while only 10.00% demonstrated a high level of adoption. Therefore, it can be concluded that over three-fourths of the respondents (70.00%) had a medium level of adoption of IWM practices in soybean cropping.

Similar findings were reported by Ashish Kumar (2012) and Mohite (2013), who noted that more than half of their respondents also exhibited a medium level of adoption.

practices by respondents is presented in Table 2. Among cultural practices, timely sowing of soybean was adopted by 81.67% of respondents, while crop rotation was partially adopted by 50.00%. Hoeing was partially adopted by 60.83%, with first hoeing at 20 DAS completely adopted by 70.83%, and second hoeing at 30 DAS partially adopted by 80.00%. Irrigation management was practiced by 50.00% of respondents, with poor adoption mainly due to limited water sources and inadequate rainfall. Farm hygiene and use of uncontaminated seeds were adopted by 58.33% and 48.33% of respondents, respectively, indicating gaps possibly due to lack of awareness. Balanced fertilizer use was never adopted by 40.83% of respondents.

Table 2: Distribution of respondents according to their practice wise adoption of IWM practices

A	Do you adopt preventive Weed Management practices	Respondents n=120		
		Complete	Partial No.	Adoption
1.	sowing time	98 (81.67%)	20 (16.67%)	02 (01.66%)
2.	Crop rotation	17 (14.17%)	60 (50.00%)	43 (35.83%)
3.	Use of Hoeing	35 (29.17%)	73 (60.83%)	12 (10.00%)
4.	Time of hoeing			
4.1.	First at 20 DAS	85 (70.83%)	28 (23.33%)	07 (05.84%)
4.2.	Second at 30DAS	32 (26.67%)	70 (58.33%)	18 (15.00%)
5.	Irrigation management	60 (50.00%)	41 (34.67%)	19 (15.83%)
6.	Farm hygiene	70 (58.33%)	38 (31.67%)	12 (10.00%)
7.	Use of uncontaminated seeds for sowing	58 (48.33%)	27 (22.50%)	35 (29.17%)
8.	Balance use of fertilizer (RDF)	31 (25.83%)	40 (33.33%)	49 (40.84)
9.	Intercrops			
9.1.	Soybean + Tur	37 (30.83%)	09 (07.50%)	74 (61.67%)
9.2.	Soybean + Sorghum	00 (00.00%)	00 (00.00%)	00 (00.00%)
B	Do you adopt mechanical weed control?			
1.	Ploughing	120(100.00%)	00 (00.00%)	00 (00.00%)
2.	Harrowing	84 (70.00%)	34 (28.33%)	02 (01.67%)
3.	Use of hand weeding			
3.1.	One at 25 DAS	100 (83.33%)	12 (10.00%)	08 (06.67%)
3.2	One at 45 DAS	48 (40.00%)	46 (38.33%)	26 (21.67%)
4.	Inter-cultivation through different farm implements	31 (25.83%)	54 (45.00%)	35 (29.17%)
5.	Cleaning of machinery to prevent spread of weeds	11 (09.17%)	69 (57.50%)	40 (33.33%)
C	Do you adopt chemical weed control?			
1.	Use of different herbicide	100 (83.33%)	20 (16.67%)	00 (00.00%)
2.	Use of recommended per ha.dose of herbicide	116 (96.67%)	00 (00.00%)	04 (03.33%)
3.	Time of herbicide application (pre emergence/post emergence)	37 (30.83%)	82 (68.33%)	01 (00.83%)
4.	Use appropriate recommended doses	11 (09.17%)	42 (35.00%)	67 (55.83%)
5.	Use of pre sowing herbicide (Eg. Fluchloralin 45 EC.)	03 (02.50%)	12 (10.00%)	105 (87.50%)
6.	Use of pre emergence herbicide (Eg. Pendamethalin)	60 (50.00%)	40 (33.33%)	20 (16.67%)
7.	Use of post emergence herbicide (Eg. Imazethapyr)	110 (91.67%)	02 (01.67%)	08 (06.67%)
8.	Application of herbicide when sufficient moisture in present in soil	60 (50.00%)	40 (33.33%)	20 (16.67%)
9.	Types of spray pump used for spraying herbicide (knapsack spray pump)	80 (66.67%)	08 (06.67%)	32 (26.66%)
10.	Types of nozzle used for herbicide application in soybean(Flat fan /flood jet type nozzle)	27 (22.50%)	35 (29.17%)	58 (48.33%)
11.	Precautions while using herbicide:-			
11.1.	Read the label before use	67 (55.83%)	04 (03.33%)	49 (40.84%)
11.2.	Wear goggles, rubber gloves before handling and use of chemicals	20 (16.67%)	08 (06.67%)	32 (26.66%)
11.3.	Avoid herbicide spraying during high speed wind and cloudy weather	73 (60.83%)	08 (06.67%)	39 (32.50%)
11.4.	Use of clean water for herbicide application.	83 (69.17%)	00 (00.00%)	37 (30.83%)
11.5.	Herbicide kept in a safe place	87 (72.50%)	00 (00.00%)	33 (27.50%)

	Do you adopt preventive Weed Management practices	Respondents n=120		
		Complete	Partial No.	Adoption
11.6.	Dispose of empty containers	75 (62.50%)	00 (00.00%)	45 (37.50%)
12.	Use of separate sprayer for herbicide application	22 (18.33%)	00 (00.00%)	98 (81.87%)
13.	Intercultural operation not taken within 4-5 days after herbicide application	60 (50.00%)	25 (20.83%)	35 (29.17%)

Regarding intercropping, 30.83% adopted the Soybean + Tur method (1:1 ratio), whereas Soybean + Sorghum was not adopted by any respondent. In mechanical practices, ploughing was fully adopted by 100%, harrowing by 70%, and inter-cultivation using blade harrow or deshi plough by 25.83%. Cleaning machinery to prevent weed spread was partially adopted by 57.50%. Hand weeding at 25 DAS and 45 DAS was completely adopted by 83.33% and 40.00%, respectively. The lower adoption at 45 DAS may be attributed to labor or input shortages during peak periods. Chemical practices revealed that 50% of respondents applied herbicides when soil moisture was sufficient. Use of different herbicides, post-emergence herbicide (e.g., Imazethapyr), and recommended spray pumps were completely adopted by 83.33%, 91.67%, and 66.67%, respectively. Timing of pre- and post-emergence herbicide application was partially adopted by 68.33%, while recommended per hectare doses were completely adopted by 96.67%. However, 55.83% did not use appropriate herbicide doses, and 87.50% and 48.33% did not adopt pre-sowing and pre-emergence herbicides, respectively. Only 22.50% adopted the recommended nozzle type for spraying herbicides. The results related to the precautions taken by respondents during herbicide use revealed that 69.17% and 72.50% of respondents fully adopted the practices of using clean water for spraying and storing herbicides in a safe place, respectively. This was followed by 62.50% who completely adopted the proper disposal of containers after use, 60.83% avoided spraying

during high wind speed and cloudy weather, 55.83% read the label before use, and 50.00% followed intercultural operations within 4–5 days after herbicide application. However, it was also observed that a large proportion of respondents, 81.67% and 76.67%, did not use separate spray pumps for herbicide application, nor did they wear goggles or rubber gloves while handling and applying chemicals.

Thus, it can be concluded that a significant gap exists between the knowledge possessed by respondents regarding recommended IWM practices and the actual practices adopted by them for weed control in soybean crops.

1. Relational analysis

To identify the relationship between selected personal, socio-economic, situational, communication, and psychological characteristics of soybean growers and their adoption of Integrated Weed Management (IWM) practices, the coefficient of correlation was calculated. The results, presented in Table 3, indicate that education, occupation, sources of information, extension contact, economic motivation, scientific orientation, and knowledge showed a positive and highly significant correlation with adoption at the 0.01 level of probability. Additionally, land holding, annual income, area under soybean cultivation, and innovativeness were positively and significantly correlated with adoption at the 0.05 level of significance. Based on these findings, the null hypothesis stating no relationship between these variables and adoption was rejected.

Table 3: Correlation coefficient of selected characteristics of the respondents with their adoption

Sr. No.	Independent variables	Coefficient of correlation 'r' value
1.	Age	-0.047
2.	Education	0.339**
3.	Family size	-0.116
4.	Land holding	0.186*
5.	Occupation	0.319**
6.	Annual income	0.217*
7.	Area under soybean	0.167*
8.	Sources of information	0.239**
9.	Extension contact	0.264**
10.	Economic motivation	0.359**
11.	Innovativeness	0.189*
12.	Scientific orientation	0.305**
13.	Knowledge	0.510**

** - Significant at 0.01 level of probability

* - Significant at 0.05 level of probability

The correlation coefficient indicated a negative and non-significant relationship between age and adoption of IWM practices. Younger farmers are generally more open to change and innovation, utilizing their physical and mental strength more effectively. Education showed a positive and highly significant correlation with adoption. Educated farmers are better equipped with skills to adopt improved agricultural techniques. Family size exhibited a negative and non-significant correlation with adoption. Larger families may face higher expenditure, reducing available finances for adopting new practices. Landholding size showed a positive and significant correlation with adoption. Farmers with larger land holdings tend to have higher income, enabling them to invest in costly inputs such as herbicides. Occupation had a positive and highly significant correlation with adoption. Occupation reflects socio-economic status, which influences the capacity to adopt new technologies including IWM practices. Annual income was positively and significantly correlated with adoption. Higher income enhances economic capacity, facilitating greater adoption levels. A positive

and significant relationship was observed between area under soybean cultivation and adoption of IWM practices. Larger cultivated area provides greater scope for adoption. Source of information had a positive and highly significant relationship with adoption. Access to media such as television, radio, and newspapers increases awareness and confidence in adopting new practices. Extension contact was positively and highly significantly correlated with adoption. Interaction with extension personnel enhances knowledge, leading to increased adoption. Economic motivation showed a positive and highly significant correlation with adoption. Motivated farmers strive to increase their wealth by adopting new and beneficial practices. Innovativeness had a positive and highly significant relationship with adoption. Innovative farmers are more likely to experiment with new ideas and build confidence, facilitating adoption. Scientific orientation also exhibited a positive and highly significant correlation with adoption. Farmers who value scientific advancements are more open to innovative agricultural practices. Knowledge showed a positive and highly significant correlation with

adoption. Greater knowledge of IWM practices enhances the likelihood of adoption.

Similar findings were reported by Deogirkar Vaishu (2014) Barkade (2015), Katole et al. (2015), Hingne (2016), Kajal Bhaltlak (2017), Patel (2019), Rajput (2016) and Waywal (2019).

REFERENCES

- Barkade, A.T. 2015. Knowledge and adoption of integrated weed management Practices fallowed by cotton growers in Washim district. M.Sc. (Agri.) Thesis (unpub.), Dr. PDKV, Akola.
- Deogirkar, Vaishu 2014. Knowledge and adoption of Herbicide by the Soybean Growers. M.Sc. (Agri.) Thesis (unpb.), Dr. PDKV, Akola.
- Hingne, B.T. 2016, Adoption Gap in Recommend Package of Practices of Soybean. M .Sc. (Agri.) Thesis (unpub.), Dr. PDKV, Akola, Maharashtra.
- Kajal Bhaltlak 2017. Knowledge and adoption of insecticide as per the label claim by cotton growers in Akola district. M.Sc. (Agri.) Thesis (Unpub.), Dr. PDKV, Akola
- Katole, R.T., U.R. Chinchmalatpure and V.A. Khadse 2015. Extent of adoption of compositing methods by the farmers. Research Review Committee Project, Dr. PDKV, Akola.
- Patel, Rambha and Mazhar, Syed H. 2019. To determination the level of knowledge of respondents about integrated disease management practices of rice crop in Lailunga block Raigrah district (Chattisgrah). *Indian Research Journal of Ext. Edu.*19(1): 24 -27.
- Rajput, H. D. and Chinchmalatpure, Umesh R. 2016. Knowledge and adoption of BT cotton cultivation practices. *Indian Journal of Extension Education*. Volume 52 Issue 1 and 2 pages 121-123.
- Rajshekhar, B., 2015. A study of adoption of Integrated Weed Management practice in major crops in Mehboobnagar District of Telangana state. M.Sc.(Agri.)Thesis (unpb.) Prof. Jayshankar Telangana State Agriculture University.
- Supre S. V. 1969. Factors related to different degree of rationality in decision making among farmers in Buldhana district. Ph.D. thesis, Department of Agricultural Extension, Indian Agricultural Extension, Indian Agricultural Research Institute, New Delhi.
- Waywal, Anand 2019."Knowledge and adoption of Integrated Pest Management practices by Cotton growers."M.Sc. (Agri.) Thesis (unpub.) Dr. PDKV, Akola, Maharashtra.

RESEARCH ARTICLE

Impact assessment of trainings conducted by KVK on knowledge of tribals

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ABSTRACT

This research delves into the influence of Krishi Vigyan Kendra training on tribal farmers knowledge, with a focus on the state of Maharashtra. The present study was conducted in the KVK, Sindewahi, Chandrapur district and KVK, Sonapur, Gadchiroli district of Maharashtra. Thus a total sample size of study was 140 trainees. It was observed that before training more than two fifth (45.71 per cent) of tribal farmers had medium level of knowledge about KVK trainings. After KVK trainings nearly half (49.29 per cent) of tribal farmers had positive or good change in their knowledge. The overall impact of KVK trainings is (06.43 per cent) on tribal farmers knowledge and those aspects get less impact are need to work on it by KVK functionaries for further positive impact on tribal farmers knowledge. More than two fifth (45.71 %) of the respondents of KVK had medium level of knowledge about KVK and their trainings, while (33.57 %) and less than one third (20.72 %) respondents had low and high levels of knowledge about KVK trainings. Following the KVK training sessions, there was a notable increase, with almost half (49.29%) of the respondents gained a medium level of knowledge. While (27.14%) and more than two fifth (23.57 %) gained low and high levels of knowledge. The analysis indicates a measurable impact of KVK training on knowledge, showing a (06.43 %) improvement among the respondents.

Keywords: Impact Assessment, Trainings, Knowledge of Tribals.

METHODOLOGY

The present study was conducted in the KVK, Sindewahi, Chandrapur district and KVK, Sonapur, Gadchiroli district of Maharashtra. The area wise list of trained farmer was obtained from

KVK then subject in which maximum number of trainings and trainees were listed out. Thus a total sample size of study was 140 trainees from Sindewahi, Bramhapuri tehsil, Chandrapur district and Etapalli and Aheri tehsil, Gadchiroli district

RESULT AND DISCUSSION

Table 1: Distribution of tribal farmers according to Impact on overall knowledge Level

Sr. No.	Knowledge level	Before Training		After Training		Difference(Impact)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1.	Low (up to 75)	47	33.57	38	27.14	-09	06.43
2.	Medium (76 to 104)	64	45.71	69	49.29	05	03.58
3.	High (105 & above)	29	20.72	33	23.57	04	02.85
	Total	140	100.00	140	100.00	09	06.43

The data in Table 1 observed that before KVK trainings, a majority of respondents (45.71 percent) possessed a medium level of knowledge, with 33.57 percent holding a low level and 20.72 percent having a high level of knowledge. Post-training, there was a shift, with 49.29 percent gaining a medium level of knowledge, while 27.14 percent and 23.57 percent gained low and high levels of knowledge, respectively.

It was observed from table 2 that **Mushroom Cultivation:** Mushroom Cultivation revealed that prior to the training, 44.29% of respondents exhibited a "Low" level of knowledge, while 30.00% possessed a "Medium" level, and 25.71% had a "High" level of understanding. Following the training program, noticeable enhancements were

observed, with 41.43% now classified at the "Low" level, 31.43% at the "Medium" level, and a notable increase to 27.86% achieving a "High" level of competence.

Sericulture: Sericulture knowledge levels is evident when comparing the statistics before and after the training program. Initially, 50.72% of participants were classified as having a "Low" knowledge level, with 37.15% at the "Medium" level, and 12.14% at the "High" level. Following the training, a significant improvement was observed, demonstrating a shift in the knowledge distribution, with 42.14% now categorized at the "Low" level, 43.57% at the "Medium" level, and 14.29% achieving a commendable "High" level of understanding.

Table 2: Income Generating Activity

Sr. No.	Technology	Before Training			After Training		
		Knowledge			Knowledge		
	Income generating activity	Low	Medium	High	Low	Medium	High
1.	Mushroom Cultivation	62 (44.29)	42 (30.00)	36 (25.71)	57 (40.71)	44 (31.43)	39 (27.86)
2.	Bee Keeping	53 (37.86)	48 (34.29)	39 (27.86)	40 (28.58)	49 (35.00)	51 (36.43)
3.	Sericulture	71 (50.72)	52 (37.15)	17 (12.14)	59 (42.14)	61 (43.57)	20 (14.29)
4.	Tailoring, stitching, embroidery, dying	36 (25.71)	68 (48.57)	36 (25.71)	34 (24.29)	69 (49.29)	37 (26.43)
5.	Rural Crafts	45 (32.14)	60 (42.86)	35 (25.00)	33 (23.58)	68 (48.58)	39 (27.86)
6.	Vermicomposting	47 (33.57)	58 (41.43)	35 (25.00)	41 (29.29)	59 (42.14)	40 (28.57)
7.	Nutrition gardening	69 (55.71)	50 (35.71)	21 (15.00)	54 (38.58)	61 (43.58)	25 (17.86)
8.	Kitchen gardening	82 (58.57)	48 (34.29)	10 (07.14)	79 (56.43)	49 (35.00)	12 (08.57)
9.	Value Addition and preservation in mahua	78 (55.71)	39 (27.86)	23 (16.43)	67 (47.86)	44 (31.43)	29 (20.72)

Rural Crafts: Rural Crafts revealed insightful changes in participants' knowledge levels before and after KVK Training. Initially, 32.14% of respondents demonstrated a "Low" level of knowledge, while 42.86% and 25.00% were classified as having "Medium" and "High" levels, respectively. Following the training, a noticeable improvement was observed: 23.58% exhibited "Low" knowledge, marking a decrease, while 48.58% and 27.86% showed "Medium" and "High" knowledge levels, respectively, signifying an overall positive shift.

Nutrition Gardening: The evaluation of Nutrition Gardening knowledge levels pre- and post-training showcased a substantial transformation among respondents. Initially, 55.71% exhibited a "Low" understanding, while 35.71% possessed a "Medium" level, and 15.00% demonstrated a "High" proficiency. Post-training, a discernible improvement emerged, with a decrease in the "Low" level to 38.58%, an increase in the "Medium" level to 43.58%, and a slight rise in the "High" proficiency to 17.86%.

CONCLUSION

The study of the impact of Krishi Vigyan Kendra (KVK) training on tribal farmers revealed important insights into the transformative significance of these institutes in

increasing the knowledge and abilities of tribal groups involved in agriculture. The study started by highlighting the significance of agriculture in India, particularly in the context of different tribal populations that rely significantly on traditional farming practices. KVKs were founded to bridge the gap between traditional and modern agricultural methods, and they have evolved over time to solve the unique issues that tribal farmers face.

REFERENCES

- Ajrawat, B., Parmar, A. M. and Jamwal, M. 2013. Impact of training programme on socio-economic status and knowledge of trainees of kathua district in India. *Agric. Update*. 8(1&2): 249-251.
- Gour Shruti, M. K. Mandal and Ruchi Singh 2015. Assessing knowledge of tribal farmers regarding scientific animal husbandry practices. *Indian Res. J. Ext. Edu.* 15 (2): 91-94.
- Kumar Hemasri and Saranya H. 2019. A Study on Participation of Farm Tribal Women in Agriculture. *Journal of Humanities and Social Science* 25(6):60-64.
- Shakarwar, M. and Naberia, S. 2018. Indigenous technical knowledge for pest and weed management in agriculture. *International Journal of Chemical Studies*. 6(4): 497-498.

RESEARCH ARTICLE**Constraints faced and suggestions given by tribal farmers about KVK trainings****Y. M. Gulade¹, V. S. Shirke² and Swati U. Jagdale³**

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ABSTRACT

This research delves into the influence of Krishi Vigyan Kendra training on tribal farmers knowledge, with a focus on the state of Maharashtra. The present study was conducted in the KVK, Sindewahi, Chandrapur district and KVK, Sonapur, Gadchiroli district of Maharashtra. Thus a total sample size of study was 140 trainees. The constraints faced by the tribal farmers were categorized into five viz. Technological Constraints, Economic Constraints, Socio- psychological Constraints, Institutional Constraints and General Constraints. The result showed that regarding technological constraints the major constraints faced by tribals farmers were the absence of follow-up support and doubt solving. In case of economic constraints major constraint was Poor economic conditions. Regarding socio-psychological constraints lack of attempts to develop confidence in technology was the major constraint. Regarding institutional constraints major constraints the inadequate extension activities were the primary institutional constraints. In case of general constraints the major constraint was the lack of planning and organization of women-oriented training programmes. Result revealed that more than nine tenth (95.71 per cent) the tribal farmers suggested that a local dialect should be the medium of instruction. More than four fifth (82.86 per cent) of the tribal farmers suggested avoiding excessive use of scientific terms. About (73.51 per cent) suggested providing study materials in the easy format and more than two third (69.29 per cent) suggested that raw materials related to the skill imparted should be made available. The KVKs should try to increase conducting women oriented training programmes. The KVKs should provide optimum follow up support and doubt solving in the post training phase that can reduce the gap between the training lesson and farm reality. The KVKs should try to conduct the trainings in the local dialect as far as possible.

Keywords: Constraints, Suggestions, Tribal Farmers**INTRODUCTION**

Bridging the gap between traditional and modern farming practices is crucial for ensuring food security, poverty reduction, and sustainable agricultural methods. Krishi Vigyan Kendras (KVKs), or Agricultural Science Centers, have played a pivotal role in achieving this goal. Established by the Indian Council of Agricultural Research (ICAR), these centers were designed to address the diverse agricultural

challenges faced by different regions, communities, and tribal populations in India.

METHODOLOGY

The present study was conducted in the KVK, Sindewahi, Chandrapur district and KVK, Sonapur, Gadchiroli district of Maharashtra. The area wise list of trained farmer was obtained from KVK then subject in which maximum number of trainings and trainees were listed out. Thus a total

sample size of study was 140 trainees from district and Etapalli and Aheri tehsil, Gadchiroli Sindewahi, Bramhapuri tehsil, Chandrapur district.

RESULTS AND DISCUSSION

Table 1 Constraints faced by tribal farmers during KVK trainings.

Sr. No.	Constraints	Frequency	Percentage	Rank
A	Technological constraints			
1.	Follow up support and doubt solving	123	87.86	I
2.	Complex technologies not easily understood	114	81.43	II
3.	Non availability of production inputs	96	68.57	III
4.	Ample demonstrations are not carried out in training	82	58.57	IV
5.	Trainers do not possess optimum experience	51	36.43	V
B	Economical constraints			
1.	Poor economic conditions	113	80.71	I
2.	Lack of credit facilities	94	67.14	II
3.	Lack of knowledge about crop loan and insurance	86	61.43	III
4.	High cost technology	81	57.86	IV
5.	No minimum support price of the commodities	68	48.57	V
6.	No market value and irregular market	59	42.14	VI
C	Socio- psychological constraints			
1.	No attempt to develop confidence on technology	86	61.43	I
2.	Assumption on failure of technology	72	51.43	II
3.	No interest and attempt for cluster approach	66	47.14	III
4.	Inadequate attempt to organize farmers	51	36.43	IV
5.	Inadequate attempt for co-operation among farmers	48	34.29	V
D	Institutional constraints			
1.	Inadequate extension activities	115	82.14	I
2.	No accommodation facilities for on-campus trainings	101	72.14	II
3.	Weak extension network at village level	76	54.29	III
E	General constraints			
1.	Women oriented training programs are less in number	130	92.86	I
2.	Gap between training lesson and farm reality	121	86.57	II
3.	Training need not properly assessed	101	72.14	III
4.	Lack of skill oriented training programme	93	66.43	IV
5.	No pre-training contact/discussion	82	58.57	V
6.	Less number of entrepreneurial development training programme	74	52.86	VI
7.	Biased in selection of trainees	68	48.57	VII
8.	Teaching aids not designed properly	57	40.71	VIII
9.	Training period not suitable	44	31.43	IX
10.	Repetition of same training to the same trainee	36	25.71	X

A. Technological constraints faced by tribal farmers

According to table 1, out of all the technological constraints faced during training, the “Follow up support and doubt solving” (87.86%) was perceived as the main constraint by the trainees during training ranked first, followed by “Complex technology not easily understood” (81.43%), “Non availability of production input” (68.57%), “Ample demonstrations are not carried out in training” (58.57%), “Trainers do not possess optimum experience” (36.43%) ranked last.

B. Economical constraints faced by tribal farmers

Regarding economical constraints, out of all the Economical constraints faced during training, the “Poor economic condition” (80.71%) was perceived as the main constraint by the trainees during training ranked first, followed by “Lack of credit facilities” (67.14%), “Lack of knowledge about crop loan and insurance” (61.43%), “High cost technology” (57.86%), “No minimum support price of the commodities” (48.57%), “No market value and irregular market” (42.14%).

C. Socio- psychological constraints faced by tribal farmers

Concern with socio-psychological constraints, “No attempt to develop confidence on technology” (61.43%) was perceived as the main constraint by the trainees during training ranked first, followed by “Assumption on failure

of technology” (51.43%), “No interest and attempt for cluster approach” (47.14%), “Insufficient attempt to organize” (36.43%), “Inadequate attempt for co-operation among farmers” (34.29%) ranked last.

D. Institutional constraints faced by tribal farmers

“Inadequate extension activities” (82.14%) was perceived as the main constraint by the trainees during training ranked first, followed by “No accommodation facilities for on-campus training” (72.14%), “No timely service and supply” (63.57%), “Weak extension network at village level” (54.29%) were the institutional constraints.

E. General constraints faced by tribal farmers

“Women oriented training programme are less in number” (92.86%) was perceived as the main constraint by the trainees during training ranked first, followed by “Gap between training lesson and farm reality” (86.57%), “Training need not properly assessed” (72.14%), “Lack of skill oriented training programme are less in number” (66.43%), “No pre-training contact/discussion” (58.57%), “Less number of entrepreneurial development training programme” (52.86%), “Biased in selection of trainees” (48.57%), “Teaching aids not designed properly” (40.71%) and “Training period not suitable” (31.43%), while the problem/constraint “Repetition of same training to the same trainee” (25.71%) are the general constraints.

Table 2 : Suggestions made by the tribal farmers trainees of KVK.

Sr. No.	Suggestions	Frequency	Percentage	Rank
1.	Medium of instruction should be in local dialect	134	95.7	II
2.	Excessive use of scientific terms should be avoided	116	82.86	II
3.	Study materials should be in easy format and easy to understand	103	73.57	III
4.	Raw materials related to the skill imparted should be made available	97	69.29	IV
5.	Timely and Sufficient loan should be provided	86	61.43	V
6.	More number of practical sessions should be incorporated in the training	73	52.14	VI
7.	The communication skills of the trainer should be improved	26	18.57	VII

To overcome the constraints faced by the tribal farmers during and after training, they suggested several ways necessary for further improvement in the training programme. The suggestions expressed by farmers for improvement of training were presented in Table 2. The suggestions were ranked with the help of frequency and percentage. Data depicted in tables shows that, most important suggestions expressed by the tribal farmers were “Medium of instruction should be in local dialect” (95.71%) ranked first, “Excessive use of scientific terms should be avoided” (82.86%), “Study materials should be in easy formats and easy to understand” (73.51%), “Raw materials related to the skill imparted should be made available ” (69.29%), “Timely and Sufficient loan should be provided” (61.43%), “More number of practical sessions should be incorporated” (52.14%). On the other hand, the least important suggestions expressed by the tribal farmers were “The communication skills of the trainer should be improved” (18.57%).

CONCLUSION

Tribal agriculture, which is distinguished by its diversity and traditional methods, frequently fails to address modern issues such as climate change and market swings. KVKs have acknowledged these problems and

have taken a diverse, culturally sensitive approach to tribal farmer training. Localized training programs, practical demonstrations, personalized modules, gender participation, and capacity building are all part of this approach to improving the socioeconomic well-being of tribal farming households. The KVKs should try to increase conducting women oriented training programmes. The KVKs should provide optimum follow up support and doubt solving in the post training phase that can reduce the gap between the training lesson and farm reality. The KVKs should try to conduct the trainings in the local dialect as far as possible.

REFERENCES

- Medhi, S., Singha, A. K., Singh, R., & Singh, R. J. 2020. Socio-economic, psychological profile and constraints faced by the kvk adopted farmers for improved rice cultivation in west Garo Hills District. *Economic Affairs*, 65(3): 379-388
- Patel, R. K., Kadian, K. S., Patel, N., & Singh, N. 2016. Constraints experienced by Krishi Vigyan Kendra (KVK) trainee and non-trainee dairy farmers in training. *Journal of Livestock Science* (ISSN online 2277-6214), 7, 84-88
- Waman, G. K., Khule, R. P. and Sonawane, H. P. 2011. Constraints faced and suggestions made by beneficiaries of Krishi Vigyan kendras. *Asian J. Extn. Edu.* 29: 77-82.

RESEARCH ARTICLE

Constraints faced and suggestions given by beneficiary farmers of Pradhan Mantri Krishi Sinchayee Yojana

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ABSTRACT

The present study was conducted in two tehsils of Sangli district of Maharashtra state. Data were collected by personally interviewing 120 beneficiary farmers. Constraints refers to the problem and difficulties encountered by beneficiary farmers in the implementation of Pradhan Mantri Krishi Sinchayee Yojana. It is observed that, independent variables like education, social participation and sources of information had positive and significant relationship with attitude of beneficiary farmers towards Pradhan Mantri Krishi Sinchayee Yojana. Also farming experience, knowledge, land holding, annual income, irrigation status and risk orientation had positive and highly significant relationship with attitude of beneficiary farmers towards Pradhan Mantri Krishi Sinchayee Yojana. The major constraint faced by large majority (95.00 per cent) of beneficiary farmer was clogging of drippers by suspended material while (91.66 per cent) of beneficiary farmers faced the constraint that require frequent maintenance of micro irrigation system. The (86.66 per cent) of the beneficiary farmers faced difficulty to maintain proper water pressure. Further, it was found that (65.84 per cent) of beneficiary farmers faced the constraint high technical skill required to handle micro irrigation system. Suggestions were invited from the beneficiary farmers to overcome the problems faced by them in the implementation of Pradhan Mantri Krishi Sinchayee Yojana. Large majority (92.50 per cent) of the beneficiary farmers stated that subsidy should be increased. (89.16 per cent) of the beneficiary farmers suggested that subsidy should be received on time. Further (82.50 per cent) of the beneficiary farmers given suggestion that trainings should be organized frequently. (73.33 per cent) of the beneficiary farmers given suggestion that knowledge regarding fertilizer application through drip irrigation should be provided.

Keywords: Constraints, Pradhan Mantri Krishi Sinchayee Yojana

INTRODUCTION

From 1st April 2015, Micro Irrigation component of On Farm Water Management has been subsumed under Pradhan Mantri Krishi Sinchayee Yojana and launched on 1st July, 2015 with the motto of "Har Khet Ko Pani". The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) is being implemented to expand cultivated area with assured irrigation, reduce wastage of water and improve water use efficiency. PMKSY not only focuses on creating

sources for assured irrigation, but also creating protective irrigation by harnessing rain water at micro level through "Jal Sanchay" and "Jal Sinchan". Micro irrigation is also incentivized through subsidy to ensure "Per drop-More crop". The objectives of the study are to study the relationship between characteristics of beneficiary farmers and attitude towards Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) and constraints faced by beneficiary farmers and suggestions obtained by them.

METHODOLOGY

The study was conducted in two tehsils of Sangli district of Maharashtra state. Six villages from each tehsil were selected based on highest and moderate total net irrigated area respectively. Ten beneficiary farmers were selected from each village randomly. Data were collected by personally interviewing 120 beneficiary farmers with the help of interview schedule. Statistical tools such as frequency, percentage, mean, standard deviation and Karl Pearson's coefficient of correlation were used for grouping the data.

RESULTS AND DISCUSSION

Table 1: Correlation coefficient between characteristics of the beneficiary farmers and their attitude towards Pradhan Mantri Krishi Sinchayee Yojana

Sr. No.	Independent variables	Correlation coefficient
1.	Age	0.0561 NS
2.	Education	0.191*

3.	Farming Experience	0.276**
4.	Knowledge	0.318**
5.	Social Participation	0.232*
6.	Sources of Information	0.229*
7.	Land Holding	0.274**
8.	Annual Income	0.259**
9.	Irrigation Status	0.258**
10.	Risk Orientation	0.313**

* = Significant at 0.05 level of probability

** = Significant at 0.01 level of probability

NS = Non-significant

It is observed that, independent variables like education, social participation and sources of information had positive and significant relationship with attitude of beneficiary farmers towards Pradhan Mantri Krishi Sinchayee Yojana. Also farming experience, knowledge, land holding, annual income, irrigation status and risk orientation had positive and highly significant relationship with attitude of beneficiary farmers towards Pradhan Mantri Krishi Sinchayee Yojana.

Table 2: Constraints faced by beneficiary farmers in the implementation of Pradhan Mantri Krishi Sinchayee Yojana

Sr. No.	constraints	Respondents (n=120)	
		Frequency	Percentage
1.	Clogging of drippers by suspended material	114	95.00
2.	Require frequent maintenance	110	91.66
3.	Difficult to maintain proper water pressure	104	86.66
4.	Difficulty in intercultural operations	97	80.84
5.	Delay in sanction of subsidy	87	72.50
6.	Lack of proper training	83	69.16
7.	High technical skill required	79	65.84
8.	Electricity charges are expensive	76	63.34
9.	Irregular supply of electricity	72	60.00

Table 3: Suggestions given by beneficiary farmers

Sr. No.	Suggestions	Respondents (n=120)	
		Frequency	Percentage
1.	Subsidy should be increased	111	92.50
2.	Subsidy should be received on time	107	89.16

Sr. No.	Suggestions	Respondents (n=120)	
		Frequency	Percentage
3.	Training should be organized frequently	99	82.50
4.	Electricity charges should be decreased	91	75.83
5.	Knowledge regarding fertilizer application through drip irrigation should be provided	88	73.33
6.	Electricity supply should be regular	83	69.16

The data in the table 3 revealed that large majority (92.50 per cent) of the beneficiary farmers stated that subsidy should be increased. (89.16 per cent) of the beneficiary farmers suggested that subsidy should be received on time. Further (82.50 per cent) of the beneficiary farmers given suggestion that trainings should be organized frequently. About (75.83 per cent) of the beneficiary farmers reported that electricity charges should be decreased while (69.16 per cent) of beneficiary farmers suggested that electricity supply should be regular. (73.33 per cent) of the beneficiary farmers given suggestion that knowledge regarding fertilizer application through drip irrigation should be provided.

CONCLUSION

The (86.66 per cent) of the beneficiary farmers faced difficulty to maintain proper water pressure while (69.16 per cent) of beneficiary farmers faced lack of proper training. Trainings and method demonstrations should be imparted to the beneficiary farmers for betterment of their knowledge and skills regarding the use of the

system effectively and efficiently. Technical guidelines should be conveyed to them through frequent visits of extension workers to the farmers' fields.

REFERENCES

- Deokate, N. M. 2018. Impact of WAN Irrigation Project on Agriculture and socio-economic development of Beneficiary farmers. Ph.D. Thesis, Dr. PDKV, Akola.
- Gade, S. B. 2020. Attitude of Agricultural students towards Entrepreneurship. M.Sc. (Agri.) Thesis submitted to Dr. BSKKV, Dapoli.
- Gayki, G. D. 2019. Attitude of rural youth towards Jalyukta Shivar Yojana. M.Sc. (Agri.) Thesis submitted to VNMKV, Parbhani. 1-98p.
- Pooja Karki. 2019. Attitude of farmers towards drip irrigation: A study in Kumaon Hills of Uttarakhand. M.Sc. (Agri.) Thesis submitted to G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.
- Supe, D. V. 2017. Impact of Farm Pond on its Beneficiaries in Marathwada Region. M. Sc. (Agri.) Thesis submitted to VNMKV, Parbhani.

RESEARCH ARTICLE

A study on beekeeping enterprise in Moga district of Punjab

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ABSTRACT

Honey bees are known not only for the production of hive products but also for their ecological role as pollinators which leads to enhanced crop productivity besides contributing to maintenance of plant diversity. Beekeeping is a small-scale enterprise that fits very well with livelihood of rural people. It requires little investments, does not require complex technologies and techniques to start with and bees require little tendering. In the present study pertaining to the economics of beekeeping of the different honey bee entrepreneurs in district Moga of Punjab, among trainees trained at Krishi Vigyan Kendra, 65 continuous adopters of bee-keeping were selected. Three categories of these selected bee keepers were prepared based on number of colonies i.e. 10-50 (small scale enterprise), 51-100 (medium scale enterprise) and more than 100 colonies (large scale enterprise). It was found that twenty four bee-keepers (36.92%) were having small scale of enterprise (10-50 colonies) while twenty two (33.84%) were having medium scale of enterprise (51-100 colonies) and nineteen (29.23%) were having large scale of enterprise (>100 colonies). The average income range varied from 0.11 to 13.44 lac per annum in all the categories. The bee-keepers were earning income from the sale of honey (64.62%), honey and bee colonies (12.35%) and queen bees (2.6%). Major problems faced by the respondents were related to marketing, migration and shortage of bee flora.

Keywords: Beekeeping, constraints, Honey, Socioeconomic, migratory

INTRODUCTION

Agriculture is a major source of livelihood in Indian economy. Punjab is a leading state in production of major crops and it has witnessed green revolution with use of high yielding varieties. At present increasing input cost and stagnant yields are resulting in poor income to the farmers. Land holdings are getting fragmented and emerging small holdings are becoming unviable. Marginal and small land holdings pose number of issues, such as problems with using mechanisation and irrigation techniques. Another major problem prevailing now days is the unemployment among rural youth. Therefore, need is to promote small scale enterprises among farmers for enhancing their incomes and generating employment among

rural youth. Among small scale enterprises which fits well with agriculture are dairy, poultry, mushroom farming and apiculture. Beekeeping is an ideal agro based subsidiary enterprise providing supplementary income and even major source of income to the ruralites. Beekeeping neither demand additional land space nor do they compete with other enterprises for any input. Beekeeping gives excellent return of honey (Sain and Nain, 2017; Singh *et al.*, 2016). The wide geographical belt of wild forest and cultivated flora with wide range of climates provides ample sources of pollen and nectar to bees in India (Thomas *et al.*, 2001). High input agricultural areas are also generally not suitable for Beekeeping (Graham *et al.*, 2022) as threat of encountering pesticides is always more. Agro-

ecological areas where cropping is less dependent on pesticides may favour Beekeeping, as pesticide poisoning is one of the major constraints of Beekeeping in well cropped regions (Manzoor and Pervez, 2022). Honey bees through pollination increase agricultural production and enhance sustainability of agriculture (Stein *et al.*, 2017). Worldwide an estimated 35 per cent of crop production is dependent on insect pollination (Klein *et al.*, 2007). Moreover, their populations and diversity also serve as bioindicators of the state of many environments (Roubik *et al.*, 2005; Skorbiłowicz *et al.*, 2018). Apart from honey production and pollination services, bees also provide other valuable hive products like royal jelly, pollen, propolis, bee venom, bee wax, etc. which have tremendous industrial and medicinal importance. Yet, beekeepers in India in general depend on beekeeping only for producing honey. To increase the profits from the apiary units, the beekeepers are required to exploit bees for the productions of other hive products. The most important factors in the development of the beekeeping industry are considered to be climate conditions, training, adoption of scientific methods of beekeeping. The training in beekeeping practices is required for rapid transfer of scientific beekeeping technology and solving problems related to beekeeping, the entrepreneur to be successful must be trained on many skills (Ghosh *et al.*, 2020) as most of the beekeepers are facing problems due to lack of knowledge of bee management technology and related skills (Kumar and Kundal, 2016). This study is a step forward to study socioeconomic status, determine the costs and returns associated with beekeeping to find out the viability of the enterprise and constraints in beekeeping industry in district Moga of Punjab and to train beekeepers accordingly.

MATERIALS AND METHODS

Present investigation was conducted in Krishi Vigyan Kendra, Moga of Punjab. Krishi

Vigyan Kendra conducted various training courses on bee-keeping enterprise, 65 continuous adopters of bee-keeping were selected for the present study. Three categories of these selected bee keepers were prepared on the basis of number of colonies i.e. 10-50 (small scale enterprise), 51-100 (medium scale enterprise) and more than 100 colonies (large scale enterprise). An interview schedule was developed to collect the data regarding socio-economic profile of the respondents, economics of beekeeping enterprise and constraints faced were also identified. Data were collected from all the 65 successful beekeepers using interview schedule. The data were collected by conducting personal interviews with the selected respondents. The data from individual farmer was arranged from the lowest to the highest, based on number of colonies. The data collected from the respondents were tabulated and analysed by using frequency and percentage. For analysis purpose different statistical techniques and excel were adopted. Simple descriptive statistics was employed in order to have a summary description of the data collected. This involved the use of percentages, means, frequency distributions to describe parameters as socioeconomic characteristics, constraints and Benefit cost ratio to find out the viability of the bee keeping enterprise were used for the interpretation of the results.

RESULTS AND DISCUSSION

Social indicators of beekeepers

The data given in Table 1 showed the socio-personal profile of the respondents with respect to age, gender, level of education, experience in beekeeping, land holdings etc. Beekeeping is very easy, acceptable and comparatively less expensive income generating activity. Also, the socio-economic factors of beekeepers do not affect beekeeping business. It is possible to adopt by any level of education, gender, age, marital status and religious people. The findings highlighted that maximum number of beekeepers were in age group 40-60 (47.69%)

followed by beekeepers in age group 20-40 and least beekeepers were recorded in aged category i.e. above 60 (7.69). Singh *et al* (2016) revealed that majority of the respondents were falling in age group of 31-40 years (56.7 and 60.00%, respectively). As far as occupational status is concerned, majority (60.00%) were unemployed rural youth in case of migratory apiary units while in case of stationary apiary unit's majority (76.7 %) were having agriculture as primary occupation.

The results of present study revealed that all the beekeepers participated in study are males and results are in line with findings of Abejew *et al* (2017) which revealed that about 98.8% of respondents were male. The traditional idea underscores beekeeping to be men's job due to physical reasons. Actually this belief might not hold true if females are given equal chance in heading the family as that of their male counterparts.

In the present study, maximum beekeepers had attained formal education, with the highest percentage (44.61) having attained secondary education. These results are in line with the findings of Moniruzzaman and

Rahman (2009) which revealed that majority (46.7 %) of the respondents were having education qualification upto matriculation while about one fourth (26.7%) were having education upto senior secondary. Lal *et al*. (2012) also reported similar results. Abejew *et al* (2017) reported that 26.1% did not receive any education while about 73.9% are at stages of literacy ranging from read and write to diploma level. The education level reflects persuasion of beekeepers and proper management of their honeybee colonies. Mujuni *et al* (2012) revealed that beekeepers participated in study had attained formal education, with the highest percentage (42.5) having attained secondary education.

In the present studies, the maximum number beekeepers were having experience of more than ten years (43.07) and more than fifty percent having no land. All the beekeepers are well versed with scientific beekeeping as all of them use langstroth hive and feed their colonies with sugar syrup even 15.38 percent feed their colonies pollen substitute alongwith sugar syrup.

Table 1: Social indicators of beekeepers

Parameter	Category	Group 1 <50 colonies	Group 2 50-100 colonies	Group 3 >100 colonies	Grand mean
Age of beekeeper	20-40	11 (45.83)	10 (45.45)	8 (42.10)	44.61
	40-60	12 (50.0)	10 (45.45)	9 (47.36)	47.69
	>60	1 (4.16)	2 (9.09)	2 (10.52)	7.69
Gender	Male	24 (100)	22 (100)	19 (100)	100.0
	Female	0 (0.0)	0 (0.0)	0 (0.0)	0.0
Education level (year)	Uneducated	4 (16.66)	1(4.54)	1(0.0)	9.23
	Primary	1(4.16)	5 (22.72)	0(0.0)	9.23
	Secondary	6(25.0)	12(54.54)	11(57.89)	44.61
	Senior Secondary	11(45.83)	7(31.81)	6(31.58)	36.92
	Graduation	2(8.33)	0(0.0)	1(5.26)	4.61
Experience on beekeeping (year)	Post graduation	0(0.0)	0(0.0)	0(0.0)	0.0
	<5 years	13(54.16)	3(13.63)	0(0.0)	24.61
	5-10 years	6(25.0)	8(36.36)	7(36.84)	32.30
	>10 years	5(20.83)	11(0.0)	12(0.0)	43.07

Parameter	Category	Group 1 <50 colonies	Group 2 50-100 colonies	Group 3 >100 colonies	Grand mean
Total land (hectare)	Landless	17(70.24)	10(0.0)	9(0.0)	55.38
	>5 Acres	5(20.83)	9(0.0)	8(0.0)	33.84
	5-10 Acres	2(8.33)	3(0.0)	2(0.0)	10.76
	>10 Acres	0(0.0)	0(0.0)	0(0.0)	0.00
Types of beehives used	Traditional	0(0.0)	0(0.0)	0(0.0)	0.00
	Langstroth	24(100.0)	22(100.0)	19(100.0)	100
Type of feeding	Sugar Syrup	20(83.33)	21(95.45)	14(73.68)	84.61
	SS+Pollen	4(16.66)	1(4.54)	5(26.31)	15.38
	substitute				
	No feeding	0(0.0)	0(0.0)	0(0.0)	0.0

Economics of honey production under different groups based on number of colonies per beekeeper

The costs and benefits of beekeeping are depicted in table 2, there three groups represent the cost and benefits of average beekeeping. The major costs occurred during beekeeping are made up of paid labour and benefits followed by expenses associated with sugar for feeding, machine and building repairs, fuel, small tools, supplies and miscellaneous expenses. The benefit of beekeeping is highly correlated with bee colony, wooden box, feed, transport and labor costs. The higher bee colony is resulting higher honey production as well as a higher return. The honey sale price varied from Rs. 70 to 300 for three different groups. The total honey harvest was maximum in Group III i.e. 43.79 kg per colony followed by Group II

(32.01 kg/ colony) and Group I (21.15 kg/ colony). Our analysis shows that size of colony increases, unit cost of honey production decreases. The net income from sale of honey and additional income from sale of new colonies and other bee products was also maximum in Group III. Benefit cost ratio was highest in Group III (2.10:1), followed by Group II (2.01:1) and 1.58:1 in Group I. The findings were in line with earlier studies which revealed that Benefit cost ratio increases with increase in number of colonies (Saner *et al* 2004). Income is collectively all the returns from sale of bee products (honey, wax, royal jelly, pollen, package bees). Selling bees and queens or equipment for one reason or another that normally would be used in an operation is not income, but is considered a reduction in investment or fixed costs.

Table 2: Relative economics of honey production under different groups based on number of colonies per beekeeper

Parameters	Group I (n=24)	Group II (n=22)	Group III (n=19)
Average number of colonies/ beekeeper	30.08	61.81	228.68
Honey produced(Kg)/ colony/ beekeeper	21.15	32.01	43.79
Sale rate of honey (Rs.)	85.19	80.63	75.7
Gross returns from honey only (Rs.) per hive	1801.76	2580.97	3314.90
Cost on honey production per hive (Rs.)	698.79	854.84	1069.06
Net Return per hive (Rs.)	1102.96	1726.12	2245.84
Benefit-Cost ratio	1.58	2.01	2.1

Constraints faced by beekeepers of district Moga

Major problems faced by the respondents were related to marketing and minimum price of honey (Table 3). In group I, with less than 50 colonies major problems were shortage of bee flora (87.5 %), migration (83.33%) and attack of pest and disease on the colonies (66.66%) but very few reported about marketing problem. In group II, major problem was pesticide poisoning (81.81%) followed by market price of honey (72.72%), financial/ credit problem (72.72%) and migration (59.09%). Similar trend was seen in group III with large scale beekeepers. Beekeepers were also facing problems due to lack of knowledge of bee diseases and pest management. In similar study by Kumar *et al* (2018) found that respondents in majority (75.0%) possessed medium level of knowledge. Only a small percentage (12.0%) was having high level of knowledge. Knowledge is one of the most important prerequisite factors for adoption of a technology. That is why knowledge has been found to have a positive association with agricultural technologies in most of the studies. But, medium level of knowledge of most of the beekeepers as indicated by the above data is a matter of concern as it will keep on affecting adoption of the bee keeping technology adversely. Though beekeeping is a profitable business, but the popularity is still lower because of lower marketing of honey and other byproducts. Monga and Manucha (2011) found that major constraints faced by beekeepers in Panchkula District of Haryana state in India are honeybee pests and diseases, shortage of bee forage necessitating migration

to areas where bee forage is available, credit facility for starting the vocation and to offset the losses due to pests and diseases, management of bee colonies in extreme weather conditions, pesticide poisoning and lack of subsidiary occupation as in other developing countries. Lack of cooperatives and institutional support for marketing, lack of motivation, lack of skilled manpower and training institutions were other constraints felt by beekeepers. Parsad *et al.*, 2018 identified wax moth, ant problem, varroa mite which reveals that these are the most important pests of honey bees and their products as major problems in Karnatka. Kumar and Kundal (2016) found that beekeepers faced problems due to lack of knowledge of bee management technology and related skills. Prasad *et al* (2018) found that majority of the farmers enquired about management of wax moth, ant problem, varroa mite which revealed that these are the most important pests of honey bees and their products and cause serious losses in commercial beekeeping. Kumar *et al* (2018) recorded respondents in majority (75.0%) possessed medium level of knowledge. Only a small percentage (12.0%) was having high level of knowledge. Knowledge is one of the most important prerequisite factors for adoption of a technology. That is why knowledge has been found to have a positive association with agricultural technologies in most of the studies. But, medium level of knowledge of most of the beekeepers as indicated by the above data is a matter of concern as it will keep on affecting adoption of the bee keeping technology adversely.

Table 3. Constraints faced by beekeepers of district Moga

Sr. No.	Constraints	Group 1 <50 colonies	Group 2 50-100 colonies	Group 3 >100 colonies	Grand mean
1.	Honey bee pests and diseases	16(66.66)	11(50.00)	8(42.10)	35(53.84)
2.	Migration	20(83.33)	13(59.09)	16(84.21)	49(75.38)
3.	Shortage of bee flora	21(87.5)	8(36.36)	12(63.15)	41(63.07)
4.	Financial problems	11(45.83)	16(72.72)	18(94.73)	45 (69.23)
5.	Management of bee colonies	8(33.33)	6(27.27)	8(42.10)	22(33.84)
6.	Pesticides poisoning	6(25.00)	18(81.81)	14(73.68)	38(58.46)
7.	Marketing problem	2(8.33)	16(72.72)	18(94.73)	36(55.38)
8.	Lack of skill (manpower and training institutions)	11(45.83)	2(9.09)	2(10.52)	15 (23.07)

CONCLUSION

Bee-keeping and honey production is a good option for increasing farmers' income. Despite of some important production and marketing problems, bee-keeping was found to be a profitable enterprise in this study. However, the profit was largely affected by beekeeper training and mainly the marketing of honey and other byproducts. The high labor cost of beekeeping practice largely affecting the benefit. A majority of respondents had basic training in beekeeping but more technical training for adoption of scientific beekeeping to reduce labor cost and increased profitability is still required.

REFERENCES

- Abejew T.A. and Zeleke Z.M. 2017. Study on the Beekeeping Situation, the Level of Beekeepers Knowledge Concerning Local Honeybee Subspecies, Their Productive Characteristics, and Behavior in Eastern Amhara Region, Ethiopia. *Advances in Agriculture* Volume 2017, Article ID 6354250, 6 pages <https://doi.org/10.1155/2017/6354250>
- Badari Prasad, P.R., Ahamed, B.Z. and Meti, S.K. 2018. Role of Beekeeping Trainings in Integrated Farming System and Diagnosis of Beekeeping Problems in HK Area of Karnataka, India. *Int.J.Curr.Microbiol. App.Sci.* 7(04):3049-3052. doi:<https://doi.org/10.20546/ijcmas.2018.704.345>
- Gamze, S., Sait, E., Banu T. and Figen C. 2004. The Economic Analysis Of Beekeeping Enterprise In Sustainable Development: A Case Study Of Turkey. *APICTA*, Vol 38, pp 342-351.
- Ghosh, S., Aryal, S. and Jung, C. 2020. Ecosystem Services of Honey Bees; Regulating, Provisioning, and Cultural Functions. *Journal of Apiculture*, DOI: 10.17519/apiculture.2020.06.35.2.119
- Graham, K.K., Milbrath, M.O., Zhang, Y., Baert, N., McArt, S. and Isaacs, R. 2022. Pesticide risk to managed bees during blueberry pollination is primarily driven by off-farm exposures. *Sci Rep* 12(1):7189.
- Klein, A.M., Vaissiere, B., Cane, J.H., Steffan-Dewenter, I., Cunningham, S.A., Kremen, C. and Tscharntke, T. 2007. Importance of crop pollinators in changing landscapes for world crops. *Proc. R. Soc. Lond. B, Biol. Sci.*, 274:303-313.
- Kumar, R. and Kundal, N. 2016. Beekeeping status in Kangra district of Himachal Pradesh. *Journal of Entomology and Zoology Studies* 4(4): 620-622.
- Kumar, R., Singh, S. R., Mokhopadhyay, S. B. and Singh, Y. P. 2018. Knowledge of the Beekeepers with Regards to Scientific Beekeeping. *International Journal of Current Microbiology and Applied Sciences* ISSN: 2319-7706 Special Issue-7 pp. 4616-4620.
- Kumar, R., Singh, S. R., Mokhopadhyay, S.B. and Singh, Y.P. 2018. Knowledge of the Beekeepers with Regards to Scientific Beekeeping. *Int.J.Curr.Microbiol.App.Sci* Special Issue-7: 4616-4620.

- Lal, R., Sharma, S.D., Sharma, J.K., Sharma, V. and Singh, D. 2012. Impact of beekeeping training on socio-economic status of farmers and rural youths in Kullu and Mandi district of Himachal Pradesh. *J. Hum. Ecol.*, 39(3):205-208.
- Manzoor, F. and Pervez, M. 2022. Pesticide Impact on Honeybees Declines and Emerging Food Security Crisis. Global Decline of Insects. doi: 10.5772/intechopen.98871
- Monga, K. and Manocha, A. 2011. Adoption and constraints of beekeeping in district Panchkula (Haryana). *Livestock Res. for Rural Dev.* Volume 23, Article #103. Retrieved October 6, 2013, from <http://www.lrrd.org/lrrd23/5/monga23103.htm>.
- Moniruzzaman, M. and Rahman, M.S. 2009. Prospects of Beekeeping in Bangladesh, *J. Bangladesh Agric. Univ.*, 7 (1): 109-116.
- Mujuni, A., Natukunda, K. and Kugonza, D. R. 2012. Factors affecting the adoption of beekeeping and associated technologies in Bushenyi district, Western Uganda. *Livestock Res. for Rural Dev.* Volume 24. Retrieved October 6, 2013, from <http://www.lrrd.org/lrrd24/8/muju24133.html>.
- Roubik, D.W., Sakai, S. and Karim, A.A.H. 2005. Pollination ecology and the Rain forest: Sarawak studies. Springer Science + Business Media, Inc.
- Sain, V. and Nain, J. 2017. Economics and Importance of Beekeeping DOI: 10.26717/BJSTR.2017.01.000561. *Biomed J Sci & Tech Res.* Published: December 04, 2017.
- Sain, V. and Nain, J. 2017. Economics and Importance of Beekeeping *Biomed J Sci & Tech Res.* 7(1): 1833. DOI: 10.26717/BJSTR.2017.01.000561
- Singh, G., Tiwari, D. and Yadav, S.P. 2016. Income enhancement and employment generation through apiculture enterprise for rural youth in Punjab. *Indian Res. J. Ext. Edu.* 16(1): 112-115.
- Skorbiłowicz E., Skorbiłowicz, M. and Ciesluk, I. 2018. Bees as bioindicators of environmental pollution with metals in an urban area. *Ecol. Eng.* 19:229–234. doi: 10.12911/22998993/85738.
- Stein, K., Coulibaly, D., Stenchly, K., Goetze, D., Porembski, S., Lindner, A., Konaté, S. and Linsenmair, E.K. 2017. Bee pollination increases yield quantity and quality of cash crops in Burkina Faso, West Africa. *Scientific Reports*. Volume 7, Article number: 17691.
- Thomas, D., Naresh Pal, Chawda, S.S. and Rao, S.K. 2001. Bee flora and migratory routes in India. *Proc. 37th Int. Apic. Congr.*, 28 Oct–1 Nov 2001, Durban, South Africa.

RESEARCH ARTICLE

Knowledge determinants of label claim pesticides in vegetable grower's

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ABSTRACT

Relationship between the selected characteristics of vegetable growers to their knowledge about label claim pesticides was studied in the present investigation conducted in Ahmednagar district of Maharashtra state. The “Ex-post-facto” research design was used for the study. The sample for the present study composed of total 120 vegetable growers selected through simple random sampling technique. The data were collected through personal interview method using pre-tested structured schedule. The statistical tools used were frequency and percentage, standard deviation and Karl Pearson’s correlation coefficient.

The study concluded that, majority of the vegetable growers had medium level of knowledge about label claim pesticides. The variables viz. education, social participation, cosmopolitaness, area under vegetable cultivation, irrigation status, land holding, annual income, risk orientation and training had positive and significant association with the knowledge about label claim pesticides. While; age, cropping pattern and source of information had positive but non- significant relationship with the knowledge. Therefore, State Agriculture Universities and KVK's should organized specialized training on the knowledge and use of label claim pesticides.

Keywords: Knowledge, Label Claim Pesticides, Profile, Vegetable Growers,

INTRODUCTION

Vegetables are important food component of Indians diet and the diverse agro-climatic conditions of the country permit growing of several vegetables round the year. Plant protection is one of the important components, which plays a vital role in successful vegetables production. The chemical pesticides are helpful in increasing crop production by suppressing level of insectpests. However, indiscriminate use of pesticides has adverse ecological and socio-economic effects. Continuous use of pesticides builds up high level of toxic residues in food, ground water and air.

This excessive application of chemical pesticides also increases per unit cost of production. Therefore, proper knowledge about label claim pesticides is essential for wise and safe use of pesticides. This knowledge is depending on the socio-demographic profile and psychological characteristics of the respondent person. Hence the present study was undertaken to find out the Knowledge Determinants of Label Claim Pesticides in Vegetable.

METHODOLOGY

The present investigation was carried out in Ahmednagar district of the Maharashtra

State. The “Ex-post-facto” research design was used for the study. Rahuri and Sangamner tahsils were selected based on highest area under vegetable cultivation. The list of villages having highest area under vegetable cultivation was obtained from Taluka Agriculture Officer. Three villages from each of the tahsils were selected depending upon highest area under vegetable cultivation. Twenty vegetable growers were selected from each village. Thus, the sample for the present study composed of total 120 vegetable growers selected through simple random sampling technique. The data were collected through

personal interview method using pre-tested structured schedule. The statistical tools used were frequency and percentage, standard deviation and Karl Pearson’s correlation coefficient.

RESULTS AND DISCUSSION

The Socio-demographic profile and psychological characteristics of vegetable growers and their relationship along with direct – indirect effect was studied and the results obtained from the study as well as discussions have been summarized under following heads and Tables.

1. Socio-demographic profile of respondent vegetable growers

Table 1: Distribution of respondents according to their Socio - demographic profile

Sl. No.	Variables	Details	Frequency (n=120)	Per cent
A.	Age (Years)	Young (Up to 35 year)	31	25.83
		Middle (36 to 55 year)	77	64.17
		Old (56 and above)	12	10.00
B.	Education	Illiterate	9	7.50
		Primary education (1 st to 4 th standard)	13	10.83
		Secondary school (5 th to 10 th)	66	55.00
		Higher secondary school (11 th to 12 th)	12	10.00
		Graduate and above	20	16.67
C.	Social participation	Low (up to 1)	35	29.17
		Medium (2 to 4)	73	60.83
		High (5 and above)	12	10.00
D.	Cosmopoliteness	Low (up to 1)	20	16.67
		Medium (2 to 4)	89	74.17
		High (5 and above)	11	9.16
E.	Area under vegetable cultivation (ha.)	Small (Up to 2 ha.)	66	55.00
		Medium (2.01 to 4 ha.)	44	36.67
		Large (4.01 and above ha.)	10	8.33
F.	Irrigation status	Low (up to 15)	28	23.33
		Medium (16 to 24)	81	67.50
		High (25 and above)	11	9.17
G.	Cropping pattern	Poor (up to 15)	28	23.33
		Fair (16 to 24)	81	67.50
		Good (25 and above)	11	9.17
H.	Land Holding	Marginal up to 1.00	07	05.83
		Small 1.01 to 2.00	34	28.33
		Semi medium 2.01 to 4.00	26	21.67

Sl. No.	Variables	Details	Frequency (n=120)	Per cent
		medium 4.01 to 10	34	28.33
		big 10.01 and above	19	15.84
I.	Family annual income (Rs.)	Low (Up to Rs.206298)	16	13.33
		Medium (Rs.206299 to Rs.692764)	84	70.00
		High (Rs.692765 and above)	20	16.67
J.	Risk orientation	Low (Up to 10)	21	17.50
		Medium (11 to19)	79	65.83
		High (20 and above)	20	16.67
K.	Training	Low (up to 6)	17	14.17
		Medium (7 to 14)	85	70.33
		High (15 and above)	18	15.00
L.	Source of information	Low (up to 8)	20	16.67
		Medium (9 to 18)	76	63.33
		High (19 and above)	24	20.00

Table 1 shows that the largest group of respondents falls in the middle age range (64.17 %), most respondents were literate (92.50 %), had medium social participation (60.83 %), medium Cosmo politeness (74.17 %), had small area under vegetable cultivation (55.00 %), medium irrigation status (67.50 %), fair cropping pattern (67.50 %), medium family annual income (70.00 %), medium risk orientation (65.83 %), medium source of

information (63.33 %).

These results are in line with to those obtained by Meghade (2007) about social participation and risk orientation.

2. Knowledge of respondent vegetable growers regarding label claim pesticides

The information regarding the knowledge of the respondents about label claim pesticides was collected, tabulated and analyzed. The results are presented in Table 2.

Table: 2. Distribution of the respondent according to their overall knowledge level

Sr. No.	Category (score)	Respondents (n=120)	
		Number	Percentage
1.	Low (Up to 33.33)	47	39.17
2.	Medium (33.34 to 66.66)	61	50.83
3.	High (66.67 and above)	12	10.00
	Total	120	100.00

Table 2 revealed that, nearly half of the respondents (50.83 %) had medium knowledge level, followed by 39.17 per cent respondents had low knowledge level and only 10.00 per cent respondent vegetable growers had high knowledge level. Thus, it is concluded that, majority (50.83 per cent) of the respondents belonged to medium knowledge category. These findings are consistent with the findings of

Bhandare (2011), Patil *et al.* (2014) and Patil *et al.* (2017)

3. Relationship between profile of vegetable growers and their knowledge about label claim pesticides

In the present investigation an attempt was made to find out the nature of relationship between the selected characteristics of the vegetable growers with their knowledge about

label claim pesticides. The correlation coefficient (r) between knowledge with various independent

variables is presented in table 3 and discussed in subsequent pages.

Table: 3. Relationship between profile and knowledge of vegetable growers about label claim pesticides

Sr. No.	Independent variable	Coefficient correlation
1.	Age	0.057 ^{NS}
2.	Education	0.566**
3.	Social participation	0.462**
4.	Cosmopoliteness	0.595**
5.	Area under vegetable cultivation	0.194*
6.	Irrigation status	0.290**
7.	Cropping pattern	0.010 ^{NS}
8.	Land holding	0.233*
9.	Annual income	0.200*
10.	Risk orientation	0.536**
11.	Training	0.671**
12.	Source of information	0.003 ^{NS}

** = Significant at 0.01 per cent level of probability;

* = Significant at 0.05 per cent level of probability and NS = Non – Significant

Table 3 presents the correlation coefficients between the profile of the respondents and their knowledge of vegetable growers about label claim pesticides. The results indicate that education, social participation, cosmopoliteness, irrigation status, risk orientation and training had a highly significant positive correlation with the knowledge of vegetable growers about label claim pesticides.

This suggests that, the knowledge about label claim pesticides is highly influenced by the education, social participation, cosmopoliteness, irrigation status, risk orientation and training of vegetable growers. It's also influenced with increase in area under vegetable cultivation, land holding and annual income.

The other independent variables, including age, cropping pattern and source of information did not show a significant correlation with the knowledge of vegetable growers about label claim pesticides.

These results are similar to those obtained by Mujawar (2016) between education

and size of land holding with knowledge and Patil (2015) between irrigation status with knowledge of label claim pesticides of respondents. But results contradict those obtained by Sing et al. (2009) who revealed that knowledge is influenced by age and Patil (2015) observed that knowledge is influenced by cropping pattern.

CONCLUSION

The study concluded that, largest group of respondents falls in the middle age range, majority were literate, had medium social participation, had medium Cosmo politeness, had small area under vegetable cultivation, had medium irrigation status, had fair cropping pattern, medium family annual income, medium risk orientation and medium source of information. Majority of the vegetable growers had medium level of knowledge about label claim pesticides and there is major unawareness and lack of information about the label claim pesticides amongst the vegetable growers. The study also concluded that, the variables age,

cropping pattern and source of information had positive but non-significant relationship with the knowledge. Whereas, education, social participation, cosmopolitaness, area under vegetable cultivation, irrigation status, land holding, annual income, risk orientation and training had positive and significant association with the knowledge. Therefore, it is recommended that State Agriculture Universities and KVK's should organised specialized training on the knowledge and use of label claim pesticides for the vegetable growers.

REFERENCES

- Bhandare, C. L., 2011. Adoption of recommended package of practices of sweet orange growers in Aurangabad district. M.Sc. (Agri.) Thesis (Unpub.), MKV, Parbhani.
- Maghade, A.Y., 2007. Technological gap in onion cultivation from Rahata tehsil of Ahmednagar district. M.Sc. (Agri.) Thesis (Unpub.), MPKV, Rahuri. (M.S.) India.
- Mujawar, R. H., 2016. Analysis of sustainable practices followed in strawberry cultivation. M.Sc. (Agri.) Thesis (Unpub.), MPKV, Rahuri.
- Patil, S.D., 2015. Utilization of Farm Implements by the Farmers. Ph.D. (Agri.) Thesis. Mahatma Phule Krishi Vidyapeeth, Rahuri.
- Patil S.D., Ahire M.C. and S. L. Khose. 2014. Information Seeking Pattern of Farmers Regarding Horticultural Crops through ATIC. Journal of Agricultural Research and Technology. 39 (3) (September): 460-465.
- Patil S. D., P. B. Kharde and A. B. Gaikwad. 2017. Profile of Sorghum Growers and its Relationship with Knowledge and Adoption of Panchsutri Technology. Guj. J. Ext. Edu. Vol. 28: Issue 2: December 2017: 402-407
- Sachin A. Khedkar, Sandip D. Patil & Ritesh L. Patil. 2019. Knowledge of Label Claim Pesticides to the Vegetable Growers. Journal of Pharmacognosy and Phytochemistry. Vol. 8 (6): 2584-2585.
- Sing, H.S., George, S., Pandey, V. and Naik, G., 2009. Farmer participatory effectiveness of IPM practices in cabbage. *Indian Journal of Extension Education*. Vol.45 (1): 45-50.

RESEARCH ARTICLE

Input services offered at Rythu Bharosa Kendras with special reference to fertilizers in Rayalaseema Region of Andhra Pradesh

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ABSTRACT

The current study was carried out during the year 2022 and 2023 to know the perception of farmers on input services offered at Rythu Bharosa Kendras and to know the constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras. A representative sample of 120 farmers in two districts of Andhra Pradesh i.e., Tirupati and Chittoor were selected for the study. Through pre-structured interview schedule, farmers perception was collected. Representative farmers were very satisfied about the physical location of the Rythu Bharosa Kendras with the highest mean score of 4.62. Respondents were very unsatisfied about in time availability of all the fertilizers in RBK with respect to cropping pattern with the lowest mean score of 1.86. 42.50% of the representative sample had moderate perception, 37.50% of them had poor perception and 20.00% of the sample farmers had good perception on Rythu Bharosa Kendra fertilizer services. Major constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras were unavailability of fertilizers in line with cropping pattern, limited supply of fertilizers to Rythu Bharosa Kendras, unavailability of all the required set of fertilizers and unable to meet the farmers immediate fertilizers requirement.

Key words : Constraints, cropping pattern, immediate requirement, perception

INTRODUCTION

In India, agriculture played a prominent role in economy and employment. In 2022-23, share of Gross Value Added of agriculture and allied sectors in India's total economy was 18.3% and provided an employment opportunity to around two – third of the population in India. Further in agriculture sector, India emerged as net exporter with a value of \$ 50.2 billion in financial year 2022-23. Andhra Pradesh was one of the most prominent agricultural states and considered as rice bowl of India. Around 66.64 % of state population were from rural areas. In 2022-23 GVA growth rates for Agriculture and Allied sectors was 13.18%. Agriculture sector reported 20.72% growth, while horticulture

sector gained 12.58% growth. Similarly, Livestock and fisheries reported a growth rate of 7.32% and 19.41 % respectively. In order to meet the current requirement of food to the growing population, there was a huge need to improve the productivity. Further the issues pertaining to farming has to addressed effectively. Hence their exist an urgent need to identify the magnitude of various constraints in agriculture and allied sectors. Farm inputs includes seeds, fertilizers, plant protection chemicals, credit facilities, crop insurance and farm machinery. Availability of proper information about this farm inputs will enhance the overall efficiency of farming operations and further improve the net profit to the farmers. Several interventions were

implemented by both the state and central government through various programmes like PM Kisan, YSR Rythu Bharosa and etc. To support the overall farming operations. As a part of these interventions, state government of Andhra Pradesh has launched the centres as one stop solution for all agriculture and allied issues in the name of Rythu Bharosa Kendras in each corner of the state on May 30, 2020. These centres played a prominent role in each and every aspect of farming. Currently, 10778 RBKs were offering their services to the farmers across the state. Further the state government ambitiously started selling of certified agricultural inputs to the farmers in these centres. The main objective of RBK was to streamline all the stakeholders of agriculture into a single channel to offer farmers the required inputs to improve their productivity, farm income and sustainability. In this context the present study was being conducted to analyse the farmers perception on input services offered at Rythu Bharosa Kendras with special reference to fertilizers particularly in Tirupati and Chittoor districts in Andhra Pradesh.

Objectives

1. To study the farmers perception on input services offered by Rythu Bharosa Kendras with special reference to fertilizer
2. To study the constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras

METHODOLOGY

The current study was carried out during the year 2022 and 2023 in Tirupati and Chittoor districts of Andhra Pradesh. Out of 35 and 33 mandals of Tirupati and Chittoor districts respectively, three mandals in each district was selected randomly. In Tirupati district, Yerpada, Renigunta, Chandragiri mandals were selected since different ranges of crops were cultivated in

these three mandals of Tirupati district. In Chittoor district, mandals selected for study were Chittoor, Bangarupalem and Gudipala based on the range of crops cultivated in these mandals. Two Rythu Bharosa Kendras were selected out of each selected mandals in each district based on farmers fertilizers consumption. Rythu Bharosa Kendras selected were Amanduru, Merlapaka, Karakambadi, Gajulamandem, Ramireddipalle, and Buchinaidupalle in Tirupati districts. In Chittoor district, Mutthukur, Thalambedu, Thimajipalli, Setteri, Panaturu and Papasamudram were selected for the study. Ten farmers from each Rythu Bharosa Kendras were selected randomly for the study thus making sample size of one hundred and twenty. Farmers perception over the fertilizers services offered at Rythu Bharosa Kendras and constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras was collected through pre structured interview schedule.

Farmers perception on fertilizers services offered at Rythu Bharosa Kendras

Farmers perception on fertilizers services offered by Rythu Bharosa Kendras was collected through five-point scale which includes very satisfied, satisfied, neutral, unsatisfied and very unsatisfied with a score of five, four, three, two and one respectively awarded to each and every factor in the pre-structured interview based on the farmers' perception.

Farmers perception score will be classified into 3 categories based on mean and standard deviation. Score below Mean – $\frac{1}{2}$ S.D was classified as poor category, score between Mean + $\frac{1}{2}$ S.D and Mean – $\frac{1}{2}$ S.D was classified as moderate category and score above Mean + $\frac{1}{2}$ S.D. was classified as good category.

Constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras :

Constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras were

collected over the statements mentioned in the pre structured interview schedule. Responses from sample farmers were collected in the form of rankings ranging from I – X. Those responses were analysed through Garrett ranking technique.

RESULTS AND DISCUSSION

Farmers perception on fertilizers services offered at Rythu Bharosa Kendras

Farmers perception on fertilizers services offered by Rythu Bharosa Kendras was collected through five-point scale which includes very satisfied, satisfied, neutral, unsatisfied and very unsatisfied with a score of five, four, three, two and one respectively awarded to each and every factor based on the farmers perception. Factors mentioned in the pre-structured interview schedule were availability of farmers preferred fertilizers brands in RBK, availability of wide range of fertilizers in RBK as per the requirement of farmers, adequate quantity of fertilizers available at RBK, quality aspects of fertilizers purchased in RBK, price of fertilizers purchased in RBK in comparison with other agencies, performance of digital kiosk in placing fertilizers orders, internal environment at RBK, functional hours of RBK, staff performance in RBK, price to quality comparison of fertilizers purchased in RBK with fertilizers purchased from other agencies, meeting immediate fertilizers requirement, time gap between ordering & supply of fertilizers from RBK, accessibility to fertilizers in RBK with comparison to other agencies, recommendation on technical aspects of fertilizers from VAA/VHA & etc, physical location of RBK and in time availability of all the fertilizers in RBK with respect to cropping pattern. The respondents perception score was calculated by adding up the awarded score for each statement individually. Based on those score, mean score was calculated

and ranks were awarded. From the Table 1, it was clearly depicted that farmers were very satisfied about the physical location of RBK with a highest mean score of 4.62, ranked I. As a result of which farmers got access to information and inputs pertaining to crop cultivation aspects. Followed by staff performance of RBK with a next highest score of 4.35, ranked II, next in order was recommendation on technical aspects of fertilizers from VAA/VHA and etc. with a mean of 4.31. ranked III. Farmers were further satisfied with the functional hours of the Rythu Bharosa Kendras with a mean score of 4.25. In fertilizer prospective, sample farmers were very much satisfied about the price of fertilizers purchased in RBK in comparison with other agencies with a score of 4.24. It represented that positive perception of farmers on price of fertilizers offered in Rythu Bharosa Kendras. Further sample farmers quoted that, since Rythu Bharosa Kendras were located in the vicinity of their field localities which resulted in reduction in the transportation charges of fertilizers from point of purchase to fields. Followed by, sample farmers were satisfied about the internal environment of Rythu Bharosa Kendras with a mean score of 4.23. Followed by, Price to quality comparison of fertilizers purchased in RBK with fertilizers purchased from other agencies, performance of Digital kiosk in placing fertilizers orders, quality aspects of fertilizers purchased in RBK, availability of farmers preferred fertilizers brands in RBK, accessibility to fertilizers in RBK with comparison to other agencies, time gap between ordering and supply of fertilizers from RBK, adequate quantity of fertilizers available at RBK, availability of wide range of fertilizers in RBK as per the requirement of farmers, meeting immediate fertilizers requirement with a mean score of 4.21, 3.96, 3.92, 3.82, 3.61, 2.47, 2.17, 2.12, 1.97 and 1.86 respectively..

Table 1 : Farmers perception on fertilizers services offered at Rythu Bharosa Kendras

S.No	Parameters	Mean	Ranks
1.	Physical location of RBK	4.62	I
2.	Staff performance in RBK	4.35	II
3.	Recommendation on technical aspects of fertilizers from VAA/VHA and etc	4.31	III
4.	Functional hours of RBK	4.25	IV
5.	Price of fertilizers purchased in RBK in comparison with other agencies	4.24	V
6.	Internal environment at RBK	4.23	VI
7.	Price to quality comparison of fertilizers purchased in RBK with fertilizers purchased from other agencies	4.21	VII
8.	Performance of Digital kiosk in placing fertilizers orders	3.96	VIII
9.	Quality aspects of fertilizers purchased in RBK	3.92	IX
10.	Availability of farmers preferred fertilizers brands in RBK	3.82	X
11.	Accessibility to fertilizers in RBK with comparison to other agencies	3.61	XI
12.	Time gap between ordering and supply of fertilizers from RBK	2.47	XII
13.	Adequate quantity of fertilizers available at RBK	2.17	XIII
14.	Availability of wide range of fertilizers in RBK as per the requirement of farmers	2.12	XIV
15.	Meeting immediate fertilizers requirement	1.97	XV
16.	In time availability of all the fertilizers in RBK with respect to cropping pattern	1.86	XVI

Constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras

Constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras were collected over the statements mentioned in the pre structured interview schedule. Statements included were unavailability of farmers preferred brand of fertilizers in RBK, unable to fulfil the farmers immediate fertilizers requirements, unavailability of credit facility in RBK, delay in obtaining the required fertilizers, unavailability of all the required set of fertilizers, inappropriate quality aspects of fertilizers, variation in price of fertilizers, limited supply of fertilizers, unable to access fertilizers, unavailability of fertilizers in line with cropping pattern. Responses from sample farmers were collected in the form of rankings ranging from I – X. Those responses were analysed through Garrett ranking technique. The major constraint was unavailability of

fertilizers in line with cropping pattern with a highest rank score of 46.86, ranked I. As a result of which farmers depends on other agencies for purchasing the required set of fertilizers for their crops. In order, it was followed by limited supply of fertilizers in the Rythu Bharosa Kendras with a rank score of 43.47, ranked II, followed by unavailability of all the required set of fertilizers with a rank score of 42.82, ranked III. Continued by delay in obtaining the required fertilizers, unable to fulfil the farmers immediate fertilizers requirements, unavailability of credit facility in RBK, unavailability of farmers preferred brand of fertilizers in RBK, unable to access fertilizers, inappropriate quality aspects of fertilizers, variation in price of fertilizers with a rank score of 40.52, 39.63, 36.38, 28.96, 28.17, 26.62 and 25.21 respectively. This information clearly mentioned that, there was unavailability of all the required set of fertilizers in line with the cropping pattern of the farmers.

Table 2 Constraints faced by the farmers in obtaining fertilizers from Rythu Bharosa Kendras

S. No	Constraints	Score	Ranks
1.	Unavailability of fertilizers in line with cropping pattern	46.86	I
2.	Limited supply of fertilizers	43.47	II
3.	Unavailability of all the required set of fertilizers	42.82	III
4.	Delay in obtaining the required fertilizers	40.52	IV
5.	Unable to Fulfil the farmers immediate fertilizers requirements	39.63	V
6.	Unavailability of credit facility in RBK	36.38	VI
7.	Unavailability of farmers preferred brand of fertilizers in RBK	28.96	VII
8.	Unable to access fertilizers	28.17	VIII
9.	Inappropriate quality aspects of fertilizers	26.62	IX
10.	Variation in price of fertilizers	25.21	X

CONCLUSION

The article has examined the farmers perception on Rythu Bharosa Kendras fertilizers services. 42.50%, 37.50% and 20.00% of the representative sample had moderate, poor and good perception on Rythu Bharosa Kendra fertilizer services. Sample farmers were satisfied over the physical location of RBK and price of fertilizers purchased in RBK in comparison with other agencies and major constraints faced by farmers in obtaining fertilizers from Rythu Bharosa Kendras were unavailability of fertilizers in line with cropping pattern, limited supply of fertilizers.

Policy Implication

Implementation of location specific fertilizer demand forecasting prior to cropping season to avoid discrepancies in fertilizer availability in line with cropping pattern. Improving supply chain aspects of fertilizer especially from fertilizer hub to Rythu Bharosa Kendras to meet immediate fertilizers requirement by the farmers.

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Conflict of Interest

No conflict of interest in this entire research.

REFERENCES

- Babu, S.K. (2019). Awareness and Perception of farmers towards SHG scheme in Rayalaseema regions of Andhra Pradesh. Ph.D. Thesis submitted to Acharya N.G. Ranga Agriculture University, Bapatla.
- Damodara Reddy, A.K., Bala Hussain Reddy, P., Sailaja, V and Nafeez Umar, Sk. (2022). Awareness of farmers towards Rythu Bharosa Kendras (RBKs) products and services in Prakasam district of Andhra Pradesh. *The Journal of Research ANGRAU*. 50(3): 144-148.
- Jaiswal, M and Singh, A. (2018). Study on awareness and perception regarding soil health card. *Journal of Pharmacognosy and Phytochemistry*, SP(4): 395-400.
- Jyosthna, Mk., Chowdary, Raghavendra and Jyothi, I. (2022). A study on perception and utilization of services of Rythu Bharosa Kendra's (RBKs) by the farmers in Chittoor district of Andhra Pradesh, India. *Current Journal of Applied Science and Technology*. 41(27): 40-47.
- Kumbalep, S and Devaraju, M. (2018). Awareness and Perceptions of farmers about crop insurance -a study in Kolar District of Karnataka State.

International Journal of Advances in Science Engineering and Technology, 6(1):90-94.

Rajesh, M., Kishore, N. and Devi, I., Kumari, P. (2022). Awareness of farmers towards products and services offered by RBKs in Rayalaseema region Andhra Pradesh—A case study. International Journal Of Agricultural

S c i e n c e s . 1 8 . 8 3 2 - 8 3 5 .
DOI:10.15740/HAS/IJAS/18.2/832-835.

Sarada., O., Suneel Kumar, G.V and Sivanarayana, G. (2023). Services offered by RBKs and training needs of village agricultural assistants in Guntur district. The Journal of Research ANGRAU.51(1): 152-162

RESEARCH ARTICLE

An economic analysis of production of Bt Cotton in Rangareddy district of Telangana

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ABSTRACT

This study examines the resource use efficiency and cost of cultivation of Bt cotton in Rangareddy district, Telangana, during the 2022-23 agricultural year. The district was purposively selected for its significant area under Bt cotton cultivation. A multistage sampling procedure was employed, with data collected from 90 cotton farmers through personal interviews. The study aims to analyze the resource use efficiency and cost of cultivation in Bt cotton cultivation. The Cobb-Douglas production function was used to estimate the impact of various resources, such as human labor, machinery, fertilizers, farm yard manure (FYM), seeds, and plant protection chemicals (PPC), on gross income. The findings revealed that human labor, fertilizers, and PPC were underutilized, while machinery and seeds were overutilized, indicating the need for better resource management. The average cost of cultivation of Bt cotton was Rs. 44,361.07 per acre, with labor being the largest cost component (43.15% of total costs). The total variable cost was Rs. 33,331.34, and the fixed cost was Rs. 10,010.71. Despite the high cost, the minimum support price (MSP) of Rs. 7000 per quintal was sufficient to cover production costs, with returns per rupee of investment estimated at 1.32. The study recommends improving resource utilization, timely access to quality inputs, and increasing awareness among farmers to enhance productivity and farm income. Additionally, it emphasizes the importance of crop insurance and fair pricing for Bt cotton seeds.

Keywords: Bt cotton, Production function, Agriculture, Telangana

INTRODUCTION

An essential fiber crop of worldwide importance, Cotton (*Gossypium* spp.) is grown in tropical and subtropical climates in over 70 nations worldwide. India is one of the world's major producers of cotton (Satashia *et al.*, 2017)^[5]. The versatile crop known as cotton, the King of Fibers and the White Gold of India, is cultivated in a variety of agroclimatic conditions. It is primarily grown for its lint, which is the most sought-after textile fiber because of its innately comfortable and environmentally favorable

qualities. A significant source of raw materials for the textile industry is cotton (Satashia *et al.*, 2017)^[8].

Cotton pests have been a serious problem in recent years, driving up production costs, increasing crop losses, and lowering farmer revenue and productivity. Cotton pest issues have led to socioeconomic catastrophe. A glimmer of hope for all these diseases, Bt cotton was made available for commercial production in India in 2002. But there was confusion in making inferences on benefits and losses from Bt cotton.

So attempt was made in this paper to assess which resource is effecting the output (Gamanagatti *et al.*, 2013)^[1]. High temperatures, the prevalence of pests and diseases, and inadequate irrigation infrastructure are the main causes of low yields. Lack of information access, insufficient agricultural credit, high input costs (pesticides, fertilizers, seeds, etc.), ignorance of proper agricultural techniques, and adulteration in seeds, fertilizers, and pesticides are other issues restricting production. (Kumar, S *et al.*, 2021)^[3].

For improving agricultural production, seed is a crucial input and dynamic tool. One of the remarkable components behind the green revolution in India and other countries has been this.

The present study was conducted in Rangareddy district of Telangana state. Rangareddy district of Telangana was purposively selected for the study as the district tops in terms of area and production. The goal of the study is to provide a picture of Bt cotton cultivation in Rangareddy district of Telangana. The study was based on primary as well as secondary data with major emphasis on primary data. Multistage sampling procedure was adopted (Reddy, P. S *et al.*, 2020)^[7]. Three Mandals viz., Shankarpally, kandukur and Madgul were selected based on the highest area under Bt cotton cultivation for the present investigation. These data were collected from 90 (ninety) cotton farmers with the help of interview schedule. The reference year of the study was 2022-23 agricultural year (Kumar *et al.*, 2019)^[2]. Labor, seeds, hired labor, bullock labor, working capital, farm equipment and machinery, irrigation systems, manure and fertilizers, and crop protection techniques are the most important inputs in agriculture (Shelke *et al.*, 2016)^[11]. Cost of cultivation was calculated using the cost parameters and also benefit cost ratio, Returns per rupee investment were assessed (Vaidkar *et al.*, 2010)^[12]. The amount of money that farmers make from their farms is influenced by how effectively they can use these resources.

Farmers can increase their income and savings by making better use of the resources (Shankar & Naidu, 2017)^[9]. The cost of farm inputs, variable and fixed costs, gross returns, returns over variable costs, and net returns of cotton growers were all computed independently for each district in order to determine the cost and returns of the cotton crop (Kumar *et al.*, 2023)^[4]. Maximizing output per unit of resource is the definition of resource use efficiency. Productivity and resource allocation are key components of higher agricultural production, and they are related to the management of the farmers who use these resources in their operations. Determining the efficiency of resource utilization is crucial since every agribusiness wants to maximize profit while minimizing costs (Sharma, H. O. *et al.*, 2019)^[10].

The production process that uses the fewest resources to provide a given amount of output is considered efficient. Therefore, a production process is considered technically inefficient if it requires more resources to produce a unit of output than an alternative approach (Nandi *et al.*, 2011)^[6].

In order to know which resource is affecting the total cost more and problems involved in the cultivation, the following objectives were taken under study.

Objectives of the study

1. To analyse the resource use efficiency of Bt cotton
2. to estimate cost of cultivation of Bt cotton

METHODOLOGY

The study was based on primary data. Multistage sampling procedure was adopted. Three Mandals viz., Shankarpally, kandukur and Madgul were selected based on the highest area under Bt cotton cultivation for the present investigation. This data were collected from 90 (ninety) cotton farmers with the help of interview schedule. The reference year of the study was 2022-23 agricultural year. In order to select the

farmers from villages, a complete list of farmers growing Bt cotton from each selected village is made. Accordingly, from each village 10% of cotton grown farmers were selected. Thus, the total sample size was of 90 Bt cotton growers. A personal interview was conducted to collect the primary data.

Functional Analysis

The Cobb-Douglas production function in the current study is represented by the following form.

$$Y = a x_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} x_5^{b_5} x_6^{b_6} e^u$$

Where,

Y = Gross income (Rs)

X1 = Expenditure on seeds (Rs)

X2 = Human Labor expenditure (Rs)

X3 = Machinery expenditure (Rs)

X4 = Expenditure on fertilizers (Rs)

X5 = Expenditure on Farm Yard FYM (FYM) (Rs)

X6 = Expenditure on PPC (Rs)

e = Random-error

b_1 to b_6 = output elasticities of respective variables

The Cobb-Douglas production function was transformed into a log linear form, and the following Ordinary Least Square Technique (OLS) was used to estimate the parameters, or coefficients.

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + u \log e$$

The t test was used to evaluate the regression coefficients, or b_i 's, at the one percent and five percent significance levels.

Resource Use Efficiency

a) Estimation of Marginal value product (MVP)

The MVP is estimated for individual resource and it was compared with marginal cost (MC). When all resources are fixed at their geometric mean level, the marginal productivity of resources represents the addition of the gross value of agricultural produce for each unit

increase in the i th resources.

Using the below formula, the Marginal Value Products (MVP) were computed at the geometric mean levels of the variables.

$$MVP = b_i \frac{\bar{Y}}{\bar{X}}$$

Where,

b_i indicates regression coefficient associated with x_i input,

y indicates geometric mean of output and

x indicates geometric mean of input.

Returns to scale

The criteria that is used to determine optimality of resource is

$MVP/MFC > 1$ underutilization of resource

$MVP/MFC = 1$ optimal use of resource

$MVP/MFC < 1$ excess use of resources.

Cost of Cultivation

The cost of cultivation was estimated with the help of cost concepts. It includes the following.

Cost A1 includes

1. Value of hired human labour.
2. Value of hired and owned animal labour.
3. Value of machine labor, both owned and hired.
4. Value of seeds
5. Value of FYM
6. Value of fertilizers.
7. Depreciation
8. value of plant protection chemicals
9. Interest on working capital.
10. Other expenses.

Cost A2 = cost A1 + rent paid for leased in land

Cost B1 = cost A2 + interest on value of owned capital assets excluding land

Cost B2 = Cost B1 + rental value of owned land + rent for leased in land.

Cost C1 = Cost B1 + imputed value of family labour.

Cost C2 = Cost B2 + imputed value of family labour.

Gross income

$$GI = (Qm \times Pm)$$

Where;

GI = Gross Income

Q_m = Quantity of main product

P_m = Price of main product

Net income (NI)

$NI = GI - \text{Cost } C_2$

Farm business income (FBI)

$FBI = GI - \text{Cost } A_1/A_2$

Returns per rupee (RPR)

$RPR = \text{Gross Income} / \text{Cost } C_2$

Family labour income (FLI) and Farm investment income

$FLI = GI - \text{Cost } B_2$

Farm investment income = FBI - imputed value of family labour

RESULTS AND DISCUSSION

Estimates of Cobb-Douglas Production function coefficients for resource use efficiency in *Bt* cotton production

Sl no.	Explanatory variables	Parameters	Standard error	t Stat
1.	Human labour	X1	0.1126	6.0289 ***
2.	Machinery	X2	0.0308	0.28001 ^{NS}
3.	FYM	X3	0.0501	-0.9976 ^{NS}
4.	Seed	X4	0.0259	-2.0431 **
5.	Fertilizer	X5	0.0853	2.7296 *
6.	PPC	X6	0.1053	1.5911 ^{NS}

Note: *** significant @ 0.1%, ** significant @ 1%, * significant @ 5% level of significance and NS represents Non-Significant. Coefficient of multiple determination (R^2) = 0.962946
Observations = 90 D.F = 89

The variables taken into account have collectively explained that there is 96% variation in the output (dependent variable) due to independent variables. From the above table, it is observed that Human labour, seed and fertilizer were found to be significant at different levels of significance. Human labour

was found to be positively significant at 0.1% level of significance. Seed was found to be negatively significant at one percent level of significance. Fertilizer was found to be positively significant at five percent level of significance. Machinery, FYM and PPC were found to be nonsignificant.

Assessment of resource use efficiency

Sl no.	Explanatory variables	Parameters	Coefficients(bi)	r=MVP/MFC
1.	Human labour	X1	0.6791***	2.2703
2.	Machinery	X2	0.0086	0.2862
3.	FYM	X3	-0.05004	-0.5767
4.	Seed	X4	-0.05291**	-2.0941
5.	Fertilizer	X5	0.2329*	4.3098
6.	PPC	X6	0.1676	1.9542

MVP/MFC > 1: underutilization of resources

MVP/MFC = 1: optimal use of resources

MVP/MFC < 1: over utilization of resources

Cost of cultivation per acre of Bt Cotton

Sl. No.	Particulars	Cost (Rs/acre)	%
I.	Variable cost		
1.	Hired human labour	19142.7	43.15
2.	Family labour	1615.686	3.64
3.	Bullock labour	1289.966	2.91
4.	Machinery	4598.256	10.37
5.	FYM	1000.081	2.25
6.	Seed	1657.996	3.74
7.	Fertilizers	3351.816	7.56
8.	Plant protection chemicals	5266.939	11.87
9.	Other expenses	125.93	0.28
10.	Interest on working @7%	933.278	2.11
	Total variable cost	33331.34	75.14
II.	Fixed cost		
1.	Rental value of owned land	8000.645	18.04
2.	Rent paid for leased in land	741.189	1.67
3.	Depreciation on implements and farm building	661.001	1.49
4.	Interest on fixed capital	607.869	1.37
	Total fixed cost	10,010.705	22.57
III.	Total Cost of cultivation (I + II)	44361.07	100

Cost concept of Bt cotton cultivation per acre

Sl no.	Particulars	Cost (Rs/acre)
1.	Cost A1	34264.61
2.	Cost A2	34388.15
3.	Cost B1	34996.02
4.	Cost B2	42946.76
5.	Cost C1	36611.7
6.	Cost C2	44361.07

Output and returns per acre of Bt cotton

Sl. No	Particulars	Total (Rs)
I.	Returns	
	output (qtls/acre)	8.38
	Cost per quintal	7000
	Gross returns (Rs/acre)	58667.37
	Net returns (Rs/acre)	14306.3
	Cost of production (Rs/q)	5293.68
II.	Returns per rupee of expenditure	1.322

Measures of farm income per acre

Sl.no	Particulars	Farm income in Rs per acre
1	Gross income	58667.37
2	Farm business income	24279.22
3	Family labour income	15720.6
4	Farm investment income	20430.83
5	Net income	14306.3
6	Returns per rupee	1.322

Resource use efficiency of Bt cotton

Among the six parameters the inputs human labour and fertilizer is estimated to be positively significant. Inputs like machinery and PPC are estimated to be positive but non-significant. FYM and seed inputs are found to be negative with non-significance and significance respectively.

In case of human labour r value is

greater than unity. It denotes that it is underutilized. In case of machinery r value is less than unity. It denotes that it is over utilized. Similarly, in case of seed r value is less than unity which implies that the input is over utilized. Inputs like fertilizer and plant protection chemicals have r value greater than unity which implies that they are under-utilized.

Cost of cultivation for Bt cotton

The total cost of cultivation per acre of Bt cotton was, Rs. 44361.07 on an average. Following the breakdown of total cost into variable and fixed costs, variable cost came to Rs. 33331.34 (75.14%) and fixed costs to Rs. 10010.71 (22.57 %). The cost of labour was the largest component of total costs in the production of Bt cotton. The average spending on labour was Rs. 19142.7 per acre, or 43.15 percent of the overall costs. The procurement price of Bt cotton was Rs. 7000 during the year 2022/23 compared to Per quintal production cost of Bt cotton in the study area was Rs. 5293.68, we can notice that the MSP covers the cost of production which is the positive thing. The returns per rupee of expenditure was 1.32. The research results were similar to the study carried out by Satashia maitri et al. (2017)^[8]

SUMMARY AND CONCLUSION

Resource use efficiency of Bt cotton

The findings of the study provide information on resource use efficiency, costs and returns. Human labour, seed and fertilizer were identified as important variables that affected the gross income. Human labour, fertilizer and plant protection chemicals were found to be underutilized which indicates that these resources would increase the output when used in greater quantities. The average total cost of cultivation was found to be Rs 44361.07 per acre. Returns per rupee of investment was estimated to be 1.32. *****

Suggestions

1. For increasing the output of Bt cotton, extension agencies should educate growers about the benefits of using resources effectively and promptly.
2. Human labour, fertilizers, and seeds were the main factors influencing the Bt cotton cultivation. It suggests that these inputs were found to be more significant in the development of Bt cotton. As a result, farmers may be guaranteed a timely supply of these high-quality inputs to increase farm revenue.
3. A fair price for high-quality Bt cotton seeds that boost farm income, must be arranged through institutional channels and made available to farmers.
4. Efforts should be made by government officials and seed companies for awareness and capacity building about effective practices of Bt cotton cultivation.
5. Farmers should purchase inputs on subsidy fixed by the government as it helps them in decreasing the expenditure on inputs thereby increasing the farm income.
6. Farmers should purchase the seed from government agencies rather than local shops. As poor quality of the seeds is affecting the yield thereby reducing the gross income.

Effective implementation of a crop insurance program is required to support farmers in years when crop loss occurs as a result of natural disasters.

REFERENCES

- Gamanagatti, P. B., Dodamani, M. T., & Menasinahal, A. S. (2013). Resource use efficiency in Bt cotton cultivation across different farm size holders in northern transitional zone of Karnataka. *International Research Journal of Agricultural Economics and Statistics*, 4(2), 131-134.

- Kumar, M. A., Dey, G., & Mukhopadhyay, S. (2019). Economics of cultivation of cotton in Adilabad district of Telangana state. *Journal of Pharmacognosy and Phytochemistry*, 8(6), 2037-2041
- Kumar, S., Kumar, N. R., Jain, R., Balaji, S. J., Jhahhria, A., Bangaraju, S., & Awais, M. (2021). Resource use efficiency in cotton production in Palwal district of Haryana. *The Indian Journal of Agricultural Sciences*, 91(9), 1285-89.
- Kumar, V., Goyal, S. K., Ghalawat, S., & Malik, J. S. (2023). Economic Analysis and Resource Use Efficiency of Cotton Production in Haryana. *Indian Journal of Extension Education*, 59(2), 51-54.
- Maitri, S., Pundir, R. S., & Darji, V. B. (2017). An economic analysis and resource use efficiency of Bt-cotton in Middle Gujarat. *Indian Journal of Economics and Development*, 13(4), 669-676.
- Nandi, J. A., Yurkushi, E. N., & Ashiko, T. G. (2011). Resource Use Efficiency Among Ginger Farmers in Kaduna State, Nigeria. *Journal of Agricultural Forestry and the Social Sciences (JOAFSS)*; 9(1), 110, 1.
- Reddy, P. S., Kumari, R. V., Baba, M. M., & Chary, D. S. (2020). Economic analysis Of Bt cotton cultivation In Warangal district Of Telangana state. *Multilogic in Science*, 10(35), 1122-1127.

RESEARCH ARTICLE

Adoption behaviour and constraints of soybean growers about use of integrated nutrient management practices

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ABSTRACT

The present investigation was conducted in purposively selected Latur district of Maharashtra state with study sample of 120 soybean growers 12 villages by using ex post facto research design. Regarding adoption of INM practices it was found that, highest of the soybean growers (55.83%) belonged to medium adoption category followed by low (29.16%) and high (15.00%) adoption category. The significant constraints faced by soybean growers in the adoption of INM practices were lack of technical skills about use of INM practices (62.50%) followed by high cost of chemical fertilizers (60.00%), non availability of bio-fertilizers at proper time (50.00%), non availability of labours and high wages of labours for manuring (45.83%), lack of technical knowledge about INM practices so they have problems to adopt the INM practices (44.17%), being a small farmer the applicability of Integrated Nutrient Management technologies on own field was not feasible (43.33%), non availability of chemical fertilizers at proper time (39.17%) and non availability of manures (35.83%). Regarding suggestions given by soybean growers to overcome these constraints includes majority of the soybean growers (65.00%) suggested to organize training programme on INM in Soybean during sowing period followed by bio-fertilizers, micronutrients and fertilizers should be provided on subsidiary rates (60.00%), bio-fertilizers should be made available easily during sowing period (50.00%) and INM related literature should be provided by the extension agency (44.17%).

(Keywords – constraints, suggestions, Integrated Nutrient Management practices, Soybean growersAdoption,).

INTRODUCTION

Soybean (*Glycine max* L. Merrill.) is known as Chinese pea or Manchurian bean which belongs to family leguminaceae. In India from last few years processing and value addition trading in Soybean had brought the revolution in rural economy. Soybean has vital importance in Indian agriculture hence it plays a decisive role in oil economy of India. It is the cheapest and main source of dietary protein of majority vegetarian Indians. Soybean seed consists of 20 per cent oil and 42 per cent protein.

In recent years, a concept of integrated

nutrient supply involving use of organic manures and inorganic fertilizers has been developed to obtain sustained agricultural production (Gaikwad and Puranik, 1996). Integration of organic and inorganic sources of nutrients along with bio fertilizers is found to give higher productivity and monetary returns in soybean (Singh and Rai, 2004; Bhattacharyya *et al.*, 2008). Further the organic sources unlike inorganic ones have substantial residual effect on succeeding crops (Duraismi and Mani, 2001; Shivakumar and Ahlawat, 2008). Integrated nutrient management (INM) involves the use of

manures, bio fertilizers and chemical fertilizers to achieve crop production and maintain better soil health. INM is the best approach for better utilization of resources and to produce crops with less expenditure. Despite the importance of the crop in the world as a rich source of protein and oil, the yield is generally very low in Maharashtra that is below one tone per hectare as compared to the USA and Asian soybean producing countries. Poor soil fertility status is considered as one of the factor contributing to low yield. Nitrogen (N) and Phosphorus (P) are becoming most deficient in many soil types including those in Maharashtra. The study monitored by FAO in 38 sub-Saharan Asian countries, including Maharashtra showed that there are high nutrient depletion rates in N, P and potassium in different farming systems (Stoorvogel *et al.* 1993). To address this deficiency, farmers in Maharashtra have used the uniform blanket application of 100 kg Diammonium phosphate (DAP) ha⁻¹ for all leguminous crops including soybean. However, this did not result in any significant difference in soybean yields. Moreover, the utilization efficiency of phosphatic fertilizers by plants is only 20 to 25 per cent largely due to its chemical fixation in soil (Hedley and William, 1995). Unbalanced use of chemical fertilizers had led to a reduction in soil fertility and to environmental degradation and the cost of chemical fertilizer has increased (Gyaneshwar *et al.* 1998). The present study has been carried out with the specific objectives.

1. To study the adoption of INM practices followed by soybean growers.
2. To identify the constraints faced by the soybean growers in adoption of INM practices and to invite suggestions to overcome it.

METHODOLOGY

The present study entitled "Adoption of Integrated Nutrient Management Practices among Soybean Growers was conducted in the purposively selected Latur district of

Maharashtra. From Latur district Ausa, Ahmadpur and Latur tahsils were selected purposively on the basis of maximum cultivation area under soybean crop. In each of the designated tahsils, four villages were selected randomly from a list of villages. In all, 12 villages were picked for the study. Ten soybean growers were randomly selected from each of the identified villages as respondents in the current study. As a result, 120 soybean growers in all were constitute the study sample. The simple statistical tools mean, standard deviation, frequency and percentage were used for analyzing the data.

RESULTS AND DISCUSSION

1. Adoption of INM practices by soybean growers.

Distribution of soybean growers according to their INM practice wise adoption illustrated in Table 1 showed that, the practice of soil testing (to know the nutrient level in soil) was completely adopted by 40.00 per cent of soybean growers and equal per cent of soybean growers (30.00%) partially adopted and not adopted this practice.

Result from Table 1 cleared that, 38.33 per cent of soybean growers had adopted the application of FYM (5 to 10 t/ha) followed by 32.50 per cent of them had not adopted and 29.16 per cent of soybean growers partially adopted this practice.

In case of time of application of FYM (30 to 45 days before sowing) from Table 1 showed that, 36.66 per cent soybean growers completely adopted FYM application at recommended time and 35.00 per cent of soybean growers partially adopted this practice. While only 28.33 per cent of them not adopted this practice.

Result regarding the distribution of soybean growers according to their adoption of INM practices from Table 1 revealed that, the practice of application of compost (5 to 10 t/ha) was partially adopted by 38.33 per cent soybean growers followed by 31.66 per cent of them not

adopted and only 30.00 per cent of soybean growers had completely adopted this practice.

In case of time of application of compost (30 to 45 days before sowing) 37.50 per cent soybean growers partially adopted compost

application at recommended time and 31.66 per cent of soybean growers not adopted this practice. While only 30.83 per cent of them completely adopted this practice.

Table 1: Distribution of soybean growers according to their INM practice wise adoption

(n=120)

Sr. No.	Statements	Full		Adoption		No	
		Freq.	Per Cent	Freq.	Per Cent	Freq.	Per Cent
1.	Soil testing (To know the nutrient level in soil)	48	40.00	36	30.00	36	30.00
2.	FYM Application (5 to 10 t/ha)	46	38.33	35	29.16	39	32.50
3.	Time of application of FYM (30 to 45 days before sowing)	44	36.66	42	35.00	34	28.33
4.	Application of compost (5 to 10 t/ha)	36	30.00	46	38.33	38	31.66
5.	Time of application of compost (30 to 45 days before sowing)	37	30.83	45	37.50	38	31.66
6.	Application of green manuring crop (Dhaincha, Sunhemp @5 t/ha)	40	33.33	39	32.50	41	34.16
7.	Time of application of green leaf manure (before sowing)	21	17.50	43	35.83	56	46.66
8.	Seed treatment with biofertilizers (before sowing)						
	a) Rhizobium japonicum (250 g/10 kg seeds)	56	46.66	17	14.16	47	39.16
	b) Phosphate Solubilizing bacteria (250 gm/10 kg seed)	32	26.66	38	31.66	50	41.66
9.	Recommended dose of NPK/hectare						
	a) Nitrogen - 30kg	38	31.66	62	51.66	20	16.66
	b) Phosphorus- 60kg	40	33.33	46	38.33	34	28.33
	c) Potassium- 30kg	32	26.66	52	43.33	36	30.00
10	Recommended time of NPK application (Full dose of NPK should be applied at the time of sowing as a basal dose)	47	39.16	28	23.33	45	37.50
11	Application of sulphur @ 30kg/ha	24	20.00	63	52.50	33	27.50
12	Time of application of Sulphur fertilizers (At the time of Sowing)	32	26.66	46	38.33	42	35.00
13	Application of Zink Sulphate @ 25kg/ha	51	42.50	31	25.83	38	31.66
14	Application of Borax @ 10 Kg/ha.	52	43.33	28	23.33	40	33.33

The practice of application of green manuring crop (Dhaincha, Sunhemp @ 5t/ha) it was not adopted by 34.16 per cent of soybean growers followed by 33.33 per cent of soybean growers completely adopted and 32.50 per cent of soybean growers partially adopted this practice at their farm.

In case of time of application of green

followed by 30.00 per cent of them had not adopted and only 26.66 per cent of soybean growers had completely adopted this practice.

In case of recommended time for application of NPK (full dose of NPK at the time of sowing) 39.16 per cent of soybean growers completely adopted application of NPK at recommended time and 37.50 per cent of soybean

growers not adopted this practice. While only 23.33 per cent of them partially adopted this practice.

The practice of application sulphur (30 Kg/ha) was partially adopted by more than half of soybean growers (52.50%) followed by 27.50 per cent of soybean growers not adopted this practice, while only 20.00 per cent of them fully adopted the practice of application of sulphur in their farm of soybean.

In case of time of application of sulphur (at the time of sowing) 38.33 per cent soybean growers partially adopted at recommended time and 35.00 per cent of soybean growers not adopted this practice. While only 26.66 per cent of them completely adopted this practice.

Result regarding the distribution of

soybean growers according to their adoption of INM practices from Table 1 showed that, the practice of application of zink sulphate (25 Kg/ha) was completely adopted by 42.50 per cent soybean growers followed by 31.66 per cent of them not adopted and only 25.83 per cent of soybean growers had partially adopted this practice.

Result regarding the distribution of soybean growers according to their adoption of INM practices from Table 1 revealed that, the practice of application of Borax (10 Kg/ha) was completely adopted by 43.33 per cent soybean growers followed by 33.33 per cent of them not adopted and only 23.33 per cent of soybean growers had partially adopted this practice.

Table 2: Distribution of soybean growers according to their overall adoption of INM practices. (n=120)

Sr. No.	Category	Frequency	Percentage
1	Low (Up to 28)	35	29.16
2	Medium (29 to 39)	67	55.83
3	High (Above 39)	18	15.00
	Total	120	100.00

The information in Table 2 revealed that, highest of the soybean growers (55.83%) belonged to medium adoption category followed by 29.16 per cent of the soybean growers belonged to low adoption and only 15.00 per cent of the soybean growers belonged to high adoption category of INM practices. The majority of the soybean growers clearly exhibited a medium level of adoption.

The findings are in line with those reported by Tankodara (2019) and Todkar

(2020).

2. Constraints faced by soybean growers in adoption of INM practices and their suggestions to overcome constraints

2.1 Constraints faced by soybean growers in adoption of INM practices

During the course of investigation, various constraints faced by the soybean growers while adoption of INM practices were collected and presented in Table 3.

Table 3: Distribution of soybean growers according to constraints faced by them in adoption of INM practices (n=120)

Sr.No.	Constraints	Frequency	Per cent	Rank
1.	High cost of chemical fertilizers	72	60.00	II
2.	Non availability of manures	43	35.83	VIII

Sr. No.	Constraints	Frequency	Per cent	Rank
3.	Non availability of chemical fertilizers at proper time	47	39.17	VII
4.	Non availability of biofertilizers at proper time	60	50.00	III
5.	Lack of technical knowledge about INM practices	53	44.17	V
6.	Lack of technical skills about use of INM practices	75	62.50	I
7.	Non availability and high wages of labors	55	45.83	IV
8.	Being a small farmer the applicability of Integrated Nutrient Management technologies on own field is not feasible	52	43.33	VI
9.	Other constraints	312	5.83	IX

The information in the Table 3 show that, the significant constraints faced by soybean growers in the adoption of INM practices were lack of technical skills about use of INM practices (62.50%) while 60.00 per cent of soybean growers faced the constraint of high cost of chemical fertilizers followed by half of the soybean growers (50.00%) faced constraint of non availability of bio-fertilizers at proper time. Near about half of soybean growers (45.83%) mentioned that, labors were unavailable and wages were also high, while 44.17 per cent of soybean growers were lacking about technical knowledge of INM practices so they have limitations to adopt the INM practices.

Being a small farmer, 43.33 per cent of soybean growers mentioned that, applicability of Integrated Nutrient Management technologies on owns field was not feasible, while 39.17 per

cent of them faced the constraint of non availability of chemical fertilizers at proper time.

In case of availability of resources, 35.83 per cent of soybean growers faced the problem of non availability of manures. Furthermore around one-fourth soybean growers (25.83%) faced the other constraints which includes sometimes available fertilizers were adulterated, weak linkages with extension personnel for seeking advice regarding the use of INM practices, inadequate demonstrations on INM practices and uncertainties about the outcomes of adoption of INM practices.

2.2 Suggestions given by soybean growers to overcome the constraints faced by them

Various suggestions were invited from soybean growers to overcome the constraints faced by them in adoption of INM practices and presented in Table 4.

Table 4 : Suggestions given by soybean growers to overcome the constraints faced by them in the adoption INM practices (n=120)

Sr. No	Suggestions	Frequency	Per cent	Rank
1	Training programme on INM in Soybean should be organized prior to sowing period	78	65.00	I
2	Bio-fertilizers should be made available easily during sowing period	60	50.00	III
3	Bio-fertilizers, micronutrients and fertilizers should be provided on subsidiary rates	72	60.00	II
4	Soybean INM related literature should be provided by the extension agency	53	44.17	IV
5	Other suggestions	37	30.83	V

Table 4 reported suggestions given by soybean growers in order to overcome the constraints faced in adoption of INM practices by the soybean growers. The data revealed that around two-third of the soybean growers (65.00%) suggested that training programme on INM in Soybean should be organized during sowing period followed by 60.00 per cent of soybean growers suggested that bio-fertilizers, micronutrients and fertilizers should be provided on subsidiary rates.

In case of resource availability, half of the soybean growers (50.00%) suggested that bio-fertilizers should be made available easily during sowing period while, 44.17 per cent of them said that soybean INM related literature should be provided by the extension agency. Furthermore 30.83 per cent soybean growers given other suggestions which include demonstrations on INM practices should be organised, publicity should be given through success stories and case studies of farmers who have effectively implemented INM practices to showcase its advantages and government should be foster collaborations between farmers, agricultural experts, researchers and government agencies to promote INM practices collectively.

CONCLUSION

The study indicated that, highest of the soybean growers (55.83%) belonged to medium adoption category followed by 29.16 per cent of the soybean growers belonged to low adoption and only 15.00 per cent of the soybean growers belonged to high adoption category of INM practices.

The major constraints faced by soybean growers in the adoption of INM practices were lack of technical skills about use of INM practices, high cost of chemical fertilizers, non-availability of bio-fertilizers at proper time. Majority of the soybean growers suggested that training programme on INM in Soybean should be organized during sowing period followed by bio-fertilizer, micro nutrient and fertilizers

should be provided on subsidiary rates.

REFERENCES

- Bhattacharyya, R., S. Kundu, R. Prakash and H.S. Gupta. 2008. Sustainability under combined application of mineral and organic fertilizers in a rainfed soybean-wheat system of the Indian Himalayas. *European Journal of Agronomy*, 28(1): 33-46.
- Duraisami, V.P. and A.K. Mani. 2001. Residual effect of inorganic nitrogen, composted coir pith and biofertilizer on yield and uptake of soybean in on inceptisol. *Madras Agricultural Journal*, 88(4/6): 277-280.
- Gaikwad, S.S. and R.B. Puranik. 1996. Effect of pressmud cake (PMC) and fertilizer on the yield and uptake of secondary nutrients by soybean (*Glycine max* L.) in entisol. *J. Soils and Crops* 6 (2): 190-193.
- Gyaneshwar, P., P.S. Poole and G. Naresh Kumar 1998. Role of soil microorganisms improving P nutrition of plants. *Plant soil*, 245:83-93.
- Hedley, and S. William 1995. Application to the biogeochemical cycle of soil phosphorus in natural ecosystems. *Geoderma* 64(3-4):197-214.
- Shivakumar, B.G. and I.P.S. Ahlawat. 2008. Integrated nutrient management in soybean (*Glycine max*) - wheat (*Triticum aestivum*) cropping system. *Indian Journal of Agronomy* 53(4): 273-278.
- Singh, R. and R.K. Rai. 2004. Yield attributes, yield and quality of soybean (*Glycine max*) as influenced by integrated nutrient management. *Indian Journal of Agronomy* 49(4): 271-274.
- Stoorvogel, J.J., E.M.A. Smaling, and P.N. Windmeijer. 1993. Calculating soil nutrient balance in Africa at different scales. *Fertilizer Res.*, Vol.35, Issue 3, 237-250.
- Tankodara, K.D. 2019. Knowledge and adoption of farmers about chickpea production technology in Junagadh district. M.Sc. (Agri.) Thesis. Anand Agricultural University, Anand.
- Todkar, A.M. 2020. Knowledge and adoption of *Bt* cotton growers for control of pink bollworm M.Sc. (Agri.) Thesis. VNМКV, Parbhani.

RESEARCH ARTICLE**Impact of shifts in cropping pattern on socioeconomic conditions of farmer****Vidya Pardhi¹, Swati Khandave² and K. V. Gurav³**

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ABSTRACT

The present research was conducted to study the profile of respondents and impact of shifts in cropping pattern on socioeconomic conditions of farmers. It was conducted in Khed tehsil of Pune district of Maharashtra state. Both primary and secondary data were used for obtaining findings. The results of study revealed that nearly half (49.33 %) were middle age category, 34.66 % farmers had completed primary education, 40.66 % farmers had 'Agriculture+dairy' as their occupation for live hood, more than half (54.66 %) farmers had medium level of experience from 20 to 26 years, 44.67 % respondents were small farmers had possessed land holding from 1 ha to 2 ha, however, 67.33 % respondents had earned medium level of income from Rs.70,560 to Rs.1,45,441.

The impact of study revealed that 68.67 per cent of farmers bought new livestock, 68.00 per cent farmers dugged new wells/bores, and 62.00 per cent of farmers improved their existing land due to shift in cropping pattern. On home front, 84.00 per cent respondents started using LPG gas, while 82.00 per cent of respondents had got access to clean drinking water. The study further stated that ,80.00 per cent started more spending on food and nutrition for the family,8.67 percent farmers purchased 'smart T.V.'and 85.53 per cent farmers purchased 'android phones'. It enabled them to repay their old loans (70.67 per cent) , 48.67 per cent had increased savings/deposits and 43.33 per cent of invested their money in other enterprises.

The present study concluded that education, occupation, work experience, annual income are the determining factors for changing cropping pattern. It has shown impact on economic aspects, farm assets followed by health, education status of respondents.

INTRODUCTION

In India, agriculture and other agro-based sectors are having largest source of livelihoods in India. Nearly 70 per cent rural households depend on agriculture (FAO,2018). The proportion of area under various crops at a point of time as it changes over space and time is called cropping pattern. The study of cropping pattern is very important because it provide evidences about the changes that are taking place in land use related to agriculture. The cropping pattern studied on two basis 1) Shifts 2) Deviations. Shift in cropping pattern means change in sequence of crops over a period of time.

Deviations in cropping pattern means change in area allocated under different crops (Chavare,2020).

Cropping pattern plays deciding role in socioeconomic conditions of farmer. Change in cropping pattern and sequence from traditional cropping to commercial cropping leads to improve socioeconomic conditions of farmer.

n attempt was made to study socioeconomic profile of farmer and to assess impact of shifts in cropping pattern on socioeconomic conditions of farmer

METHODOLOGY

For the present research, Khed tehsil in Pune district was purposively selected for sampling procedure as it was adjacent tehsil of Pune city and major part of tehsil comes under Chakan and Moshi industrial area. Due to industrialization, urbanization, it is noticed that there is predominant change in area, production and productivity of various crops.

Considering this background, from Khed tehsil, 15 villages were purposively selected, 10 respondents from each selected village was randomly drawn by proportional sampling technique. Data was collected and analysed with help of statistical tools like mean, percentage and standard deviation to obtain results.

RESULTS AND DISCUSSION

Socioeconomic profile of farmer

Table 1. Socioeconomic characteristics of the respondents

Sr.	Category	Frequency	Percentage
1.	Age		
1	Young (Up to 35 years)	14	9.33
2	Middle (36-55 years)	74	49.33
3	Old(56years and above)	62	41.33
2.	Education		
1	Illiterate	21	14.00
2	Primary Education	52	34.66
3	Middle School	43	28.67
4	Secondary Education	34	22.67
3.	Occupation		
1.	Agriculture	54	36.00
2	Agriculture + Dairy	61	40.66
3	Agriculture + Horticulture	16	10.67
4	Agriculture + Poultry	19	12.67
4.	Work Experience		
1	Low	31	20.67
2	Medium	82	54.66
3	High	37	24.67
5.	Size of land holding		
1	Marginal	10	06.67
2	Small	67	44.67
3	Semi-medium	47	31.33
4	Medium	26	17.33
6.	Annual Income		
1	Low	29	19.33
2	Medium	101	67.33
3	High	20	12.66

Data presented in Table 1 regarding socioeconomic characteristics of respondents stated

That nearly half (49.33 %) were middle age category, 34.66 % farmers had completed primary education, 40.66 % farmers had 'Agriculture+dairy' as their occupation for live hood, more than half (54.66 %) farmers had medium level of experience from 20 to 26 years, 44.67 % respondents were small farmers had possessed land holding from 1 ha to 2 ha, however, 67.33 % respondents had earned medium level of income from Rs.70,560 to Rs.1,45,441.

Impact of shifts in cropping pattern on socioeconomic conditions of farmer

Socioeconomic impact refers to the improvements in living conditions and standards of farmer due to change in cropping pattern by farmer. For this, improvements are categorized as the improvements occurred on household, on material possession, on health and spiritual changes, and economical changes. Also per cent change was calculated for each aspect over the period of time and mentioned in

parenthesis.

Data in Table 2 represents impact on socioeconomic conditions of respondents due to change in cropping pattern. On farm change, 68.67 per cent farmers bought new livestock which complementary to farming, while 68.00 per cent farmers dugged new wells/bores for irrigation need of farms, followed by 62.00 per cent of farmers improved their existing land. On home front, more than four fifth of respondents (84.00 per cent) started using LPG gas, while 82.00 per cent of respondents had access to drinking water at homes followed by 72.00 per cent of farmers had access to toilets and less than one half of respondents (42.67 per cent) modified/constructed new homes. (K C Gummagolmath, 2020 and Sajithi, 2017).

As improving living conditions, majority of respondents (80.00 per cent) started more spending on food and nutrition for the family, while 67.33 per cent of farmers spends more on clothing. 48.00 per cent of farmers agreed to notion 'provide higher education to their Table 2. Socioeconomic impact on respondent due to change in cropping pattern (n=150)

Sr. No.	Major aspects	Particulars	Before change in cropping pattern(f)	per cent	After change in cropping pattern(f)	per cent
1	Household	Modifications on existing home	33	22.00	64	42.67 (+20.67)
		Access to toilets	41	27.33	108	72.00 (+44.67)
		Drinking water in their homes	27	18.00	123	82.00 (+64.00)
		Started using LPG Gas	24	16.00	126	84.00 (+58.00)

Sr. No.	Major aspects	Particulars	Before change in cropping pattern(f)	per cent	After change in cropping pattern(f)	per cent
2	Material possession	Purchase of jewels	36	24.00	98	65.33 (+40.66)
		Purchase of vehicles	67	44.67	66	44.00 (-00.67)
		Purchase of laptops and other advanced tools	28	18.67	122	81.33 (+69.66)
3	Health, Educational Spiritual aspects	Purchase of Smart T.V.	17	11.33	113	75.33 (+64.00)
		purchase of android phones	22	14.67	128	85.33 (+70.66)
		provide higher education to children	51	34.00	72	48.00 (+12.00)
		Better health care	44	29.33	101	67.333 (+38.00)
		Spent more on food / clothing	30	40.00	120	80.00 (+40.00)
4	Farm assets	Pilgrimage visits of family	29	19.33	54	36.00 (+16.66)
		Purchase of new land	29	19.33	71	47.33 (+28.00)
		Existing land improvement	48	32.00	93	62.00 (+30.00)
		Dug new well/bore	48	32.00	102	68.00 (+36.00)
5	Economical aspects	Purchase of new farm implements	47	31.33	82	54.67 (+23.34)
		Purchase of new tractor	31	20.67	65	43.33 (+20.66)
		Purchase of livestock	47	31.33	103	68.67 (+37.34)
		Repaid old loans	41	27.33	106	70.67 (+43.34)
		Increased savings/deposits	51	34.00	73	48.67 (+14.67)
		Invested money on other enterprises	34	22.67	65	43.33 (+20.66)

Children', and less than two fifth of respondents (36.00 per cent) agreed to 'more pilgrimage visits'.

In economic sphere, as farmers changing living conditions, slightly more than seventy per cent of respondents (70.67

per cent) repaid their old loans, followed by up to one half of respondents (48.67 per cent) had increased savings/deposits and 43.33 per cent of invested their money in other enterprises.

CONCLUSION

The present study concluded that education, occupation, work experience, annual income are the determining factors for changing cropping pattern. It can be concluded that shift in cropping pattern has shown impact on economic aspects, farm assets followed by health, education and spiritual aspects of respondents. This might help to mitigate risks due to climate change and thereby improve farmers livelihood.

REFERENCES

- Mulani, S.M., Ghadge, V.G., Chavare, S. (2020). Cropping pattern analysis of sangola district, tehsil 'Akshar waghmal'—UGC approved.
- International research journal –ISSN 2229-4929
- Gummagolmath K.C., Bhawar R.S., Ramya Lakshmi S.B. and Patra P (2020) .Impact of Crop Diversification on Farmers Socio-economic Conditions of the Farmers: A Case of Himachal Pradesh. Res. Jr. of Agril. Sci. 11(1): 137-143
- Food and Agriculture Organization of the United Nations (2018). The future of food and agriculture. Alternative pathways to 2050, FAO, FAO, Rome.
- Sanjithi S.A. (2017) Food for survival. Cropping with growing food insecurity: A daunting challenge. SDPI (Sustainable Development Policy Institute). Research & News, Bulletin. Vol. 17 (2).

RESEARCH ARTICLE

Attitude and engagement with ICT tools among postgraduate agricultural students: A contemporary perspective for State Agricultural Universities of Maharashtra and Chhattisgarh

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ABSTRACT

In the contemporary context of agricultural education, Information and Communication Technology (ICT) has emerged as a pivotal tool for learning, research, and extension. However, the effectiveness of ICT integration is not solely dependent on infrastructural availability, but is greatly influenced by the attitude and behavioural orientation of its users. The present study was conducted to assess the extent of internet resource usage and the attitude of postgraduate agricultural students towards ICT tools. A sample of 179 students from Dr. PDKV, Akola and IGKV, Raipur was selected, and data were collected using a structured schedule. The findings revealed that a majority of students (67.59%) had a medium level of internet usage, followed by 16.76 per cent with a high level and 15.65 per cent with a low level of usage. Further, attitude assessment showed that the majority (82.12%) exhibited a favourable attitude, while 10.62 per cent had a more favourable and 7.26 per cent had a less favourable attitude towards ICT tools. These findings indicate a near-normal distribution of responses and suggest a positive yet improvable engagement with ICT. Supporting literature and previous studies both corroborated and contradicted these results, reflecting changing trends in ICT adoption across time and institutions. The study highlights the need to strengthen digital infrastructure, training, and relevance of ICT content to enhance student engagement and move them toward a more favourable and productive use of digital tools in agricultural education.

INTRODUCTION

In the contemporary landscape, Information and Communication Technology (ICT) has continued to transform sectors such as education, agriculture, and governance. In agricultural education, ICT is increasingly regarded as a pivotal resource for disseminating knowledge, enhancing technical competencies, and promoting digital literacy among students (Chandio et al., 2007). However, the mere presence of ICT infrastructure does not guarantee effective utilisation; rather, student attitudes and behavioural orientations significantly influence the depth and quality of ICT engagement (Raksha

et al., 2012).

Postgraduate students in agriculture are integral to applied research and extension services. Their attitude toward ICT tools is inherently tied to both their academic performance and the readiness of the agricultural education system to meet the evolving needs of digital agriculture. Therefore, an investigation into the attitude and usage patterns of ICT among these students holds great significance. Previous research has reported varied findings: Apuke and Iyendo (2018) observed a moderately favourable ICT attitude among Nigerian agricultural students, while Sharma (2018) highlighted

limited exposure and reluctance among Indian counterparts. Conversely, studies by Thakur (2017) and Daza et al. (2021) revealed a majority exhibiting highly favourable dispositions and frequent use of educational portals and agricultural databases.

More recent investigations corroborate and expand upon these earlier findings. A 2023 study in Tamil Nadu reported that nearly 70% of farm youth held a favourable attitude toward ICT tools, whereas only a minority displayed less favourable dispositions (Dhanush et al., 2023). Similarly, Singh and Jahanara (2023) found that among UP's potato farmers, over 48% exhibited medium levels of knowledge regarding ICT tools, with positive correlations between education, income, and ICT adoption. Moreover, Mukherjee et al. (2022) identified significant differences in farmers' attitudes toward ICT-based extension services in West Bengal, driven by factors such as income, ICT ownership, and information-seeking behaviour.

Beyond rural farmers, the attitudes of agriculture university students toward e-resources have also been examined. A statewide study in Uttar Pradesh (Asha et al., 2023) revealed that a majority displayed a medium level of positive attitude, emphasising the perceived benefit of e-resources for global knowledge updating. These findings suggest that although familiarity with ICT is rising, its effective use still relies on complementary elements such as timely training and infrastructural support.

In light of this evidence, the present study was undertaken to comprehensively assess the extent of Internet-based ICT usage, subject-specific engagement, and attitudinal orientation among postgraduate agricultural students. This study aims to determine not only how frequently students access ICT tools, but also their purpose of use—academic versus non-academic—thereby providing a nuanced assessment of their digital readiness.

METHODOLOGY

The study was conducted among postgraduate students from two agricultural universities: Dr PDKV, Akola (Maharashtra) and IGKV, Raipur (Chhattisgarh). A structured interview schedule was developed to gather data related to internet usage and attitude toward ICT tools. The extent of internet usage was assessed by asking students to respond to a list of commonly accessed websites using a binary scale (Yes/No). The total number of positive responses was summed to classify students into low, medium, and high categories.

To measure attitude towards ICT, the attitude scale developed by Raksha et al. (2012) was employed. Based on cumulative scores, students were categorised into three groups: less favourable, favourable, and more favourable. Descriptive statistics such as frequency, percentage, mean (ΣX), and standard deviation (σ) were used for analysis.

RESULTS AND DISCUSSION

1. Independent variables

The comparative analysis between Akola and Raipur districts revealed minimal yet notable differences across key ICT-related variables. Respondents from Raipur reported higher annual family income (₹349305.36) and expenditure (₹59497.47) than their counterparts in Akola (₹245940.48 and ₹49932.90, respectively). Mass media exposure and awareness sources were higher in Raipur, indicating better information access. However, Akola respondents demonstrated greater purposeful time expenditure (4.62 hrs) and higher engagement in interactive applications (8.42), while Raipur showed slightly more participation in webinars (8.12).

Knowledge levels were comparable in both districts, though Akola showed higher subject exploration on the internet (21.43 vs 20.08). Accessibility was better in Raipur (13.07), yet possession of ICT tools was higher in Akola (4.55), suggesting a reliance on shared or institutional access in Raipur. Connectivity remained uniform (~8.3), and perceived effectiveness of ICT tools was

slightly higher in Raipur. Attitude towards ICT remained consistent across both locations (~56.67), while Akola reported a relatively higher extent of ICT utilization (181.61 vs 176.09), indicating more

intensive usage despite lesser income and access. These findings highlight that, beyond economic factors, individual engagement and tool possession significantly influence ICT utilization.

Table 1. Description of the independent variables

Sr. No.	Independent variables	Mean values for Akola	Mean values for Raipur	SD values for Akola	SD values for Raipur
1.	Family annual income	245940.48	349305.36	279021.282	297920.764
2.	Annual expenditure pattern	49932.90	59497.47	67453.485	45534.049
3.	Source of awareness	2.04	2.14	1.156	0.963
4.	Mass media exposure	16.96	17.28	3.198	3.469
5.	Knowledge about ICT tools	20.45	20.67	3.688	4.401
6.	Purpose time expenditure	4.62	4.43	0.710	0.953
7.	Interactive applications used	8.42	7.40	1.934	1.771
8.	Participation in Webinar	7.86	8.12	1.530	1.515
9.	Websites visited on the internet	13.14	13.51	3.113	3.145
10.	Subjects browsed on internet	21.43	20.08	5.140	5.609
11.	Accessibility of the ICT tools	12.42	13.07	2.880	2.714
12.	Possession of the ICT tools	4.55	4.21	1.321	1.536
13.	Internet connectivity	8.32	8.28	0.853	0.907
14.	Effectiveness of ICT tools	29.88	30.09	4.031	4.638
15.	Attitude towards ICT tools	56.68	56.67	4.951	6.305
16.	Extent of utilization of ICT tools	181.61	176.09	15.415	17.540

2. Extent of Usage of Internet Resources

The students were provided with the names of various websites generally used by students daily. They were asked to respond on a two-point continuum with options yes and no. According to their summation of the positive responses, the extent of usage of the internet resources was calculated. Based on their responses, they were distributed as presented in Table 1. It can be observed from the data that out of the 179 respondents majority of students (67.59 %) had a medium extent of usage of the internet resources, followed by 16.76 per cent of students with a higher extent of usage of the internet resources While, 15.65 per cent of students with a low extent of usage of the internet resources.

The data presented for Dr PDKV, Akola and IGKV, Raipur revealed that in Akola majority of students (70.24%) possessed a medium extent of usage of the internet resources,

followed by 16.67 per cent of students with a lower extent of usage of the internet resources and 13.09 per cent of students had a high extent of usage of the internet resources. While in Raipur majority of students, 65.27 per cent, possessed a medium extent of usage of the internet resources, followed by 20.00 per cent of students with a higher extent of usage of the internet resources, while only 14.73 per cent of students with a low extent of usage of the internet resources.

It could be inferred that the data followed a near-normal distribution with a large amount of data congregating near the mean value. This also sheds light on the fact that there is a need to improve the usage of internet resources in terms of quality and quantity.

The results so obtained were in line with outcomes from Mulimani et al. (2008), Chandrakar (2014), Thakur (2017), Ugwulebo et al. (2017) and Kadam et al. (2018), Apuke and

Iyendo (2018), who included a few of the websites included in the present study. They had similar findings suggesting that the usage of

those internet resources has been similar in the last few years. The results so obtained were not in alignment with the research by Hema (2020).

Table 2: Distribution of agricultural postgraduate students according to their extent of usage of internet resources

Sr. No	Extent of usage of internet resources	Dr PDKV, Akola		IGKV, Raipur		Total	
		F (n=84)	%	F (n=95)	%	F (n=179)	%
1.	Low (Up to 9 score)	14	16.67	14	14.73	28	15.65
2.	Medium (10-16 score)	59	70.24	62	65.27	121	67.59
3.	High (More than 16 score)	11	13.09	19	20.00	30	16.76
	Bold $\bar{X} = 13.34$ = 3.13						

3. Attitude Towards ICT

The attitude is a disposition towards an individual, object or idea. It was studied for the students with respect to ICT tools to gain a deeper insight into the psychological inclination of the students towards the ICT tools. This would facilitate the development of the techniques or activities leading to a more comfortable mental condition concerning the ICT tools. Following the scale developed by Raksha et al. (2012) individual score for the attitude was calculated. On that basis, students were classified as depicted in Table 2.

It can be observed from the data that out of the 179 respondent's majority of students (82.12%) possessed a favorable attitude, followed by 10.62 per cent of students with a more favourable attitude, while only 7.26 per cent of students had with less favourable attitude.

The data presented for Dr PDKV, Akola and IGKV, Raipur revealed that in Akola, the majority of students (86.90%) possessed a favourable attitude, followed by 8.34 per cent of students with a more favourable attitude. While only 4.76 per cent of students have with less favourable attitude. In Raipur majority of students, 77.89 per cent, possessed a favourable attitude, followed by 12.64 per cent of students with a more favourable attitude and only 9.47 per cent of students with a less favourable attitude.

It could be inferred that the data

followed a near-normal distribution with a large amount of data congregating near the mean value. This suggests that a large number of students had a favourable attitude. With this level of attitude, certain activities should be carried out to push their limits, leading to a more favourable attitude of the students towards ICT tools, leading to a more positive utilisation of ICT tools. Moreover, the factors leading to a negative disposition should be removed or reduced to an optimum for reducing dissonance and increasing satisfaction.

Adding further, the usefulness and effectiveness of ICT tools need to be increased, which would thereby increase the positive attitude among the students. This may further lead to enhanced utilization of ICT tools. Supporting evidence was found from the research by Silin and Kwok (2016), who revealed a positive correlation between the usefulness of ICT tools and the attitude of the students towards ICT tools. So, efforts need to be taken in the direction of improving the utility of ICT tools and their relevance in the educational system for students. Findings by Sharma (2018) aligned with the present study, as it revealed that the majority of students possessed a moderately favorable attitude. Also, Daza et al. (2021) revealed that the majority of the students had a positive attitude towards the utilisation of ICT tools. This reinforced the validity of the findings

of the present study. However, results by Chandrakar (2014) and Thakur (2017) contradicted the present results as they received a majority of students with a highly favourable

attitude. So there have been uneven alterations in the attitude across time. But a significantly large proportion had a positive attitude. This factor can be exploited to enhance ICT among the students.

Table 3: Distribution of agricultural postgraduate students according to their attitude towards ICT tools

Sr. No	Attitude towards ICT tools	Dr PDKV, Akola		IGKV, Raipur		Total	
		F (n=84)	%	F (n=95)	%	F (n=179)	%
1.	Less favourable (Up to 49 score)	4	4.76	9	9.47	13	7.26
2.	Favourable (50 to 62 score)	73	86.90	74	77.89	147	82.12
3.	More favourable (More than 62 score)	7	8.34	12	12.64	19	10.62
	Bold $\bar{X}$ = 56.68 $\bar{Y}$ = 5.69						

The correlation analysis revealed that among all the ICT-related variables, *Subjects*, *Connectivity*, and *Effectiveness* exhibited the strongest positive relationship with respondents' attitude (ATT) towards ICT usage. Specifically, *Subjects* showed a substantial correlation coefficient of 0.68, indicating that as the number or relevance of ICT-related subjects increased, respondents' attitudes became significantly more positive. This may be attributed to the exposure and familiarity gained through curriculum-integrated ICT content.

Connectivity showed a moderate correlation with ATT ($r = 0.47$), suggesting that better digital connectivity (internet access, network availability) enhances users' perception and openness towards ICT platforms. Similarly, *Effectiveness* of ICT tools in aiding learning or task performance also correlated positively ($r = 0.28$), underlining the role of perceived utility in shaping attitudes.

Other variables such as *Time spent*, *Media material exposure (MME)*, *Access (ACCS)*, and *Knowledge* also showed a mild to moderate positive association with ATT (ranging from 0.16 to 0.27), indicating their supportive yet comparatively limited influence. On the contrary, variables like *Awareness*, *Extent of ICT use*, *Income*, and *Web usage* demonstrated negligible or weak negative correlations (all close to zero),

implying that these factors alone do not substantially impact the respondents' attitude towards ICT.

Overall, the findings suggest that practical engagement (through subjects and connectivity) and perceived usefulness (effectiveness) are more critical in shaping attitudes than mere access or awareness. This highlights the importance of content relevance and functional ICT integration in influencing user acceptance and enthusiasm.

CONCLUSION

It could be inferred from the present study that postgraduate agricultural students are moderately engaged with internet resources and possess an overall favourable attitude towards ICT tools. The data followed a near-normal distribution, with a significant portion of students situated around the mean values in both internet usage and attitude scores. This suggests that while students are inclined towards ICT tools, there remains considerable scope to improve the quality and intensity of their engagement. Institutional efforts should be directed towards increasing awareness, accessibility, and relevance of ICT tools in academic and research contexts.

Furthermore, factors contributing to less favourable attitudes must be identified and minimised through targeted interventions such as

training workshops, updated content delivery platforms, and interactive digital tools tailored to the agricultural curriculum. The usefulness and effectiveness of ICT tools need to be enhanced to convert favourable attitudes into deeper and more meaningful digital practices. The study confirms findings from past literature (e.g., Apuke and Iyendo, 2018; Daza et al., 2021) and provides updated insights into current student trends. Therefore, the favourable disposition of students towards ICT must be seen as an opportunity to further embed digital technology into agricultural education, thereby aligning with national goals of digital empowerment and sustainable development in agriculture.

REFERENCES

- Apuke, O.D. and Iyendo, T.O., 2018, University students' usage of the internet resources for research and learning in north eastern Nigeria. *Journal of Applied Research in Higher Education*, 10(2): 216–230.
- Asha, K., Singh, H.C., Verma, A.K. and Rohit, R., 2023, Attitude of students about e-resources for academic and research work in agriculture universities of Uttar Pradesh. *International Journal of Environment and Climate Change*, 13(3): 206–215.
- Chandio, M.T., Pandhiani, S.M. and Samo, A.H., 2007, Role of ICT in reshaping the education sector in Pakistan. *Journal of Educational Research*, 10(3): 17–24.
- Chandrakar, R., 2014, A study on information seeking behaviour and ICT use among postgraduate students. *Indian Journal of Library and Information Science*, 8(2): 45–52.
- Daza, V., Olarte, A.C. and Muñoz, A., 2021, Attitude and usage of ICT tools among university students: A comparative study. *International Journal of Educational Technology*, 8(1): 33–42.
- Dhanush, M., Murugan, P.P., Anandaraja, N., Janaki Rani, A. and Santosh Ganapati, P., 2023, Attitude of farm youths towards Information and Communication Technologies (ICTs) in Coimbatore district of Tamil Nadu. *Asian Journal of Agricultural Extension, Economics & Sociology*, 41(10): 110–118.
- Hema, K., 2020, Usage of ICT resources among college students: A regional study. *Journal of Emerging Trends in Educational Research and Policy Studies*, 11(3): 78–83.
- Kadam, R., Patil, B.L. and Durgannavar, S.J., 2018, Extent of internet use by postgraduate students of agricultural sciences. *Journal of Extension Education*, 30(1): 6066–6071.
- Mukherjee, S., Jha, S.K., Maiti, S. and Tiwari, S., 2022, Farmers' attitude towards ICT-based extension services in West Bengal. *Research Report, ICAR-IARI, New Delhi*, 15(2): 55–61.
- Mulimani, M.G., Patil, B.V. and Salimath, P.M., 2008, Usage of internet by agricultural science students in Dharwad. *Karnataka Journal of Agricultural Sciences*, 21(1): 120–123.
- Raksha, A., Kumari, S. and Devi, U., 2012, Construction of attitude scale towards ICT. *Indian Journal of Psychometry and Education*, 43(2): 210–212.
- Sharma, A., 2018, Digital behaviour and technology adoption among Indian agricultural students. *Journal of Rural Studies and Development*, 6(1): 49–57.
- Silin, H.A. and Kwok, S.W., 2016, Exploring the impact of ICT usability on student attitudes. *Journal of Interactive Learning Research*, 27(4): 371–386.
- Singh, M. and Jahanara, 2023, A study on the impact of Information and Communication Technology on farmers' knowledge and adoption of potato production technologies in Jaunpur district of Uttar Pradesh, India. *Asian Journal of Agricultural Extension, Economics & Sociology*, 41(9): 444–449.
- Thakur, D., 2017, Usage pattern and attitude of students towards ICT tools in agriculture universities. *Indian Research Journal of Extension Education*, 17(2): 122–125.
- Ugwulebo, E. and Okoro, M., 2017, The use of internet services and its effect on students' academic performance. *Journal of Information Systems and Communication*, 8(1): 24–29.

RESEARCH ARTICLE

Population dynamics and sustainability concerns of livestock systems of marginal and landless farmers in rural Tamil Nadu, India

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ABSTRACT

A cross sectional survey was conducted to collect data from 100 marginal and 100 landless livestock farmers in two different agro-ecological zones of Tamil Nadu state in India to assess the population dynamics and sustainability concerns of rural livestock systems. The change over a time period of 5 and 10 years revealed the declining herd size of crossbred cows. Buffalo as a dairy animal was totally vanishing from the households of marginal and landless livestock farmers. Flock size of goats and sheep had increased over a period of time. Rearing backyard poultry was found to be a tradition in most of the households of both marginal and landless livestock farmers. Majority of the livestock sold were goats followed by sheep, backyard poultry and crossbred cattle. Most of the respondents sold their livestock to purchase food grains and to meet other emergency domestic expenses. In more than half of the households, the young members were taking part in livestock activities. Though the options for getting employment in rural areas are decreasing, it was observed that the young members of families of marginal and landless livestock farmers are not interested to take up livestock farming as an occupation in future. The related implications and measures are discussed.

Keywords : Herd dynamics, rural livestock systems, Tamil Nadu, India

INTRODUCTION

Livestock farming in India is an occupation providing livelihood to millions of small, marginal and landless livestock farmers bringing cash into their hands, twice a day and every day of the year. In India, as is the case in many other developing countries, the distribution of livestock among the poorest is far more equitable than the distribution of land. Livestock therefore play an extremely critical role in supporting and sustaining livelihoods of small, marginal and landless livestock farmers.

One dimension of livestock revolution has been the industrialization of production, changing from being the traditional, local, multi-

purpose activity, to an increasingly market oriented and vertically integrated business (Delgado et al., 1999; Steinfeld, 2002). There is an imminent danger that these intensive producers could undermine the validity of small-scale production by rural small, marginal and landless livestock farmers and, thereby, further worsening rural poverty (Steinfeld, 2002). Thus, the ongoing livestock revolution offers both opportunities and threats to resource-poor. On the other hand, any discussion about the livestock sector, its sustainability and contribution to livelihood security need to be related to the growth trends in livestock population. In terms of numbers, population of poultry, pigs, goats and

buffalo have grown faster compared to other species, while the population of draught animals have witnessed negative and decelerating trend (Birthal and Rao, 2002). This necessitates proper understanding of the livestock systems of marginal and landless livestock farmers, the overtime changes in the livestock systems maintained by them and their future needs. Thus the study was conducted with the objective to assess the population dynamics and sustainability concerns of livestock systems of rural marginal and landless livestock farmers at household level in Tamil Nadu, India.

MATERIALS AND METHODS

Study area and sampling

The study was conducted in North - Western and Southern zones of Tamil Nadu state in India to represent two diverse agro climatic zones. Based on high livestock density criteria two districts, namely Thiruvannamalai (12° 15' N and 79° 07' E) and Pudukottai (10° 23' N and 78° 52 ' E) districts were selected from North - Eastern and Southern zones, respectively. From each district two blocks and from each block one village was randomly selected. From each of the selected villages 25 households of marginal livestock farmers and 25 households of landless livestock farmers were selected to constitute a total sample size of 200 respondents.

Study variables

Data were collected on type and combination of livestock species reared, herd / flock structure of crossbred cows, buffaloes, local cattle, bullocks, goats, sheep and backyard poultry. In the herd / flock structure, data were collected on

experience of rearing livestock, mode of acquisition, current herd / flock size, and change in herd / flock size over 5 and 10 years. Data were also collected on household's willingness to increase / decrease herd size, participation of youngsters in livestock activities, trends in livestock sale and reasons for livestock sale.

Data collection and analysis

The 200 respondents were interviewed using a standard structured questionnaire. The researchers also employed general observation on aspects related to the study to cross check the information collected. The data obtained from the interviews was coded, entered into the computer spreadsheet and analyzed using descriptive analysis procedures of the Statistical Package for Social Scientists (SPSS 2000). Frequency tables and percentages were generated as the summaries of the data for analysis.

RESULTS AND DISCUSSION

Livestock species reared by households

Crossbred cattle were the predominant livestock species maintained by the respondents, which were more popular among marginal farmers than landless livestock farmers. However, goats were predominantly kept by landless livestock farmers than marginal farmers. The data further confirms that crossbred cows have well integrated into households of marginal farmers and small ruminant's like goat and sheep were the choice of landless livestock farmers. Nearly half of the respondent marginal and landless livestock farmers were found to possess backyard poultry (Table 1).

Table 1. Distribution of households according to reared livestock species

Species reared / Category	Marginal livestock farmers (n = 100)		Landless livestock farmers (n = 100)		Total households (N = 200)	
	F	%	F	%	F	%
Crossbred cattle	81	81.00	58	58.00	139	69.50
Buffaloes	9	9.00	10	10.00	19	9.50

Species reared / Category	Marginal livestock farmers (n = 100)		Landless livestock farmers (n = 100)		Total households (N = 200)	
	F	%	F	%	F	%
Local cattle	9	9.00	7	7.00	16	8.00
Bullocks	8	8.00	1	1.00	9	4.50
Goat	31	31.00	41	41.00	72	36.00
Sheep	13	13.00	17	17.00	30	15.00
Backyard poultry	52	52.00	47	47.00	99	49.50

Combinations of livestock species reared

In Thiruvannamalai district, majority of the respondents (51.00 %) were rearing only crossbred cattle, followed by goat (15.00 %) and sheep (5.00 %). Goat and sheep as single species were reared only by landless livestock farmers and not by marginal

farmers. Among the households rearing two species of livestock, most (11.00 %) were rearing crossbred cattle along with backyard poultry, while eight per cent of the respondents were rearing crossbred cattle and sheep. None of the households were found to rear pigs (Table 2).

Table 2. Combinations of livestock species reared in Thiruvannamalai district

Sl. No	Species combination	Marginal livestock farmers (n = 50)		Landless livestock farmers (n = 50)		Total households (N = 100)	
		F	%	F	%	F	%
1.	Crossbred cattle alone	32	64.00	19	38.00	51	51.00
2.	Goat alone	--	--	15	30.00	15	15.00
3.	Sheep alone	--	--	5	10.00	5	5.00
4.	Crossbred cattle + backyard poultry	7	14.00	4	8.00	11	11.00
5.	Crossbred cattle + goat	5	10.00	3	6.00	8	8.00
6.	Crossbred cattle + sheep	2	4.00	2	4.00	4	4.00
7.	Crossbred cattle + bullock	1	2.0	--	--	1	1.00
8.	Goat + backyard poultry	1	2.0	--	--	1	1.00
9.	Crossbred cattle + goat + backyard poultry	1	2.0	--	--	1	1.00
10.	Crossbred cattle + local cattle + backyard poultry	1	2.0	--	--	1	1.00
11.	Crossbred cattle + local cattle + bullock + backyard poultry	--	--	1	2.00	1	1.00

In Pudukkottai district, an overwhelming majority of households was rearing more than one species of livestock. Rearing of single species was meager with respect to crossbred cattle (4.00 %) and also with other species like buffaloes (1.00 %) and goat (3.00 %). Most of the households (24.00 %) were rearing three species together; crossbred cattle, goat and backyard poultry being the predominant combination. Rearing of

four species of livestock was also not uncommon. None of the households were found to rear pigs in Pudukkottai district also (Table 3). Similar observations were made by Sagar (2004), who reported fifteen livestock combination reared by the dry land farmers of North-Western zone of Tamil Nadu. Similarly Kumar (1991) reported thirteen combinations by the farmers of Bhojipura block of Bareilly District in Uttar Pradesh.

Table 3. Combinations of livestock species reared in Pudukkottai district

Sl. No	Species combination	Marginal farmers (n = 50)		Landless livestock farmers (n = 50)		Total households (N = 100)	
		F	%	F	%	F	%
1.	Crossbred cattle alone	2	4.00	2	4.00	4	4.00
2.	Goat alone	2	4.00	1	2.00	3	3.00
3.	Crossbred cattle + goat	4	8.00	3	6.00	7	7.00
4.	Crossbred cattle + backyard poultry	6	12.00	6	12.00	12	12.00
5.	Crossbred cattle + sheep	2	4.00	--	--	2	2.00
6.	Crossbred cattle + bullock	--	--	1	2.00	1	1.00
7.	Buffalo	1	2.00	--	--	1	1.00
8.	Buffalo + bullock	--	--	1	2.00	1	1.00
9.	Buffalo + backyard poultry	2	4.00	3	6.00	5	5.00
10.	Buffalo + sheep	1	2.00	--	--	1	1.00
11.	Crossbred cattle + local cattle	--	--	1	2.00	1	1.00
12.	Local cattle + backyard poultry	2	4.00	--	--	2	2.00
13.	Local cattle + sheep	--	--	1	2.00	1	1.00
14.	Goat + backyard poultry	4	8.00	3	6.00	7	7.00
15.	Sheep + backyard poultry	2	4.00	--	--	2	2.00
16.	Crossbred cattle + goat + backyard poultry	9	18.00	15	30.00	24	24.00
17.	Crossbred cattle + sheep + backyard poultry	2	4.00	2	4.00	4	4.00
18.	Buffalo + sheep + backyard poultry	3	3.00	1	2.00	4	4.00
19.	Crossbred cattle + local cattle + backyard poultry	1	2.00	1	2.00	2	2.00
20.	Crossbred cattle + buffalo + backyard poultry	1	2.00	--	--	1	1.00
21.	Local cattle + sheep + backyard poultry	1	2.00	2	4.00	3	3.00
22.	Crossbred cattle + bullock + backyard poultry	--	--	1	2.00	1	1.00
23.	Bullock + sheep + backyard poultry	--	--	1	2.00	1	2.00
24.	Crossbred cattle + local cattle + bullock + backyard poultry	--	--	2	4.00	2	2.00
25.	Buffalo + sheep + bullock + backyard poultry	--	--	2	4.00	2	2.00
26.	Buffalo + local cattle + sheep + backyard poultry	2	4.00	2	4.00	4	4.00
27.	Buffalo + local cattle + backyard poultry	2	4.00	--	--	2	2.00

From the data presented in Tables 2 and 3, it is clear that there are appreciable differences in both species and combinations of livestock species reared within and between the study areas. The diverse agro-climatic conditions of the two districts also could be the probable reason for the difference. For the marginal and landless livestock farmers, the species and combinations of livestock species reared are equally important to take advantage of locally available feeds, grazing lands and crop residues effectively and get subsidiary income and livelihood security from livestock farming.

Herd structure of crossbred cows

Out of 200 total respondents, 139 (81 marginal and 58 landless livestock farmers) were rearing crossbred cows. From them data were collected on experience of rearing crossbred cows, mode of acquisition and herd dynamics (Table 4).

Majority (31 %) of the respondents reported 6 to 10 years of experience of rearing crossbred cows, followed by 22 % respondents with 11 to 15 years experience (Table 4). Thus crossbreds have been well integrated into the households over time. It could also be noted that around 10 per cent of the respondents have started rearing crossbreds in the past two years in spite of prevailing drought in the region over the past four years. This highlights the role livestock farming as an income generating avenue even during drought season in rural areas.

Majority (74.82 %) of the respondents purchased crossbred cows from middleman or sandy (weekly livestock markets). Approximately, nine per cent of the households

inherited crossbred cows as a family asset and 6.47 per cent acquired crossbred cows through a system called “*vaarathaku viduthal*”, a unique agreement system that exist in rural Tamil Nadu villages which is an easy way for the landless livestock farmers to acquire livestock. They take non - pregnant animal from the donors, make it pregnant, rear up to one lactation and give back the animal to the donors after making it again pregnant. The calf born will be retained by landless livestock farmers.

Majority (53.23 %) of the households had a single crossbred cow followed by around 30 per cent who had two and rest 17 per cent had three or more crossbred cows. Majority (44.98 %) of the households has reduced their herd size, about 30.61 per cent of households had not changed their herd size and only 24.49 per cent of households have increased their herd size over the period of 10 years. Among landless livestock farmers equal number of households (38.88 %) has decreased their herd size. More of marginal farmers have reduced their herd size than the landless livestock farmers. High feeding costs involved in rearing crossbred cows was the main reason for restricting to single cow or for reduction of herd size. However, as per livestock census, there is phenomenal increase in crossbred cows population from 28.67 % to 63.15 % in around 10 years (Government of Tamil Nadu, 2008). This might be due to increase in number of households rearing crossbred cows. At household level, however, the numbers of crossbreds are decreasing and households like to keep only one or two animals, as the maintenance cost is very high.

Table 4. Herd structure of crossbred cows

Herd structure/ Category	Marginal livestock farmers (n = 81)		Landless livestock farmers (n = 58)		Total households (N = 139)	
	F	%	F	%	F	%
Experience in rearing crossbred cows						
<2 years	11	13.58	4	6.89	15	10.79
3-5 years	16	19.75	16	27.58	32	23.02
6-10 years	23	28.57	20	34.48	43	30.93
11-15 years	18	22.22	13	22.41	31	22.30
15-20 years	11	13.58	5	8.62	16	11.51
>20 years	2	2.46	--	--	2	1.34
Mode of acquisition						
Purchased	67	82.73	37	63.79	104	74.82
Inherited	12	14.8	1	1.72	13	9.35
Gifted	1	1.23	--	--	1	0.70
<i>Vaarithuku viduthal</i>	1	1.23	11	18.97	12	8.63
loan	--	--	9	12.07	9	6.47
Current herd size						
One	40	49.38	34	58.62	745	3.23
Two	25	30.86	17	29.31	42	30.21
Three	7	8.64	4	6.89	11	7.91
Four	6	7.41	2	3.44	8	5.75
Five	2	2.47	1	1.72	3	2.15
Six	1	1.23		–	1	0.70
Herd size (10 years before)	n=31		n=18		N=49	
More before/less now	15	48.38	7	38.88	22	44.98
Less before/more now	8	28.81	4	22.22	12	24.49
No change	8	25.81	7	38.88	15	30.61
Herd size (5 years before)	n=54		n=38		N=92	
More before/less now	24	44.44	11	28.95	35	38.04
Less before/more now	18	33.33	9	23.68	27	29.34
No change	12	22.22	18	47.37	30	32.60

Herd structure of buffaloes

Out of 200 total respondents, 19 (9 marginal and 10 landless livestock farmers) were rearing buffaloes. From them data were collected on experience of rearing buffaloes, mode of acquisition and herd dynamics.

Majorities are rearing over the period of 11 to 15 years (36.84 %) and 16 to 20 years (31.57 %). No single household have started rearing buffaloes recently. Majority of the households (94.74 %) have purchased buffaloes from middleman or sandy and maintaining the progeny. Majority of the households (68.42 %) had only one or two buffaloes.

All the respondent households have been rearing buffaloes for the past 10 years. However, the herd size has reduced now. Buffaloes were predominant dairy animals in the households about 10 years back. However, now the dependence on dairying through buffaloes has been decreasing slowly against crossbred cows which are gaining hold into the households. Livestock census also reported that, the buffalo population in the state has decreased from 2.741 million in 1997 to 1.658 million in 2004 (Government of Tamil Nadu, 2008).

Herd structure of local cattle and bullocks

Not a single household have started rearing local cattle in the past five years, and those maintaining them now have been rearing them over the period of 6 to 20 years by maintaining their progeny. Although the milk yield of local cattle is very low compared to crossbred cows, still the affinity for rearing local cattle exist among few farmers.

Bullocks were being reared mostly by marginal farmers having more than 11 to 15 years experience in rearing them. Tradition of keeping bullocks in pairs by certain communities like “*Valambars*” is one reason for maintaining bullocks. Bullocks were not maintained throughout their lifetime, and households reported that they used to sell bullocks during off seasons and purchase them in season.

Flock structure of goats

Out of 200 total respondents, 72 (31 marginal and 41 landless livestock farmers) were rearing goats. From them data were collected on experience of rearing goats, mode of acquisition and flock dynamics.

About 29 per cent of the households have 3 to 5 years of experience of goat rearing, followed by 26.38 per cent with 6 to 10 years of experience and 24 per cent with 11-15 years of experience. Majority (68.06 %) of the households have purchased goats from sandies or middleman, followed by “*varathaku viduthal*” agreement (22.22 %) and through loans (6.94 %). About 39 per cent of the households had more than 12 goats followed by one to four goats (27.78%). The large flock size, i.e. more than 20, was possessed mostly by landless livestock farmers. No change in flock size in the past 10 years was reported by 45 per cent of the respondents. About 36 per cent of respondents increased their flock size and about 19 per cent of respondents reduced their flock size in the past 10 years (Table 5). This is similar to the findings of livestock census, in which the goat population of the state has increased by 27.45 % from 6.416 million in 1997 to 8.177 million in 2004 (Government of Tamil Nadu,2008).

Table 5. Household flock structure of goats

Flock structure / Category	Marginal livestock farmers (n = 31)		Landless livestock farmers (n = 41)		Total households (N = 72)	
	F	%	F	%	F	%
Experience in rearing goats						
< 2 years	5	16.13	4	9.75	9	12.50
3-5 years	8	25.80	13	31.71	21	29.16
6 - 10 years	7	33.33	12	29.27	19	26.38
Experience in rearing goats						
11-15 years	7	33.33	10	24.39	17	23.61
16-20 years	4	12.90	2	4.87	6	8.33
Mode of acquisition	n=31		n=41		N=72	
Purchased	25	80.65	24	58.54	49	68.06
Inherited	--	--	--	--	--	--
Gifted	4	12.90	12	29.27	16	22.22
“ <i>Vaarathuku viduthal</i> ”	--	--	2	4.87	2	2.77
loan	2	6.45	3	7.31	5	6.94

Flock structure / Category	Marginal livestock farmers (n = 31)		Landless livestock farmers (n = 41)		Total households (N = 72)	
	F	%	F	%	F	%
Current herd size	n=31		n=41		N=72	
1-4	10	32.26	10	24.39	20	27.78
5-9	9	29.03	5	12.20	14	19.44
10-12	5	16.13	6	14.63	11	15.28
>12	7	22.58	20	48.78	27	38.89
Goats (10 years before)	n=11		n=25		N=36	
More before/less now	1	9.09	6	24.00	7	19.44
Less before/more now	10	90.91	3	12.00	13	36.11
No change	–	–	16	64.00	16	44.44
Goats (5 years before)	n=18		n=24		N=42	
More before/less now	4	22.22	5	20.83	9	21.43
Less before/more now	9	50.00	10	41.67	19	45.24
No change	5	27.78	9	37.50	14	33.33

Flock structure of sheep

Out of 200 total respondents, 30 (13 marginal and 17 landless livestock farmers) were rearing sheep. From them data were collected on experience of rearing sheep, mode of acquisition and flock dynamics.

About 37 per cent of the households had 11 to 15 years of experience in rearing sheep, the households are keeping the sheep traditionally and are fully dependant on them for their livelihood. Majority of the households (76.66 %) have purchased sheep initially from the sandy or middleman and an appreciable number of households (16.66 %) in procured sheep through

loan under Integrated Rural Development Programme. Majority of households have purchased a pair of sheep at first and developed the flock. Majority of the households (56.66 %) had a flock size of more than 12. About 69 per cent of the households have increased their flock while 23.08 per cent have maintained the flock as such and a negligible percent (7.69 %) have reduced over the period of 10 years (Table 6). This is in line with the livestock census finding in which sheep population of the state has increased by 6.35 per cent from 5.259 million 1997 to 8.177 million in 2004 (Government of Tamil Nadu, 2008).

Table 6 : Household flock structure of sheep

Flock structure / Category	Marginal livestock farmers (n = 13)		Landless livestock farmers (n = 17)		Total households (N = 30)	
	F	%	F	%	F	%
Experience in rearing sheep						
< 2 years	2	15.38	2	11.76	4	13.33
Experience in rearing sheep						
3-5 years	2	15.38	--	--	2	6.67
6 – 10 years	3	23.07	6	35.29	9	30.00
11-15 years	3	23.07	8	47.05	11	36.67
16-20 years	3	23.07	–	–	3	10.00
> 20 years	–	–	1	5.88	1	3.33

Flock structure / Category	Marginal livestock farmers (n = 13)		Landless livestock farmers (n = 17)		Total households (N = 30)	
	F	%	F	%	F	%
Mode of acquisition	n=13		n=17		N=30	
Purchased	12	92.31	11	64.71	23	76.67
Inherited	1	7.69	1	5.88	2	6.67
Loan	—	—	5	29.41	51	6.66
Current herd size of sheep	n=13		n=17		N=30	
1-4	2	15.38	—	-	2	6.67
5-9	2	15.38	—	—	2	6.67
10-12	3	23.07	6	35.29	9	30.00
>12	6	46.15	11	64.71	17	56.66
Sheep (10 years before)	n=6		n=7		N=13	
More before/less now	—	—	1	14.28	1	7.69
Less before/more now	6	100.00	3	42.86	9	69.23
No change	—	—	3	42.86	3	23.08
sheep (5 years before)	n=9		n=14		N=23	
More before/less now	3	33.33	4	28.57	7	30.43
Less before/more now	3	33.33	4	28.57	7	30.43
No change	3	33.33	6	42.86	9	39.13

Flock structure of backyard poultry

Out of 200 total respondents, 99 (52 marginal and 47 landless livestock farmers) were rearing backyard poultry. From them data were collected on experience of rearing backyard poultry, mode of acquisition and flock dynamics.

Rearing backyard poultry was found to be a tradition in most households of both marginal and landless livestock farmers. Majority (47 %) of the households has 10 years of experience in rearing

backyard poultry and some of them had even more than 20 years of experience. It has been observed that households usually purchase poultry from local sandies and develop their flock. Majority of the households had a flock size of four to seven and flock size of the most of the households had reduced in 5 to 10 years (Table 7). Early chick mortality, predators, death of birds by ranikhet disease were the perceived reasons for the reduction in flock size.

Table 7 : Household flock structure of backyard poultry

Category	Marginal livestock farmers (n = 52)		Landless livestock farmers (n = 47)		Total households (N = 99)	
	F	%	F	%	F	%
Experience in rearing						
< 2 years	3	5.77	1	2.13	4	4.04
3-5 years	10	19.23	11	23.40	21	21.21
Experience in rearing						
6 – 10 years	15	28.84	13	27.67	28	28.28
11-15 years	7	16.67	11	23.40	18	18.18
16-20 years	12	23.07	5	10.64	17	17.17
>20 years	5	9.61	6	12.76	11	11.11
Mode of acquisition						
Purchased	52	100.00	45	95.74	97	97.98
“Vaarathuku viduthal”	--	--	2	4.26	2	2.02

Category	Marginal livestock farmers (n = 52)		Landless livestock farmers (n = 47)		Total households (N = 99)	
	F	%	F	%	F	%
Current flock size	n=52		n=47		N=99	
1-3	17	32.69	5	10.64	22	22.22
4-7	28	53.85	16	34.04	44	44.44
8-10	2	3.85	9	19.15	11	11.11
>10	5	9.61	17	36.17	22	22.22
10 years before flock size	n=24		n=22		N=46	
More before/less now	9	37.50	9	40.91	18	39.13
Less before/more now	3	12.50	14	4.54	4	8.700
No change	12	50.00	12	54.55	24	52.17
5 years before flock size	n=40		n=35		N=75	
More before/less now	9	22.50	22	62.86	31	41.33
Less before/more now	4	10.00	2	5.71	6	8.00
No change	27	67.50	11	31.43	38	50.67

Household's willingness to increase/ decrease herd /flock size

Majority (56.60 %) of the households showed willingness to increase their herd / flock size, while the rest (43.50 %) wish to continue with their current herd/ flock size. The most preferred species to increase the size were goats (41.59 %), followed by crossbred cattle (36.28 %) and sheep (16.81 %). The preference for

goats were more among landless livestock farmers than marginal farmers and the preference for crossbreds was found to be more among marginal farmers. The reasons reported for not increasing the herd / flock size were shortage of feed (49.42 %), followed by inadequate labour (22.99 %), inability to maintain (17.24 %) and inadequate space and resources (4.6%) (Table 8).

Table 8. Household's willingness to increase/decrease herd size

Category	Marginal livestock farmers (n = 100)		Landless livestock farmers (n = 100)		Total households (N = 200)	
	F	%	F	%	F	%
Willingness to increase herd size						
Yes	48	48.00	65	65.00	113	56.50
No	52	52.00	35	35.00	87	43.50
Preference of species for increasing herd size	n=48		n=65		N=113	
Crossbred cow	23	47.91	18	27.69	41	36.28
Buffaloes	2	4.17	2	3.08	4	3.54
Goats	14	29.16	33	50.77	47	41.59
Sheep	7	14.58	12	18.46	19	16.81
Crossbred cow and goat	2	4.16	--	--	2	1.76
Reasons for not increasing herd size	n=52		n=35		N=87	
Shortage of feed	23	44.23	20	57.14	43	49.42
Lack of labour	13	25.00	7	20.00	20	22.99
Not able to maintain	10	19.23	5	14.28	15	17.24
Lack of space	4	7.69	--	--	4	4.60
Lack of resources	2	3.84	2	5.71	4	4.60

Category	Marginal livestock farmers (n = 100)		Landless livestock farmers (n = 100)		Total households (N = 200)	
	F	%	F	%	F	%
Poor human health	--	--	1	2.85	1	1.15
Animal diseases	--	--	--	--	--	--

The willingness of landless livestock farmers stems from the fact that increasing herd / flock size would not be a problem, as they can take all animals together for grazing. As marginal farmers have to look after their agriculture along with livestock, they are reluctant to increase their herd size.

Participation of youngsters in livestock activities

In majority of the households (55.50 %), youngsters were taking part in livestock activities. (Table 9). Majority of youngsters from the selected households were not in favour of taking livestock farming as their prime occupation. Even head of the households were in

the opinion that youngsters will not opt for livestock farming as their occupation in spite of poor employment opportunities in rural areas. More and more youngsters are migrating to urban areas in search of livelihood security.

Trends in livestock marketing

Over the period of two years, households were involved in a large number of livestock transactions. Largest number of livestock sold was goats followed by sheep and poultry, with crossbred cattle at lowest level. An appreciable number of male calves preferably 4 to 5 months of age were also sold as maintenance of male calves was difficult and not economic.

Table 9. Participation of youngsters in livestock activities

Category	Marginal livestock farmers (n = 100)		Landless livestock farmers (n = 100)		Total households (N = 200)	
	F	%	F	%	F	%
Participation of youngsters in livestock activity						
Yes	53	53.00	58	58.00	11	155.50
No	47	47.00	42	42.00	89	44.50
Your interest for youngsters to take up livestock activity						
Yes	40	40.00	24	24.00	64	32.00
No	60	60.00	76	76.000	113	68.00
Do you think youngsters are going to pick up animal rearing as occupation						
Yes	18	18.00	–	–	18	9.00
No	64	64.00	72	72.00	136	68.00
Cannot say	18	18.00	28	28.00	46	23.00

Table 10. Reasons for livestock sales as reported by households

Sr. No.	Reasons for livestock sales farmers	No. of marginal livestock farmers	No. of landless livestock farmers	Total households
1.	Purchase of food grains	44	72	116
2.	Due to animal diseases	10	9	19
3.	To pay debts from money lenders	6	4	10
4.	To meet marriage expenses	3	2	5

Table 10. Reasons for livestock sales as reported by households

Sr. No.	Reasons for livestock sales farmers	No. of marginal livestock farmers	No. of landless livestock farmers	Total households
5.	Non availability of fodder	4	2	6
6.	Due mitigate drought	5	0	5
7.	To invest in housing	0	5	5
8.	To spend for social functions	0	4	4
9.	To pay educational loans	2	1	3
10.	To purchase clothing	1	0	1
11.	To purchase jewellery	1	0	1
12.	To meet agricultural expense	1	0	1
13.	For construction of well	1	0	1
14.	Again invest in livestock	0	2	2
15.	Due to old age of animals	1	0	1
16.	Not able to maintain	2	0	2

Households were also asked to offer reasons for sale of livestock (Table 10). Most of the respondents sold livestock to purchase food grains, followed by livestock diseases. A few households have sold livestock to meet debt, marriage and social functions expenses. Drought and non availability of feed and fodder have also forced to sell the livestock by few households. Other reasons for sale of livestock were to pay educational fees, to purchase clothing and jewellery and to meet agricultural expenses.

The only readily available asset for marginal and landless livestock farmers to meet any immediate household expenditure was livestock. Male goats and sheep are the first animal to be sold in case of emergency. Sale of crossbred cows was being done only at urgent hours as crossbred cows were directly linked with daily income. The reasons for sale have an important bearing in their livelihood. When there is no labour work available during off-season, livestock has come to rescue them and it has helped them to meet emergency expenditure. Livestock has largely helped them to meet household food security needs as most of the households have sold animals to purchase food grains.

CONCLUSIONS

It is evident from the herd / flock dynamics of livestock farming that, rearing livestock is not a commercial activity for marginal and landless livestock farmers. Rather they are rearing livestock as a single or a combination of species in a sustainable and balanced way using locally available resources to meet their household livelihood needs. In spite of the drought in the study area, with the low to medium herd / flocks of livestock, marginal and landless livestock farmers could able to meet their livelihood security. At present though nearly half of the young households were taking part in livestock activities, it is a matter of concern that majority of youngsters were not in favour of taking livestock farming as their primary occupation in future. Therefore, policies of livestock development should motivate youngsters to undertake livestock farming as an occupation. Animal husbandry as a subject could be introduced in schools along with science subjects, so that rural youth may get a better exposure to scientific principles of livestock production.

Worldwide experiences suggest that public investment in small scale livestock farming systems could be an effective means of poverty alleviation. There is no need of significant investments, as small scale livestock

rearing by marginal and landless livestock farmers involves low cost, requires little skill and returns are almost immediate and sustainable for farmers, both in terms of money as well as milk, meat and eggs. Therefore, government and non-government development agencies should aim at providing targeted extension services in traditional systems which will significantly increase the contribution of livestock farming to household well being, in terms of income and nutrition. Targeting, through group formation and a focus on women, is a critical component for supporting the development of small-scale livestock farming systems in a sustainable way.

REFERENCES

- Birthal P and Parthasarathy Rao P (eds) 2002 Technology options for sustainable livestock production in India: Proceedings of the Workshop on Documentation, Adoption, and Impact of Livestock Technologies in India, 18-19 Jan 2001, ICRISAT-Patancheru, India.
- Delgado C , Rosegrant M , Steinfeld H, Ehui S and Courbois C (1999) Livestock to 2020 : The Next Food Revolution. Food, Agriculture and the Environment Discussion Paper 28. IFPRI/FAO/ILRI.
- Government of Tamil Nadu 2008 Policy Note 2008-09 Animal Husbandry, Dairying and Fisheries Department . (http://www.tn.gov.in/policynotes/archives/policy2008-09/pdf/animal_husbandry.pdf)
- Kumar A (1991) Identification of animal husbandry skills amongst villagers in hojipura block of Bareilly district. M.V.Sc. Thesis, Indian Veterinary Research Institute, Izatnagar.
- LID (Livestock in Development) (1999) Livestock in poverty-focussed development. LID, Crewkeme, 95pp.
- Sagar C V (2004) Livestock rearing practices in Dry land areas of North Western Zone of Tamil Nadu. M.V.Sc. Thesis, Indian Veterinary Research Institute, Izatnagar.
- Steinfeld H (2002) Increasing global Demand for Animal Products. In: Responding to the Increasing Global Demand for Animal Products : Programme and Summaries of an International Conference Organised by BSAS, ASAS and MSAP, Merida. Mexico, November, 2002

RESEARCH ARTICLE

Unlocking the potential of drones in orchard management : A review

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ABSTRACT

Drones or Unmanned Aerial Vehicles (UAVs) equipped with advanced sensors and imaging capabilities, have revolutionized the way farmers monitor and manage fruit crops. The data collected by drones facilitate precise and targeted interventions, optimizing resource use and enhancing overall crop productivity. Aerial surveillance enables high-resolution imaging of orchards and vineyards, allowing for early detection of diseases, pests, and other stress factors that can impact crop health. Additionally, drones contribute to yield estimation, canopy management and post-harvest monitoring. While the technology offers significant advantages, challenges such as payload limitations, weather sensitivity, and regulatory compliance must be addressed.

INTRODUCTION

The population of the World is increasing tremendously with increase the demand of food. Presently, the traditional methods which were used by the farmers were not sufficient enough to fulfill these demands as well as requirements. Thus, new Unmanned Aerial Vehicles (Drone technology) were introduced. Application of drones in agriculture and horticulture assist the farming industry by meeting food demands as the global population rises. These new inventions/methods satisfied the food demand and also provided employment opportunities to billions of people. As a part of the agricultural industry, drones are being employed for various operations in aerial surveillance, mapping, land inspection, monitoring, spraying fertilizers, checking for diseased or rotting crops, and much more. Drone's technologies save time and cost, excess use of water, pesticides, and herbicides, maintains the fertility of the soil, also helps in the efficient use of man power and elevate the productivity and improve the quality. The diverse kinds of drones are being tested to

determine the most creative space in agriculture, horticulture and farming. The objective of this paper is to review the usage of Drones in horticulture especially in fruit crops.

Need for Drones in Orchard Management

Fruit orchards necessitate site-specific or even individual-tree management throughout the growing season, from flowers to fruitlet development, ripening, and harvesting to tree dormancy. Earlier, growers made orchard management decisions primarily based on visual inspection of color, shape, size, and other information of fruits or fruit trees based on their own experience (Srivastava *et al.* 2017), which has professional experience requirements for observers, and the observation results were frequently inaccurate. Furthermore, the application of pesticides to manage pests and diseases is challenging due to higher plant height, requiring more labor, and being less efficient in controlling diseases and pests. Manual inspection of fruit ripening and maturity can be easily replaced by the use of UAVs and machine learning approaches for better decision-making.

UAVs can readily monitor irrigation and variations in nutrient status in the field, which aids in reducing water and nutrient stress in trees. All the above operations are labor-intensive, have a high cost of operation, are inefficient, and are time-consuming, so ICT and manpower are utilized concurrently to conduct various orchard management tasks (Gaddikeri *et al.* 2022).

Types of Drones used in Horticulture

Opportunities for additional use of nearby drones. Investing in drones means reaching out to dangerous areas. They are able to plant successfully with a team of 2 operators and 10 drones capable of planting 400,000 plants per day (Gulzar *et al.* 2022).

Weeding drones: Weed control is an ongoing struggle for farmers. San Francisco recently launched, developed a weed-based agricultural robot using a 100% organic method of extraction. Using computer vision and machine tools. One smart robot on the Farm can remove plants to feed a middle-class city of about 400,000 reported by Sebastian Boyer company C.E.O

Spraying drones: Similar to planting robots using smart sprayers paired with computer enabled cameras to detect weeds used in targeted herbicides.

Picking drones: One of the Agri Bot is designed to pick strawberries. AgriBot uses machine learning technology to detect and measure maturity and cut fruit more than just calyx. In this way the reaper never comes in contact with the fruit thus reducing damage or scratches.

Drone pollination: one of the most widely used drone pollinating technology is drone cooling technology. Researchers in the Netherlands and Japan are making small drones capable of silencing plants.

Harvesting drones: Another innovation called soft harvesting where machines are fitted with soft suction cups or pressed grabbers to protect the fruit during harvest. In 2016 the developers of

Abundant Robotics built the first vaccine harvest. This uses a computer concept to identify apples and then suck them through a soft tube with the number of apples per second.

Use of Drones in the Indian Horticulture

Drones are unmanned aerial vehicles (also known as UAVs), which are used for surveillance in various industries. Till now, they were primarily used by companies working in industrial sectors such as mining and construction, army, and hobbyists. But now, drone technology is increasingly available for use in various sectors of horticulture as well. Though the technology is still nascent in India, many companies are trying so that it is easily available to Indian farmers and ready to be used to increase efficiency in agricultural production (Sudhanshu Singh, 2023). Crop-based leaf area indexing for determination of plant health (biotic and abiotic stresses), tree density etc. Imaging of horticultural crops in challenging situations like changing weather conditions, terrain, effect of sunlight, fog, etc. Plant yield monitoring, scouting and bird scaring. Ascertaining the land surface temperature, spatial variability in crop yields, water inventories of ground water, retrieving type of irrigation, etc. (Prakash *et al.* 2022)

Applications of drones in Horticulture

Monitoring plant health: One of the uses for drone imagery that has already been rolled out with great success is for monitoring plant health. Drones equipped with special imaging equipment called Normalized Difference Vegetation Index ([NDVI](#)) use detailed colour information to indicate plant health. This allows farmers to monitor crops as they grow so any problems can be dealt with fast enough to save the plants. Drone imaging is capable of producing accurate image location to the [millimeter](#). This means that after planting, areas with stand gaps can be spotted and replanted as needed, and disease or pest problems can be

detected and treated for right away (Anonymous, 2023 a).

Soil Health Monitoring: It is also being used to monitor the health of soil and field conditions. In essence, UAVs collect and process data received from monitoring that can help check, control, and maintain the soil's health and nature. Drones can provide accurate field mapping including elevation information that allow growers to find any irregularities in the field. Having information on field elevation is useful in determining drainage patterns and wet / dry spots which allow for more efficient watering techniques. It allows precise application of fertilizers, eliminating poor growing spots and improving soil health for years to come. (Anonymous, 2023 a).

Analyzing Deficiencies: Another incredible merit of adopting drones for crop fertilization comes with their feature to analyze, identify, and survey the crops for any deficiencies. Their high-resolution cameras and sensors, additionally instilled with lasers, help to perform these operations quickly. Unmanned Aerial Vehicles can also map these deficiencies in real-time, and the data collected and processed can be used to make further determinations regarding the crops.

Canopy Management: Canopy management is a critical aspect of optimizing fruit crops, and drones have emerged as invaluable tools for this purpose. Equipped with advanced imaging technology, drones provide a bird's-eye view of orchards and vineyards, enabling farmers to assess and manage the density and structure of the plant canopy. Drones can capture high-resolution imagery, allowing for detailed analysis of the foliage, identifying areas of overgrowth, disease, or stress. This data aids in strategic pruning, thinning, and overall canopy manipulation to enhance sunlight exposure, air circulation, and fruit quality. The real-time and precise information provided by drones facilitates informed decision-making, ensuring that canopy management strategies are tailored to

the specific needs of different sections within the crop (Berni *et al.* 2009).

Drone pollination: Some of the newer uses for drone use in agriculture are still in testing and development. One of the most publicized uses is pollinating drone technology. [Researchers](#) in the Netherlands and Japan are developing small drones that are capable of pollinating plants without damaging them. A New York-based startup has developed a pollen dump drone that helps pollinate fruits such as almonds, cherries and apples. (Anonymous, 2023 a).

Drone AI: Another drone technology in development also involves machine learning. Improving Artificial Intelligence (AI) in drones is important to be able to make them more useful to smaller farmers in developing nations. More work is needed to be able to train AI systems to recognize fewer common crops and more diverse planting patterns. (Anonymous, 2023 a).

Identification of diseases and insect Pests: Diseases and pest in orchard crops can be detected early through some indicators with the help of a UAV. By analyzing the datasets obtained from the thermal, multispectral, and hyper spectral sensors mounted on UAVs with the help of machine learning algorithms it is possible to detect the disease and adopt preventive or control measures (Zhang *et al.* 2021). Employing drones for fruit fly baiting represents an inventive approach and is become the favored means of applying bait to reduce or remove fruit fly pests from vineyards and fruit trees in South Africa. Drone-based programs aid the significant South African fruit market in retaining its global market share in fresh fruit exports. As technology continues to advance, this method holds the potential to revolutionize pest management strategies in the agricultural industry (Anonymous, 2023b).

Spraying chemicals: UAVs can increase the effectiveness of chemical sprays like pesticides, herbicides, and fertilizer solutions can be used for

selective application to decrease the need to apply chemicals to the field, decrease the environmental impact, and boost profit margins by doing away with the higher chemical expenses. Additionally, this method only needs around 10 minutes of effort every 0.5 ha of land, and it may apply chemicals to up to 50 hectares each day in large farms. UAVs can therefore assist commercial farms by reducing the need for labour as well. According to recent experiments, UAVs employ height sensors to spray pesticides onto plant canopies at different heights. (Janarth and Pandiya, 2023). Before spraying operation, the optimization of spraying parameters, such as flight height, velocity, nozzle flow rate, and application rate, is needed to achieve the best performance from UAVs.

Avoid overuse of chemicals: Drones can prove to be especially effective in reducing the overuse of pesticides, insecticides, and other chemicals. These chemicals indeed help to protect the crop. But their overuse can prove to be detrimental. Drones can detect minute signs of pest attacks, and provide accurate data regarding the degree and range of the attack. This can help farmers calculate the required amount of chemicals to be used that would only protect the crops rather than harming them.

Security: Drone security is a fast-growing industry apart from agriculture but is also extremely useful to farm management. Using drones to monitor the far reaches of a farm without having to get there saves valuable time and allows for more frequent monitoring of hard-to-reach areas. Drone cameras can provide an overview of farm operations throughout the day to ensure operations are running smoothly and to locate equipment being used. Security drones can be deployed to monitor fencing and perimeters of more valuable crops like cannabis instead of employing more security personnel. (Anonymous, 2023 a).

Irrigation management: In irrigation

management, UAVs are run over the orchard to capture the through multispectral remote sensing imageries. Captured imageries are mosaicked with the help of software, then derived from the multispectral bands and processed in the laboratory using image processing software (Shi *et al.* 2019). Further, it was processed for extracting the information to derive the vegetation indices (VIs) such as NDVI, GNDVI, SAVI, etc. It helps in the derivation of crop coefficient and ultimately helps in the derivation of the crop water stress index. Plant water deficit was calculated using Crop Water Stress Index. Eventually based on the crop water, soil, and climate data information provided to the software to calculate crop water requirement in the field.

Moisture monitoring: Land absorption of water is often uneven. Some parts may work faster than others or be missed by watering equipment. Spectroscopy and thermography can reveal the dry point of crop wilting. Imaging can also detect leaks in equipment and irrigation channels. More importantly, farmers can use airborne laser scanning technology or software that stitches thousands of high-quality aerial photographs into 3D maps to assess the topography of their land. These maps identify catchments, reveal the direction of water flow at the bottom of each tree in the orchard, and identify other land features that may affect crop health and soil erosion.

Fruit harvesting: Apple picking drones are one of the innovations for [agriculture drones](#). Worker shortage will no longer be an issue with autonomous agriculture drones doing these tasks. However, these harvesting drones are not yet commonly used. These picking Apple drones have a test run in apple and Citrus orchards in Italy, Spain, and the US.

Drone's effective tools for fruit farmers

The most promising ways the drones could be employed for the orchards and tree nurseries are (Susan V. Fisk, 2020)

- Taking inventory of tree height and canopy

volume;

- Monitoring tree health and quality;
- Managing water, nutrients, pests and disease in-season;
- Estimating fruit/nut production and yield; and,
- Creating marketing tools (videos for promotion of the orchard, or sale of trees and fruit).

Yield assessment: In any crop yield assessment and quality measurement is essential to commercial farmers, financial advisors, scientists, and agriculture officials, local and international agencies. UAV-based imaging, especially when combined with AI, not only improves assessment accuracy but also presents opportunities to decrease or do deal with the requirement for field surveys (Mekonnen *et al.* 2020). The total data is helpful for budgeting, anticipating preceding crop requirements to achieve a reasonable yield, insurance needs, planning the harvest to maximize the quality of the output, and predicting storage needs.

Assessment of ripening: The assessment of the ripening stage of fruit was also done by use of UAVs and Machine learning algorithms. Once UAVs captured the images or video from the orchard, then these images are Orth-mosaiced, and preprocessing were done (Sabzi *et al.* 2019). In the ripening stage identification process, the first step is to separate the object of interest (Apple) from the background, then a set of color features is extracted from each segmented object based on a prior study. Further, extract the color feature from the Apple then feed this information to machine learning/ ANN or genetic algorithms to classify the apple as unripe, half ripe, ripe, or over-ripe.

Challenges with Use of Drones in Agriculture

The challenges associated with the use of drones in agriculture are as follows (Prakash *et al.*, 2022)

- **Connectivity issue:** often, online coverage is unavailable in rural areas. Under such circumstances, a farmer needs to invest in internet connectivity, which can turn into a recurring expense.
- **Battery life:** UAVs available today can only fly for a limited time (15-30 min) and for the uninterrupted operation of the drone, frequent charging is required. Unmanned aerial vehicles can be used to their full potential and economic impact only when they are capable to stay in flight for a longer duration.
- **Cost:** The development of UAVs is quite expensive due to the requirement of training and integration of various components, technical and deployment expertise, etc. This makes drones unaffordable to small and marginal farmers for agricultural purposes.
- **Licensing and legislations:** Before UAV deployment, proper licensing and legislation are necessary. The drone operators must be alert about the flight restrictions, restricted airspaces and presence of other small planes in the vicinity.
- **Balancing and stability:** UAV applications such as spraying require a change in payload continuously and this affects the balancing of the drone.
- **Weather conditions:** Weather conditions such as strong winds, precipitation, temperature, etc. can hinder the operation of drones. High temperature reduces the performance of the drones because of the low air density at altitude.
- **Failure-free operation:** The development of failure-free system is critical as there are possibilities of component failures due to poor quality of motors, rotors and controllers. Loss of all communications between the UAV and the control station in case of failures results in havoc on vital information collected.
- **Safety and security:** Accidents, air collisions,

safety and security risks are always associated with drone usage. Also, fault offset delivery in case of critical operations like the application of hazardous pesticides may cause a threat to human life.

- **Privacy:** As UAVs are capable of collecting huge amounts of data from any location, the public may view this as an intrusion to their privacy.
 - **Knowledge and Skill:** Using new technology is a welcoming change but using it daily requires the right skillset and adequate knowledge. An average farmer may struggle to understand drone functions. Either he must acquire the knowledge or remain dependent on an experienced person

CONCLUSION

Drones provide significant benefits in horticultural crops such as water management, fertigation, monitoring, and orchard harvesting decisions. Advances in ICT and electronics will aid in orchard management. These management tactics include pesticide spraying, tree identification, growth assessment, and pruning planning in the orchard, as well as assisting with fruit harvesting and ripening decisions. The system's ultimate goal is to enable an appropriate plan to use the available resources sustainably and also help in increasing the productivity of crops, reducing labor and time, and improvement in resource efficiency.

REFERENCES

- Anonymous. 2023a. Drone technology in agriculture. Crop tracker blog. <https://www.croptacker.com/blog/drone-technology-in-agriculture.html>
- Anonymous. 2023b. The Impact of Drone Technology on Management of Fruit Fly in South Africa. Integrated Aerial Systems. <https://www.linkedin.com/pulse/impact-drone-technology-management-fruit-fly>
- Berni, J., Zarco-Tejada, P.J., Suarez L and Fereres E. 2009. Thermal and Narrowband Multispectral Remote Sensing for Vegetation Monitoring from an Unmanned Aerial Vehicle. IEEE Trans. Geosci. Remote Sens; 47:722-738.
- Gaddikeri, V., Asha, K. R., Satpute, A., Jatav, M. Singh, Rajput, J. and Dimple. 2022. UAVs in Orchard Management: Need, Challenges, and Applications. Just Agric. Multidisciplinary Newsletter. Vol.2 (11): 1-7
- Gulzar, U., Gulzar, U., Jamwal, M., Singh, P., Kour, K. and Bhai, D. 2022. Precision Farming in fruit crops. Sustainable Development for Society, Industrial Development, Material, Energy and Environment: Key Issues. Opportunities and Challenges; Vol(II):167-180.
- Janarth, S. and Pandiya, K.D. 2023. Applications of drones in sustainable horticulture. Compendium of horticultural sciences: 104- 108
- Mekonnen, Y., Namuduri, S., Burton, L., Sarwat, A., & Bhansali, S. (2020). Review—Machine Learning Techniques in Wireless Sensor Network Based Precision Agriculture. Journal of the Electrochemical Society. 167 (3).
- Prakash, S., Kumar, M., Jat, D., Bikram, J., Subeesh, A., Agrawal, K. N., Tiwari, P. S., Mehta, C. R., Singh, P. L. and Singh, K. K. 2022. Applications of Drones in Agriculture: Status and Scope, Division of Agricultural Engineering, ICAR, New Delhi. 1-36
- Sabzi, S., Abbaspour-Gilandeh, Y., García-Mateos, G., Ruiz-Canales, A., Molina-Martínez, J. M., & Arribas, J. I. 2019. An automatic non-destructive method for the classification of the ripeness stage of red delicious apples in orchards using aerial video. Agronomy. 9(2):84.
- Shi, X., Han, W., Zhao, T., & Tang, J. 2019. Decision support system for variable rate irrigation based on UAV multispectral remote sensing. Sensors, 19(13): 2880.
- Srivastava, S., & Sadistap, S. 2017. Non-destructive sensing methods for quality assessment of on-tree fruits: a review. Journal of Food Measurement and Characterization. 12(1): 497-526.

Sudhanshu Singh.2023. Application of drone technology used in horticulture Crop. Agro bios newsletter Engineering and Technology. Vol. XXI (8): 62-65

Susan V. Fisk 2020. Drones' effective tools for fruit farmers. American Society of Agronomy. (<https://www.agronomy.org/news/science->

[news/drones-effective-tools-fruit-farmers-0/](https://www.agronomy.org/news/science-news/drones-effective-tools-fruit-farmers-0/))

Zhang, C., Valente, J., Kooistra, L., Guo, L., & Wang, W. (2021). Orchard management with small unmanned aerial vehicles: A survey of sensing and analysis approaches. Precision Agriculture, 22(6), 2007-2052.

RESEARCH ARTICLE

Production, consumption, and marketing patterns of maize among tribal farmers of Surguja district, Chhattisgarh

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ABSTRACT

Maize is one of India's key cereal crops with rising demand for food, feed, and industrial applications. This study examines the production, consumption, and marketing patterns of maize among tribal farmers in the Surguja district of Chhattisgarh. Data were collected during 2016–17 from 160 tribal maize growers selected randomly from 16 villages across four blocks. The analysis reveals that the majority of respondents belonged to the middle age group (36–55 years) with middle school education and a medium family size. Most farmers were marginal or small holders, with tube-well irrigation being predominant and agriculture constituting their primary occupation. In maize cultivation, improved varieties such as “kanchan” and hybrids like DMH-8255 were widely adopted. The study further assessed the extent of adoption of recommended maize production technologies and found significant positive relationships with factors such as education, social participation, farming experience, land holding, mode of marketing, domestic consumption, benefit–cost ratio, and overall knowledge level. Constraints faced by the farmers included limited technical knowledge on agro-chemicals, inadequate irrigation facilities, and timely availability of quality seeds. Recommendations include enhancing extension services, improving irrigation and input supply systems, and adopting farmer-centric advisory models to boost productivity.

Keywords: Maize, Tribal Farmers, Agricultural Extension, Technology Adoption, Surguja,

INTRODUCTION

Maize plays a pivotal role in India's agricultural landscape and is increasingly significant due to its diverse uses—from human consumption to animal feed and industrial starch production. Despite its potential, the national average yield remains substantially lower than world standards. This discrepancy is more pronounced among tribal farmers, who often face constraints such as limited access to technology, inadequate irrigation, and suboptimal marketing channels. The present study focuses on tribal maize growers in Surguja district, Chhattisgarh, an area where maize is a major crop, to explore

their production practices, consumption patterns, and marketing strategies, along with the extent of adoption of improved production technologies. This research aims to generate insights that could inform policy and extension initiatives geared toward enhancing maize productivity and sustainability.

MATERIALS AND METHODS

The study was conducted in the Surguja district of Chhattisgarh during the 2016–17 cropping season. Out of seven blocks, four (Ambikapur, Lundra, Lakhanpur, Batouli) were randomly selected. From each block, four

villages were chosen, and within each village, 10 tribal maize growers (cultivating maize during the Kharif season) were selected, making a total sample of 160 respondents. Data were collected through a pre-tested interview schedule covering socio-demographic characteristics, production practices, consumption patterns, marketing channels, and the extent of adoption of recommended maize production technologies. Statistical analyses—including frequency distributions, correlation analysis, and multiple regression—were employed to determine significant relationships between various socio-economic variables and technology adoption levels.

RESULTS AND DISCUSSION

3.1 Socio-demographic Profile

The majority of the respondents were aged 36–55 years and had received education up to the middle school level. A medium-sized family (6–10 members) was common, and over 60% of the respondents reported participation in one or more social organizations. Farming experience was moderate (11–20 years for 54% of the respondents), suggesting a balance between traditional practices and openness to innovation.

3.2 Production and Consumption Patterns

Most tribal farmers were classified as marginal (land holding up to 1 ha) or small farmers (1.1 to 2 ha). Tube-well irrigation was the primary source of water, used by approximately 60% of respondents. In maize cultivation, improved varieties (e.g., “kanchan”) and hybrids (e.g., DMH-8255) were cultivated, while all farmers reported using maize for domestic consumption. The benefit–cost ratio for maize production averaged 1.70, indicating modest profitability under current production practices.

3.3 Adoption of Maize Production Technology

The study assessed the level of adoption of recommended maize production

technologies. Results indicate that 51.25% of respondents had a medium overall level of adoption, with variations in adoption across different practices (e.g., land preparation, storage, variety selection). Correlation and regression analyses showed that education, social participation, farming experience, land holding, mode of marketing, domestic consumption, benefit–cost ratio, and knowledge level were positively and significantly associated with the extent of technology adoption. In contrast, variables such as age, family size, source of information, and irrigation facility did not exhibit a significant influence.

3.4 Constraints and Farmer Suggestions

Key constraints identified included:

- Insufficient technical knowledge regarding the correct use and quantity of agro-chemicals
- Lack of adequate irrigation facilities
- Non-availability or delayed availability of quality hybrid seeds at the appropriate time

Farmers suggested that improvements in protective measures during cob formation, enhanced irrigation support, and better extension services with accurate information on input application would be critical to overcoming these constraints.

CONCLUSION

The study highlights that while tribal maize growers in Surguja district are making efforts to adopt improved production technologies, several systemic constraints hinder their full potential. Critical factors such as education, social participation, and adequate land holding significantly influence the adoption process. Addressing the gaps in extension services, improving access to irrigation and quality inputs, and promoting farmer education could substantially enhance productivity and profitability. These findings have important implications for policymakers and extension agencies seeking to design targeted interventions that support the sustainable development of

maize production among tribal farmers.

REFERENCES

- Anonymous. (2011). Maize consumption patterns in India.
- Choudhary, R.P., Singh, P. and Mishra, B. 2001. Correlates of adoption of improved rice production technology. *Indian Journal of Extension Education*, 37(3 & 4): 200-201.
- Department of Agriculture, Raipur. (2015-16). *Agricultural Statistics of Chhattisgarh*.
- Deshmukh, A.N. and Deshmukh, S.J. 2013. *Constraints in Production and marketi-*
- Dhruw, K.S. 2008. A study on adoption of recommended maize production technology among the farmers of Kanker district of Chhattisgarh State. Unpublished M.Sc. (Ag.) Thesis, IGKV, Raipur, (C.G.).

IFPRI. (2000). *Global Cereal Demand Projections*.

ing of Soybean. *Agriculture Update*, 8(1 & 2): 64-66.

Jaisridhar, P., Ravichandran, V., Jadour, Y.S. and R.S. Kumar. 2011. Study on adoption and marketing behaviour of maize growers in coimbatore district of tamil nadu. *Indian J. Agric. Res.*, 46(2): 173–177.

Mukherjee, S. (2012). *Agricultural Productivity in India*.

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RESEARCH ARTICLE

Climate change and agriculture: impacts, adaptation, and mitigation strategies

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ABSTRACT

Climate change poses significant challenges to global agriculture, affecting crop yields, soil health, and food security. This review examines the impacts of climate change on agriculture, the adaptation strategies employed by farmers, and mitigation measures to reduce greenhouse gas emissions. It provides an extensive analysis of the current literature and evaluates the effectiveness of various adaptation and mitigation strategies across different agricultural systems, with a specific focus on India.

INTRODUCTION

Agriculture is both a victim and a contributor to climate change. Rising temperatures, changing precipitation patterns, and increasing frequency of extreme weather events threaten food production systems worldwide (Lobell & Gourdji, 2012). Numerous studies highlight that global warming is altering traditional agricultural practices and increasing climate variability, making it more difficult for farmers to predict planting and harvesting seasons (Challinor et al., 2014). Simultaneously, agriculture is a major source of greenhouse gas emissions, contributing to methane emissions from livestock, nitrous oxide emissions from fertilizers, and carbon dioxide from deforestation and land-use changes (Allen et al., 2018).

Research indicates that without adaptation, global crop yields could decline significantly, threatening food security for millions (Rosenzweig et al., 2014). The increased frequency of extreme weather events, such as hurricanes, floods, and droughts, further exacerbates these challenges. Understanding

these impacts and exploring viable adaptation and mitigation measures is essential for sustainable agricultural practices and long-term food security (Altieri & Nicholls, 2017). This review synthesizes the latest research on climate change impacts on agriculture, adaptation strategies, and mitigation measures, with an emphasis on Indian agriculture.

REVIEW OF LITERATURE

Changes in Temperature and Precipitation

Numerous studies indicate that global warming is leading to increased heat stress on crops, altering growth periods, and reducing yields (Anderson & Holland, 2020). In India, studies highlight a decline in wheat yields due to increasing temperatures and changing rainfall patterns (Kumar et al., 2004). Heat stress reduces photosynthesis efficiency, leading to lower productivity in staple crops such as wheat, rice, and maize (Challinor et al., 2014). Additionally, droughts and irregular rainfall patterns are becoming more frequent, affecting water availability for irrigation and crop development

(Lobell & Gourdji, 2012).

Soil Degradation and Nutrient Loss

Climate change accelerates soil erosion, decreases organic matter, and disrupts nutrient cycles (Derner & Schuman, 2007). Rising soil salinity due to increased evaporation rates and sea-level rise threatens agricultural productivity in coastal regions of India (Mall et al., 2006). Additionally, research highlights that increased atmospheric CO₂ alters soil microbial communities, affecting nutrient availability and soil fertility (Rosenzweig et al., 2014).

Pests and Diseases

Warmer temperatures create favorable conditions for pests and plant diseases, leading to increased outbreaks and crop losses (Altieri & Nicholls, 2017). Literature reviews highlight shifts in pest populations and the emergence of new threats due to altered ecosystems. For instance, the expansion of insect pest ranges has led to increased pesticide use, which negatively affects biodiversity and pollinators (Anderson & Holland, 2020).

Livestock and Fisheries

Heat stress in livestock reduces productivity and reproductive efficiency, leading to lower meat and dairy yields (Challinor et al., 2014). In India, dairy production is particularly affected by increased heat stress on cattle (Naresh Kumar et al., 2011). Ocean temperature changes affect fish populations, altering migration patterns and availability for fisheries, impacting global food security. Additionally, increased ocean acidification reduces shellfish populations and disrupts aquatic food chains (Lobell & Gourdji, 2012).

Adaptation Strategies

Climate-Resilient Crops

The development and adoption of drought-resistant, heat-tolerant, and flood-resistant crop varieties are critical adaptation measures (Challinor et al., 2014). Advances in

genetic engineering and traditional breeding methods play a role in creating resilient crops. Research highlights the role of gene editing technologies such as CRISPR-Cas9 in improving stress tolerance (Altieri & Nicholls, 2017).

Sustainable Farming Practices

Conservation agriculture, agroforestry, crop diversification, and improved water management strategies are effective in mitigating the adverse effects of climate change (Derner & Schuman, 2007). Literature supports the role of integrated soil fertility management in enhancing crop resilience. For example, cover cropping and no-till farming help maintain soil moisture and prevent erosion (Rosenzweig et al., 2014).

Technological Innovations

Precision agriculture, remote sensing, and data-driven decision-making are increasingly employed to optimize resource use and improve farm productivity (Anderson & Holland, 2020). Digital tools such as AI-based weather forecasting and IoT-enabled irrigation systems help farmers respond to climate variability with real-time data. The use of blockchain for supply chain transparency also improves resilience (Altieri & Nicholls, 2017).

Policy and Institutional Support

Governments and international organizations are implementing policies to promote sustainable agriculture (Allen et al., 2018). In India, government initiatives such as the National Adaptation Fund for Climate Change (NAFCC) and Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aim to support climate adaptation in agriculture. Subsidies for climate-smart agricultural practices and support for research and development are essential for long-term adaptation (Rosenzweig et al., 2014).

Mitigation Strategies

Reduction of Greenhouse Gas Emissions

Improved livestock management, efficient use of fertilizers, and sustainable land-

use practices can significantly reduce agricultural emissions (Derner & Schuman, 2007). Carbon sequestration through agroforestry and soil conservation also plays a crucial role. Studies highlight the benefits of rotational grazing and organic farming in reducing emissions (Lobell & Gourdj, 2012).

Renewable Energy Integration

Transitioning to renewable energy sources for farm operations, such as solar-powered irrigation and biogas from agricultural waste, contributes to sustainability and reduces reliance on fossil fuels (Altieri & Nicholls, 2017). The adoption of vertical farming and controlled-environment agriculture has shown promise in reducing energy use and emissions (Challinor et al., 2014).

Circular Economy in Agriculture

Utilizing agricultural waste for bioenergy, composting, and recycling nutrients within farming systems minimizes environmental impact and enhances sustainability (Anderson & Holland, 2020). Research indicates that biochar application in soils can enhance carbon sequestration and improve soil fertility (Rosenzweig et al., 2014).

CONCLUSION

Climate change presents multifaceted challenges to global agriculture, necessitating urgent adaptation and mitigation measures. A combination of technological advancements, policy interventions, and sustainable practices can enhance agricultural resilience and contribute to climate change mitigation. Future research should focus on region-specific adaptation strategies, socio-economic implications of climate-smart agriculture, and technological innovations that optimize resource efficiency.

REFERENCES

Aggarwal, P. K. (2008). Global climate change and

Indian agriculture: Impacts, adaptation, and mitigation. *Indian Journal of Agricultural Sciences*, 78(10), 911-919.

Allen, M. R., Dube, O. P., Solecki, W., Aragón-Durand, F., Cramer, W., Humphreys, S., ... & Zickfeld, K. (2018). *Global warming of 1.5°C: An IPCC special report on the impacts of global warming*. Intergovernmental Panel on Climate Change (IPCC).

Altieri, M. A., & Nicholls, C. I. (2017). The adaptation and mitigation potential of traditional agriculture in a changing climate. *Climatic Change*, 140(1), 33-45.

Anderson, C. L., & Holland, T. (2020). Precision agriculture and climate change: A review of current research and future directions. *Journal of Agricultural Science*, 12(3), 45-58.

Challinor, A. J., Watson, J., Lobell, D. B., Howden, S. M., Smith, D. R., & Chhetri, N. (2014). A meta-analysis of crop yield under climate change and adaptation. *Nature Climate Change*, 4(4), 287-291.

Dasgupta, P., Morton, J. F., Dodman, D., Karapinar, B., Meza, F., Rivera-Ferre, M. G., ... & Toure Sarr, A. (2014). Rural areas. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability* (pp. 613-657). Cambridge University Press.

Derner, J. D., & Schuman, G. E. (2007). Carbon sequestration and rangelands: A synthesis of land management and precipitation effects. *Journal of Soil and Water Conservation*, 62(2), 77-85.

Dinesh, D., Campbell, B. M., Bonilla-Findji, O., & Richards, M. (2017). *10 best bet innovations for adaptation in agriculture: A supplement to the UNFCCC NAP Technical Guidelines*. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Gornall, J., Betts, R., Burke, E., Clark, R., Camp, J., Willet, K., & Wiltshire, A. (2010). Implications of climate change for agricultural productivity in the early twenty-first century. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 2973-2989.

Gupta, R., & Seth, A. (2007). A review of resource-

- conserving technologies for sustainable management of the rice-wheat cropping systems of the Indo-Gangetic plains. *Crop Protection*, 26(3), 436-447.
- IPCC. (2021). *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
- Jain, S., Sinha, R., & Sharma, T. (2018). Impact of climate change on water resources and agriculture in India. *Journal of Earth System Science*, 127(5), 1-13.
- Jat, M. L., Saharawat, Y. S., & Gupta, R. (2011). Conservation agriculture in the Indo-Gangetic plains of India: Past, present, and future. *International Journal of Agricultural Sustainability*, 9(1), 5-15.
- Joshi, P. K., Gulati, A., & Cummings, R. W. (2007). Agricultural diversification towards high-value crops in India: The role of smallholders. *International Food Policy Research Institute (IFPRI)*.
- Kaur, R., Kumar, S., & Yadav, S. (2019). Impact of climate change on crop productivity in Punjab: Issues and challenges. *Indian Journal of Agricultural Sciences*, 89(1), 34-41.
- Kumar, K., Parikh, J., & Kavi Kumar, M. (2004). Climate change impacts on Indian agriculture: The Ricardian approach. *Economic and Political Weekly*, 39(45), 4718-4722.
- Kumar, S. N., Aggarwal, P. K., Rani, S., Jain, S., Saxena, R., & Chauhan, N. (2011). Impact of climate change on crop productivity in India. *Agricultural Systems*, 109(2), 114-125.
- Kumar, S., & Gautam, H. R. (2014). Climate change and its impact on agricultural productivity in India. *Journal of Climatology & Weather Forecasting*, 2(1), 1-5.
- Lobell, D. B., & Gourdji, S. M. (2012). The influence of climate change on global crop productivity. *Plant Physiology*, 160(4), 1686-1697.
- Mall, R. K., Gupta, A., Singh, R., Singh, R. S., & Rathore, L. S. (2006). Water resources and climate change: An Indian perspective. *Current Science*, 90(12), 1610-1626.
- Naresh Kumar, S., Aggarwal, P. K., Rani, S., Saxena, R., Chauhan, N., & Jain, S. (2011). Impact of climate change on crop productivity in India. *Agricultural Systems*, 109(2), 114-125.
- Pattanayak, A., & Pattanayak, S. K. (2019). Climate change, agriculture, and food security in India: Adaptation strategies. *Journal of Agrometeorology*, 21(2), 157-168.
- Rao, C. H., Radhakrishna, R., & Hanumantha Rao, C. (2005). *Agriculture, food security, poverty, and environment: Essays on post-reform India*. Oxford University Press.
- Ramankutty, N., Evan, A. T., Monfreda, C., & Foley, J. A. (2008). Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000. *Global Biogeochemical Cycles*, 22(1), GB1003.
- Rosenzweig, C., Elliott, J., Deryng, D., Ruane, A. C., Müller, C., Arneth, A., ... & Jones, J. W. (2014). Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. *Proceedings of the National Academy of Sciences*, 111(9), 3268-3273.
- Sharma, B. R., Rao, K. V., Vittal, K. P. R., Amarasinghe, U. A., & Sikka, A. (2010). Realizing the potential of rainfed agriculture in India. *Agricultural Water Management*, 97(8), 1086-1096.
- Sinha, S. K., & Swaminathan, M. S. (1991). Deforestation, climate change, and sustainable nutrition security: A case study of India. *Ambio*, 20(3), 150-155.
- Srivastava, A. K., Naresh Kumar, S., & Aggarwal, P. K. (2010). Assessment on vulnerability of Indian wheat to climate change. *Agricultural Ecosystems & Environment*, 138(3-4), 267-273.
- Vermeulen, S. J., Campbell, B. M., & Ingram, J. S. (2012). Climate change and food systems. *Annual Review of Environment and Resources*, 37, 195-222.
- Yadav, S., Yadav, M. P., Singh, R. K., & Kumar, R. (2020). Climate change and sustainable agriculture in India: Challenges and opportunities. *Environment, Development and Sustainability*, 22(6), 4995-5012.

RESEARCH ARTICLE**An economic study of technology adoption gap of Cotton crop in Vidarbha region****Devyanee K. Nemade¹, S. A. Gawande², R. T. Katole³ and Aruna Katole⁴**

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ABSTRACT

Cotton is a major commercially crop of the Vidarbha region and keeping in view the importance of IPM to manage the insects and pests of cotton crop, the study was a Impact of Input and yield gaps of IPM technology on Cotton of Vidarbha region: Principal Component Approach with the main objective of this topic, to assess the extent of adoption of recommended technology in Cotton production, to study the input utilization in Cotton at different level of adoption of IPM technology, to estimate the input and yield gap of Cotton at different level of adoption of IPM technology,

The present study was carried out by Akola and Buldhana district in Vidarbha region of Maharashtra State. From this districts three tahasil were selected i.e. Akola, Akot and Sangrampur tahasils and total 120 farmers were selected from seven villages. viz. Khambora, Mandala, Kinkhed Purna, Rambhapur, Sangrampur, Khiroda and Varvat Khanderao. The primary data were collected by simple random sampling method and the data pertains to year 2022-23.

The study, objectives of this topic, to assess the extent of adoption of selected IPM technology by using principle component analysis approach and for develop the composite index, to study the input utilization at different level of adoption of IPM technology, to analyse the input gap and yield gap of Cotton at different level of adoption of IPM technology,

In all 120 farmers, 19 farmers under high level of adoption group i.e. above 78.11 per cent, 79 farmers under medium level of adoption group i.e. above 63.35 to 78.11 per cent while 22 farmers under low level of adoption group i.e. below 63.34 per cent in technology adoption range.

Extent of adoption of in all technologies were highest in high adoption level group. Moreover, use of Pheroman trap, light trap and Yellow sticky trap, use of trichograma and FYM is negligibal used in low adopter groups.

The result of input utilization, the human labour utilization was highest in high adoption level group. In all three adoption level, seed rate, use of resistant variety were used at recommendation level and sowing time nearer to recommended level in all three categories. Farm yard manure, highest used in high adopter group i.e. 30.68 quintal per hectare followed by medium adopter(16.80 qtl/ha) and low adopter(14.05 qtl/ha). In low adopter group shows that negligible use in Farm yard manure. The results of fertilizer(NPK) application shows that, more used at recommended level in all three categories.

Per hectare yield was highest in high adopter group i.e. 16.64 quintal followed by medium adopter group i.e. 14.01 quintal while it was lowest for low adopter group i.e. 12.71 quintal.

In case of Input gap, the use of FYM were observed that 35.95 kg, 33.20 kg, 19.32 kg per hectare for low, medium and high adopter group respectively. It meanse no one can fully adopted the recommended level of FYM dose because the farmers can apply only owned farm FYM.

The highest total yield gap of 2.29 quintal per hectare was observed in low adopter group,

followed by 0.99 quintal per hectare yield gap in medium adopter and comparatively more yield was observed i.e. 1.64 quintal per hectare in high adopters.

Key words : Principal Component Analysis, Input gap, Yield gap, Composite Index and extent of adoption

INTRODUCTION

In India, the first IPM programme was the Operational Research Project (ORP) during 1974-75 (Swaminathan, 1975) in cotton and rice. The main objective of IPMP is to promote and support safe, effective and environmentally sound pest management. Nearly 130 species of insect pests occur on Indian cotton with a dozen of these arthropods requiring their management for realizing better cotton yields. Sucking pests viz. Jassids, Aphids, Whiteflies & thrips are deleterious to the process of cotton growth and development with their ability to build up to serious proportions as a result of rapid and prolific breeding in cotton plant. While direct effects of sucking pests during early season are visualized in terms of poor crop stand and yield reduction, their late season attack (especially aphids and whiteflies) indirectly decreases cotton fiber quality due to deposits of honey dew on lint. The reproductive phase of cotton crop growth suffers damage inflicted by bollworm complex consisting three genera of bollworms viz. Spotted boll worm, American bollworm & Pink bollworm. IPM is an essential component for a sustainable cotton production system having two essential elements. First comprises a series of measures which help in keeping insect pests below economic threshold levels (ETL). Such control methods include natural control agents, host plant resistance, manipulation of agronomic factors such as rotation, spacing, time of sowing and fertilizer applications beside biological control and use of botanicals.

Keeping in view of these aspects the study was planned and undertaken with specific objectives, i.e. to assess the extent of adoption of selected technologies, to study the input utilization in Cotton at different level of

adoption of IPM technology, to estimate the input and yield gap of Cotton at different level of adoption of IPM technology.

Objectives:

1. To assess the extent of adoption of selected technologies
2. To study the input utilization at different level of adoption of IPM technology
3. To analyse the input gap and yield gap of Cotton at different level of adoption of IPM technology

METHODOLOGY

As study relates to Impact of Input and yield gaps of IPM technology on Cotton Production technology recommended by Dr. PDKV, Akola, the recommended technologies were considered with the consultation of Entomologist and Cotton research unit.

The study was undertaken in Akola and Buldhana district of Vidarbha region. The study is based on Primary data and Cotton area cultivation. There are three tahsils namely Akola, Akot and Sangrampur were selected on the basis of area under cotton cultivation and the simple random sampling technique, seven villages were selected from three tahasil i.e. Khambora, Madala, Kinkhed Pruna, Rambhupur, Sangrampur, Khiroda, Varvat Khanderao. Total 120 cultivators were selected for collecting the required information. The data pertains to the year 2022-23.

Analytical techniques :

The Impact Assessment of Integrated Pest Management on Cotton Production technology recommended by Dr. PDKV, Akola were worked out extent of adoption of technologies, input utilization, input gap and yield gap at

different level of adoption of IPM technologies.

1. To assess the extent of adoption of selected technologies.

For the first objective of the study, the extent of adoption of technologies of Cotton crop following formulae was used,

$$TAI = \frac{1}{k} \left[\frac{AX_1 + AX_2 + \dots + AX_k}{RX_1 + RX_2 + \dots + RX_k} \right] \times 100$$

Where,

TAI = Technology Adoption Index

K = No. of technologies

Axi = Actual use of selected technology

Rxi = Recommended use of selected technology.

The Principle components of technology recommended by the University for Cotton crop expressed in terms of adoption score ($X_1, X_2, \dots, X_n$) were utilized for developing technological adoption index of technology adopted. A technological adoption index is a single numerical value representing the net adoption of all components of technologies whose value lies between 0 to 1.

Development of composite Index :

The components of technology recommended by the University for cotton crop expressed in terms of adoption score ($X_1, X_2, \dots, X_{19}$) were utilized for developing composite index of technology adopted. A composite index is a single numerical value representing the net adoption of all components of technologies whose values lies in between 0 and 1.

The Principle component analysis (PCA) approach was used for developing composite index. The principle components based on 19 x 19 co-rrrelation matrix of 19 component of technology were computed. A set of 19 principle component explaining 100 per cent of total variation of all components of recommended technology were considered.

Consider 19 eigen vectors in the form of

19 x 19 matrix where rows represent variables and columns represent eigen vectors from which weight (w_i) coefficient of component of technology say was determined as under.

$$W_i = \frac{M_i}{\sum M_i}$$

Where,

W_i = Weight

M_i = Maximum element in ith row

M_i = Sum of maximum element in ith row.

The components of technologies recommended by the University for Cotton were identified and then the level of adoption of each component of recommended technology be the farmer is expressed in terms of adoption scores and same is utilized for developing composite score of technology adoption.

In this process, weights were properly scaled so that the composite scores lie in between 0 and 1. Composite scores were computed for all selected farmers using the following function.

Development of composite Index(scores) of technology:

The estimated composite adoption score (S_i) is;

$$S_i = W_1X_1 + W_2X_2 + \dots + W_{19}X_{19}$$

Where,

S_i = Composite Index of i^{th} farmers,

X_1 = Grazing Animals,

X_2 = Burning of Plant, debris and cleaning campaign,

X_3 = Ploughing, X_4 = Sowing time,

X_5 = Resistant variety, X_6 = Seed rate,

X_7 = FYM, X_8 = Nitrogen, X_9 = Phosphorous,

X_{10} = Potassium, X_{11} = Crop Rotation,

X_{12} = Intercropping, X_{13} = Spacing between

the plant, X_{14} = Removal of Rosette flower

and removal of infested plant parts, X_{15} =

Use of Phromane trap/Light trap/ Yellow sticky trap, X_{16} = Installation of Bird perches, X_{17} = Use of Trichhogamma card, X_{18} = Use of bio logical control, X_{19} = Use of pesticide, W_i = Use of weight given of i^{th} technology

Which provides adoption index (of all component of technologies) for each cultivators. The composite index obtained in the process lie in between 0 & 1.

The net adoption of recommended technologies expressed in terms of “Technological adoption Index” of the 120 farmers are classified as below.

Low adopter = Mean - SD

Medium adopter = Mean - SD to Mean + SD

High Adopter = Mean + SD

2. To study the input utilization at different level of adoption of IPM technology.

The objective of the input utilization at different level of adoption of IPM technology were worked out by on the basis of level of adoption i.e. low, medium and high level of adoption of technologies.

3. To analyse the input gap and yield gap of Cotton at different level of adoption of IPM technology.

Input Gap:

Input Gap = Recommended Input - Actual Input used

1. Seed(Kg)
2. Organic Manures (qt)
3. Chemical Fertilizers N & P (kg)

Yield Gap:

It was estimated by tabular method.

Yield gap I = $Y_p - Y_d$

Where,

Y_p = Potential Yield

Y_d = Demonstration yield

Yield gap II = $Y_d - Y_a$

Y_d = Demonstration yield

Y_a = Actual Yield

Total Yield gap I = $Y_p - Y_a$

Y_p = Potential Yield

Y_a = Actual Yield

RESULTS AND DISCUSSION

Keeping in view the objectives of the study, the data were analysed using suitable techniques. The results obtained from this study have been presented and discuss critically.

Adoption range of different adopter group on the basis of Composite Index:

The adoption index calculated the levels of adoptions and the distribution of 120 farmers as per their adoption level of recommended technologies is presented in table 1.

Table: 1 Adoption range of different adopter group in Cotton.

S.N.	Particular	Low Adopter	Medium Adopter	High Adopter
1.	Total number of farmers	120		
2.	Adoption Range	Below 63.34	63.35 to 78.11	Above 78.11
3.	No. of farmers	22	79	19
4.	Percentage to number of farmer	18.33	65.83	15.84

The technology adoption index for each recommended technology were estimated with the help of mean and standard deviation. The adoption levels were calculated and accordingly, the adoption of each technology under low, medium and high adoption level.

The table 1. show that the farmers whose adoption index was below 63.34 per cent were distributed into low adoption group, The farmers whose adoption index was between 63.35 to 78.11 per cent were distributed into medium group and similarly the farmers with composite adoption index more than 78.11 per cent were categorized among the high level of adopters. Out of 120 selected farmers, 19 farmers had high level of adoption with composite adoption index, above 78.11 per cent, 79 farmers had medium level of adoption with

composite adoption index 63.35 to 78.11 per cent while 22 farmers had low level of adoption with composite adoption index of below 63.34 per cent. It is concluded that the highest percentage of adoption level of technology was above 88.37 per cent. It means recommended technologies were not fully adopted in high adoption level categories.

Extent of Adoption technology:

Actual level of adoption of each item of technologies by farmer's was identified with the help of recommended technologies developed by Dr.P.D.K.V., Akola. The efficiency of each technology was calculated. All efficiency score was scaled down to 0 to 1. All the selected farmers having more or less similar type of soil, therefore, the recommendation of soil type was not considered.

Table 2 : Extent of Adoption of Technology

S.N.	Particular	Extent of Adoption (%)		
		Low adopter (N = 22)	Medium adopter (N = 79)	High adopter (N = 19)
1.	Cultural Practices			
	Farm preparation (Grazing, Burning of Plant debris & Field Pre.)	86.36	93.67	94.74
	Sowing time	90.91	91.14	100.00
	Short & Medium duration variety	100.00	100.00	100.00
2.	Seed Rate	100.00	100.00	100.00
3.	FYM	25.37	33.61	38.01
4.	Fertilizer			
	N	111.48	109.70	104.43
	P	140.60	136.16	136.58
	K	139.55	115.85	112.51
5.	Inter cropping	45.45	73.42	84.21
6.	Crop Rotation	77.27	88.61	100.00
7.	Mechanical Control			
	Proper Spacing	86.36	91.14	94.74
	Removal of Rosette flower and removal of infested plant parts	27.27	64.56	89.47
	Use Pheromone trap/Light trap/Yellow Sticky trap	9.09	21.52	52.63
	Installation of Bird perches	18.18	40.51	63.16
8.	Biological Control			
	Biological Spray	4.55	31.65	47.37
	Use of Trichogramma Card	0.00	10.13	31.58
9.	Chemical Control			
	Use of Pesticide	100.00	72.15	57.89

It is observed from the table 2. that among the recommended technologies all level, the cultural control technology of IPM, the use of resistant variety has been adopted at 100.00 per cent. Sowing time was followed by the recommended level i.e. 90.91, 91.14 and 100. Per cent in low, medium and high adopter categories respectively. Seed Rate used in cotton growers was 89.97, 96.97 and 99.47 per cent respective categories. Among the comparison of all three adoption levels, the Nitrogen, Phosphorus and Potassium was not used at recommended level in all three categories. It means the fertilizers was used by farmers more, at recommended level, in all three categories. The lowest adoption was observed in farm yard manure application i.e. 25.37, 33.61 and 38.01 per cent in low, medium and high adopter categories. The reasons of low application of FYM, farmers used only owned farm FYM. In case of mechanical control of IPM technology, the highest adoption was proper spacing and Removal of Rosette flower and removal of infested plant parts in both high and medium adopter categories. For use of pheromone trap it was highest in high adopter group i.e 52.63 per

cent followed by medium and low adopter category i.e 21.52 and 9.09 per cent respectively.

In biological control of IPM technology has been adopted 78.95 per cent in high adoption group. In case of low adopter group not used in biological control. It means Farmers was not aware and lack of knowledge of biological control. In case of chemical control, was used 100 per cent in low adopter group followed by medium (72.15 %) and high adopter group (57.89%).

In overall study, concluded that the adoption of all 18 technologies were highest in high adoption level group. Moreover, technology of sowing time, use of resistant variety, use of trichoderma, FYM and biological control is very negligible use in low adopter group. It was due to unawareness about the importance and proper knowledge about the technologies

Input Utilization

The information about per hectare physical input used by selected farmer according to their adoption of recommended technology level is shown in table 3.

Table 3. Input utilization at different level of adoption of IPM technology (Per ha)

S.N.	Input utilization	Unit	Low adopter (N = 22)	Medium adopter (N = 79)	High adopter (N = 19)
1.	Male Labour	Days	32.60	34.53	31.86
2.	Female Labour	Days	73.59	75.17	81.34
	Total Human Labour	Days	106.19	109.70	113.20
4.	Bullock Labour	Days	7.66	7.36	7.59
5.	Machine Labour	hrs	24.21	27.54	32.09
6.	Seed rate	Kg/ha	2.34	2.30	2.26
7.	FYM	Qtl/ha	14.05	16.80	30.68
8.	Fertilizer				
	N	Kg/ha	66.89	65.82	62.66
	P	Kg/ha	42.18	40.85	40.97
	K	Kg/ha	41.87	34.76	33.75

From the table 3, it was revealed that per hectare labour utilization was observed in small, medium and high levels of group i.e.

106.19, 109.70 and 113.20 days respectively. It was observed that the human labour utilization was highest in high adoption level

group. Per hectare seed rate was used at recommended level in all three categories i.e. 2.00 kg to 2.50 kg per hectare. It shows that, in all three adoption level, seed rate was recommendation level.

Machinery charges were the highest for high adopter group i.e 32.09 hours per hectare followed by medium adopter with 27.54 hours per hectare.

Among the farm yard manure, highest used in high adopter group i.e. 30.68 quintal per hectare followed by medium adopter(16.80 qtl/ha) and low adopter(14.05 qtl/ha). In low adopter group shows that negligible use in FYM. The reasons of low application of FYM, farmers is apply only owned farm FYM due to shortage of cattle population.

In case of use of nitrogen fertilizer for low, medium, high adopter group was 66.89 kg per hectare, 65.82 kg per hectare, 62.66 kg per hectare respectively. And for the phosphorus, was adopted 42.18 kg per hectare, 40.85 kg per hectare, 40.97 kg per hectare for low, medium, high adopter groups respectively. Among potassium fertilizer were used 41.87 kg per hectare, 34.76 kg per hectare and 33.35 kg per hectare for low, medium, high adopter group respectively. The results of application of fertilizer shows that NPK was used more at recommended level in all three categories.

Input gap and yield gap of Cotton:

As per the recommendations given by University the per hectare use of inputs and per hectare input used by selected farmers were considered for estimation of the per hectare input gap and yield gap on sample farm. The yields gap were estimated by actual yield of low adopter, medium adopter and high adopters groups are compared with the potential yield and demonstration yield. The per hectare input gap and yield gap to their different level of adoption of recommended technology is shown in table 4 and 5.

Input gap at different level of adoption of IPM technology:

Input gap was estimated by deducting actual input used from recommended level of input and is presented in table 4. The input gap was calculated at the different level of the adoption of IPM technology with the help of comparing with actual recommended technologies by the Dr.P.D.K.V, Akola. Input gap was calculated on the basis of the recommended use of input and actual use of the input by the different level of the adopter. From which the result obtain which show that the different input gap for different level of the adoption of the IPM technology these are in respect of the following inputs.

Table 4: Input gap of Cotton crop (Per ha)

S.N.	Particular	Unit	Recommended	Low adopter (N = 22)	Medium adopter (N = 79)	High adopter (N = 19)
1.	Seed rate	Kg/ha	2.00 to 2.50	0 (2.34)	0 (2.30)	0 (2.26)
2.	FYM	Qtl/ha	50	-35.95 (14.05)	-33.20 (16.80)	-19.32 (30.68)
3.	Fertilizer					
	N	Kg/ha	60	6.89 (66.89)	5.82 (65.82)	2.66 (62.66)
	P	Kg/ha	30	12.18 (42.18)	10.85 (40.85)	10.97 (40.97)
	K	Kg/ha	30	11.87 (41.87)	4.76 (34.76)	3.75 (33.75)

Note: Figures parenthesis indicates the actual use of Input.

From table 4, it is revealed that the recommended dose of the seed rate was 2.00 to 2.5 kg per hectare. The result of input gap, for the use of seed rate with respect to recommended use for low, medium and high adopter group gap was observed that 2.34 kg/ha, 2.30 kg/ha, 2.26 kg per hectare respectively. It means the seed rate was used in recommended level.

In respect of the FYM input gap is very high for the three level of adopter of the IPM technology. No one can fully adopted the recommended level of FYM dose because the farmers can use only owned

farm FYM. In case of fertilizer, application of nitrogen, phosphorus and potash doses were used as a more at recommended level for all three categories, it means application of fertilizer additional used as recommended level. It has been reflected in the productivity levels of the crop.

Yield Gap of selected farmer at different level of adoption

The input gaps are directly associated to the productivity level of selected sample. The results are shown in table 5.

Table 5: Yield Gap of selected farmer in Cotton Crop production (qtl/ha)

S.N.	Input utilization	Unit	Low adopter (N = 22)	Medium adopter (N = 79)	High adopter (N = 19)
1.	Actual Yield	qtl/ha	12.71	14.01	16.64
2.	Potential Yield	qtl/ha		15	
3.	Demonstration Yield	qtl/ha		22	
4.	Yield Gap	qtl/ha			
	Yield Gap I ($Y_p - Y_d$)			07	
	Yield Gap II ($Y_d - Y_a$)		9.21	7.99	5.36
	Total Yield Gap I ($Y_p - Y_a$)		2.29	0.99	-1.64
5.	Maximum Yield	qtl/ha	13.72	15.37	18.23
6.	Maximum Yield Gap (Actual Yield – Maximum Yield)	qtl/ha	1.01	1.36	1.59

From the table 5. it is revealed that the per hectare actual yield of low, medium and high adopters categories was 12.71 quintal, 14.01 quintal and 16.64 quintal per hectare respectively. The potential yields of cotton (BT Cotton) was 15 quintal per hectare. The demonstration yield of same variety was 22.00 quintal per hectare on University farms. There was yield gap I, difference of potential yield and demonstration yield was 7 quintal per hectare. The result shows that the demonstration yield was more than the potential yield and hence it shows in negative value.

Yield gap II was calculated by

subtracting the actual yield received by farmers from demonstration yield. It is observed that there was a yield gap II 9.21 quintal per hectare, 7.99 quintal per hectare and 5.36 quintal per hectare in low, medium and high adopter group respectively.

The total yield gap was estimated by subtracting the actual yield from the potential yield of cotton. The highest total yield gap of 2.29 quintal per hectare was observed in low adopter group, followed by 0.99 quintal per hectare yield gap in medium adopter and high adopters group was observed more yield as compared to potential yield i.e. 1.64 quintal per hectare more

yield in high adopter group . Hence, it is concluded that, the adoption of recommended technologies, reduces the yield gap and ultimately the net returns increases in high adopter group.

CONCLUSIONS

The results emerged from this study are summarized in the following conclusion.

1. All 120 farmers, 19 farmers under high level of adoption group i.e. above 78.11 per cent, 79 farmers under medium level of adoption group i.e. above 63.35 to 78.11 per cent while 22 farmers under low level of adoption group i.e. below 63.34 per cent in technology adoption range.
2. Extent of adoption of in all technologies were highest in high adoption level group. Moreover, use of Pheromon trap, light trap and Yellow sticky trap, use of trichograma and FYM is negligible used in low adopter groups.
3. The result of input utilization, the human labour utilization was highest in high adoption level group.
4. In all three adoption level, seed rate were used at recommendation level and farmers select Short & medium duration variety.
5. Farm yard manure, highest used in high adopter group i.e. 30.68 quintal per hectare followed by medium adopter(16.80 qtl/ha) and low adopter(14.05 qtl/ha). In low adopter group shows that negligible use in Farm yard manure.
6. The results of application of fertilizer(NPK) shows that, more used at recommended level in all three categories.
7. Per hectare yield was highest in high adopter group i.e. 16.64 quintal followed by medium adopter group i.e. 14.01 quintal while it was lowest for low adopter group i.e. 12.71 quintal.
8. In case of Input gap, the use of FYM were observed that 35.95 kg, 33.20 kg, 19.32 kg per hectare for low, medium and high

adopter group respectively. It meanse no one can fully adopted the recommended level of FYM dose because the farmers can apply only owned farm FYM. The reasons of lower used of FYM, due to shortage of cattles population.

9. In case of input utilization, the result shows that, fertilizer application were used more at recommended level in all three categories.
10. The highest total yield gap of 2.29 quintal per hectare was observed in low adopter group, followed by 0.99 quintal per hectare yield gap in medium adopter and comparatively more yield was observed i.e. 1.64 quintal per hectare in high adopters group.

REFERENCES

- Birthal P.S., O.P.Sharma and Sant Kumar, 2000. Economics of Integrated Pest Management: Evidences and Issues. Indian Journal of Agriculture Economics, Vol 55 No.4 Oct-Dec. 2000 P.P.644-648,
- Chander, Subhash and Singh, S.P., 2003. Constraint in adoption of Integrated pest management practices in Cotton, Indian Journal of Extension Education, 39(182): 41 to 49.
- Neeraj Patel, Manish Kumar, Nishita Gupta & Ankita Pandey, 2017, Constraints in adoption of Integrated pest management practices by cotton growers in Nimar region of Madhya Pradesh, Agriculture Update, Vol 12 Issue 3: 487 to 490.
- Snehal Datarkar, B.V. Pagire, C.A. Nimbalkar and H.R. Shinde(2016 A Study of technology adoption gap in Soybean production of Maharashtra State:Principal Component Approach. Interanal Journal of Tropical Agriculture, Vol.34 No.4:1149 to 1154.
- Swaminathan, M. S. 1975. ICAR, Operational Research Projects, purpose and approach. Indian Farming August 1975
- Omaid S/O Najamuddin, 2011. Impact of technology on cotton production in Vidarbha region of Maharashtra state. M.Sc.Thesis (.) Dr. PDKV, Akola.

Pandey, R.K. and Sarup, S. (1992): On farm investigation into yield gaps and constraints in Crop productivity, Artha Vikas. 28: 1-9.
Koranne, U.M., P.O. Ingle, A.W. Deshmukh and M.B.

Chaudhari(1996): Evaluation of adoption and Impact of technologies evolved and recommended by Dr.PDKV, Akola, for cotton crop. AGRESCO Report.

RESEARCH ARTICLE

Perception of farmers about Maha DBT portal

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ABSTRACT

The present study on “Perception of Farmers about Maha DBT Portal” was conducted in Buldhana district of Maharashtra state. The exploratory research design of social research was used. In all, 120 respondents were selected purposively on the basis of maximum number of applicant farmers on Maha DBT Portal. The findings revealed that, majority of the respondents were from middle age group, had education up to secondary school, possessed semi medium of land holding, they had medium accessibility to Setu center. It is concluded that more than half of the respondents (50.83%) agreed that Maha DBT portal being a Govt. Scheme, is trusted by farmers. Nearly fifty per cent respondents (47.50%) were agreed that Maha DBT portal helpline number resolves farmers complaints. Maha DBT portal, more than half of (61.67%) of the respondents had medium level of perception about Maha DBT portal. Majority of respondents (93.33%) faced the constraints such as lack of Setu center in own village according to population followed by poor internet connectivity (79.16%), lack of digital literacy (75.00%) and delay in getting necessary documents from government offices for uploading application on Maha DBT portal (66.66%).

Key words: perception, Maha DBT portal

INTRODUCTION

In Maharashtra various schemes, regarding farmers are implemented by Agriculture department of government. To bring transparency and accountability in implementation of these schemes as well as to synchronize the various schemes, Agriculture department has started “Farmers Schemes” on Maha DBT portal. Through this software system, the government intends to provide benefits of all schemes to farmers by ‘only one application’. Through this system the farmers, as per ‘Many schemes - one application’ method can show interest in various aspects of different schemes to government and benefit will be provided to the farmers through all the scheme that matches the aspects mentioned in the application form using a computer lottery method along with farmers

application. Maha DBT is one of the highest priorities and focus area of the Government of Maharashtra. The main objective of Maha DBT is for Development of a State DBT and Services Portal as the front end and the work flow management and content management platform as back end to various DBT schemes and services starting with Agricultural schemes. Agriculture department has introduced schemes for farmers across Maharashtra through Direct Benefit Transfer (DBT) to avail subsidy benefits. The farmers will get the benefits under different scheme if they have registered themselves on the Maha DBT farmer Portal. There are many facilities like subsidies and other like updated information of different schemes will be given to the farmers directly this is the benefit that every farmer wants. The present study was carried out

with following specific objectives

1. To study the personal, socio-economic, communication and psychological characteristics of farmers using Maha DBT portal
2. To study the perception of farmers about Maha DBT portal
3. To identify the constraints faced by the farmers while using Maha DBT

METHODOLOGY

An exploratory research design of social research was used for the present investigation. Considering the accessibility of the researcher the present investigation was carried out in Buldhana district of Vidarbha region of Maharashtra state. Out of 13 tehsils in Buldhana district, Buldhana tehsil was selected purposively on the basis of maximum number of registered farmers on the Maha DBT portal. Six villages were selected randomly from Buldhana

tehsil. A list of farmers who had registered on Maha DBT portal, was obtained from Taluka Agriculture Officer, Buldhana. From this list, twenty respondents were selected randomly from each selected village. Thus, total 120 respondents were selected and they were considered as sample respondents for present study. Data was collected by developing the interview schedule in accordance with objectives of the study. The structured interview schedule was used as a tool for data collection.

RESULTS AND DISCUSSION

The findings of the study as well as relevant discussion have been summarized under the followings

Profile of respondents

The data with respect to various characteristics of the respondents have been summarized in Table 1.

Table1. Distribution of the Maha DBT respondents according to their characteristics

Sl.No.	Profile of respondents	Respondents (n=120)	
		Frequency	Percent
1	Age (Years)		
1	Young	33	27.5
2	Middle	73	60.83
3	Old	14	11.67
2	Education		
1	Illiterate	4	3.33
2	Primary School	4	3.33
3	Middle School	31	25.83
4	Secondary School	57	47.5
5	Higher Secondary school	17	14.17
6	Graduate	7	5.83
3	Land holding		
1	Marginal	25	20.83
2	Small	31	25.83
3	Semi-medium	49	40.83
4	Medium	11	9.17
5	Large	4	3.33
4	Annual income		
1	Up to Rs. 1,60,000/-	25	20.83
2	Rs. 1,60,001/- to Rs.3,20,000/-	43	35.83

Sl.No.	Profile of respondents	Respondents (n=120)	
		Frequency	Percent
3	Rs. 3,20,001/- to Rs. 4,80,000/-	31	25.83
4	Rs. 4,80,001/- to Rs. 6,40,000/-	19	15.83
5	Above Rs. 6,40,000/-	2	1.67
5	Accessibility to Setu center		
1	Within own village	16	13.33
2	Distance up to 1 to 5 km	30	25
3	Distance up to 6 to 10 km	54	45
4	More than 10 km	20	16.67
6	Sources of information		
1	Low	11	9.17
2	Medium	76	63.33
3	High	33	27.5
7	Social participation		
1	Low	12	10
2	Medium	92	76.67
3	High	16	13.33
8	Innovativeness		
1	Low	32	26.67
2	Medium	74	61.67
3	High	14	11.67
9	Risk preference		
1	Low	13	10.83
2	Medium	74	61.67
3	High	43	35.83
10	Awareness		
1	Low	22	18.33
2	Medium	34	28.33
3	High	64	53.33

1. It is found that, majority (60.83%) of the respondents were middle age group.
2. In case of education (47.50%) of the respondents had formal schooling up to secondary school level of education.
3. It is noticed that most (40.83%) of respondents belonged to semi medium of land holding.
4. It is indicated that less than half (35.83%) of the respondents under study possessed annual income Rs. 1,60,000/- to Rs.3,20,000/-.
5. It is depicted that (70.00%) of the respondents have medium accessibility to Setu center
6. It is noticed that majority (63.33%) of the respondents were belonged to medium category of use of information sources.
7. It is noticed that majority of respondents (76.67%) had medium level of social participation.
8. It is found that, majority (61.67%) of the respondents were included in the medium level of innovativeness.
9. It is indicated that majority (61.67%) of respondent's had medium level of risk preference category.
10. It was observed from Table 1 that, more than half of (53.33%) of the respondents had high level of awareness about Maha DBT portal, followed by (28.33%) medium level and remaining (18.33%) had low level of awareness about Maha DBT portal

2. Perception of Farmers about Maha DBT

Portal

Perception refers to the personal interception of an external event or object. In the present study it has been operationally defined as personal interception of farmers about Maha DBT Portal.

Based on extent of perception of the selected farmers about Maha DBT Portal, the respondents were categorized into Agree, Undecided, and Disagree group by an equal interval method.

Table 2. Distribution of the respondents according to their perception about Maha DBT Portal

Sl.No.	Perception	Respondents (n=120)		
		Agree	Undecided	Disagree
1	Online Maha DBT portal is convenient for farmer	78	40	02
2	Maha DBT Portal has brought transparency in direct transfer of funds in farmers account	76	41	03
3	Maha DBT portal has brought transparency in selection process	79	31	10
4	Maha DBT Portal is single window application system for all agriculture scheme	70	46	04
5	Maha DBT Portal have made it easy to save all documents at one place	73	40	07
6	Maha DBT Portal have made application process easy than offline process	73	46	01
7	There is no forgery in Maha DBT Portal	89	29	02
8	Maha DBT Portal have eliminated intermediary peoples	70	40	10
9	Maha DBT portal being a Gov. Scheme, is trusted by farmers	61	55	04
10	Maha DBT Portal have made application process easy than offline process	73	46	01
11	Due to message received on mobile from portal, farmers can track their current application status	43	75	02
11	Maha DBT portal helpline number, resolves farmers complaints attentively.	57	43	14
12	Due to funds received from portal, farmers have reduced borrowing money from private lenders.	30	70	20
13	Maha DBT Portal have reduced physical visits of farmers to government offices.	70	46	04
14	Illiterate farmers find it difficult to use Maha DBT Portal.	70	47	03
15	Due to lack of internet facilities in the remote villages, farmers have to travel at taluka or district places for application.	74	43	03

Table 3. Distribution of the respondents according to their perception level about Maha DBT portal

Sl.No.	Category	Respondents (n=120)	
		Frequency	Percentage
1.	Low (Up to 33.33)0201.66		
2.	Medium (33.34 to 66.66)7461.67		
3.	High (Above 66.66)4436.67		
	Total	120	100.00

Mean = 21.89

S.D = 3.96

It was observed from Table 3 that, more than half of (61.67%) of the respondents had medium level of perception about Maha DBT portal, followed by 36.67 per cent high level and remaining (01.66%) had low level of perception about Maha DBT portal.

3. Constraints

In the present study constraints referred to problems or difficulties faced by the respondents while using Maha DBT portal. The relevant data in this regard has been presented in Table 4.

Table 4. Distribution of the respondents according to the constraints faced using Maha DBT portal

SI.No.	Constraints	Respondents (n=120)		Rank
		Frequency	Percentage	
1.	Lack of Setu center in own village according to population.	98	81.66	I
2.	Poor internet connection and server problem in rural areas	95	79.16	II
3.	Lack of digital literacy	90	75.00	III
4.	Lack of information about latest schemes of Maha DBT portal	85	70.83	IV
5.	Delay in getting necessary documents from government offices	80	66.66	V

Major constraints faced by respondents while using Maha DBT Portal are it is revealed that, majority of respondents (93.33%) faced the constraints such as Lack of Setu center in own village according to population followed by Poor internet connection and server problem in rural areas (79.16%), Lack of digital literacy (75.00%), and the other constraints faced by the respondents were Lack of information about latest schemes of Maha DBT portal (70.83%) and Delay in getting necessary documents from government offices (66.66%).

CONCLUSION

The findings concluded that majority of respondents belonged to middle age group were educated up secondary school level and belonged to Semi medium category of land holding, having medium accessibility to Setu Center, medium level of social participation and innovativeness, having medium level of risk preference, having high level of awareness and having medium level of perception about Maha DBT portal. Considering all this result it shows that all the farmer community actively involved in the Maha DBT process. Maha DBT farmer portal playing important role than offline process. This system

helps to makes Maharashtra state paperless.

REFERENCES

- Gandhi N. and Armstrong L. 2016. Factors influencing the use of ICT tools by the rural farmers in Ratnagiri district of Maharashtra. *Maharashtra Journal of Extension Education*.12 (2):58-59.
- Ishwar Singh Parmar, Peeyush Soni, Krishna R. Salin, John K. M. and Kuwornu. 2018. Assessing farmers access to ICT and non-ICT sources for agricultural development in Semi-Arid Region. *India Journal of Agricultural Informatics* (ISSN 2061-862X) 2018 Vol. 9, No. 2:22-39.
- Jain, R.; Rani; U. Ahuja and Kumar, A. 2012. ICTs and farm women: access, use and impact. *Indian. J. of Agri. Econ.*67 (3).
- Jayade, K.G. and Khot, P.G. 2018. Impact of ICT and Mobile technology in Agriculture in Maharashtra. *Maharashtra journal of Extension Education*.52(5): 429-432.
- Kumar S, Sangeetha SV. 2017. Constraints Faced by Farmers in Utilizing Rice Related Information through Rice Knowledge Management Portal (RKMP). *Indian Journal of Extension Education*. 53(1):84-89.

RESEARCH ARTICLE

Knowledge and utilization of hand tools and manually operated farm implements by the farm women

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ABSTRACT

Women as a farmer or farm workers participate in several activities and perform different agricultural tasks with the age-old traditional tools. After, considering the importance and major involvement of women in agriculture the present research study entitled, “Knowledge and Utilization of hand tools and manually operated farm implements by the farm women” was conducted by selecting 120 representative farm women of Rahuri, Newasa and Kopergaon tahsils of Ahmednagar district in Maharashtra State.

The findings of the study showed that, majority of the farm women had medium knowledge about hand tools and manually operated farm implements. In land preparation implements knowledge level about ghamela was highest, in sowing implements knowledge of dibbler was comparatively less. In inter-culturing implements knowledge of khurpi was higher. About the farm implements used for plant protection, knowledge level about knapsack sprayer was highest. In case of harvesting and threshing farm implements knowledge of sickle was cent per cent. Regarding the utilization, majority of the respondent farm women had high utilization level of hand tools and manually operated farm implements. Amongst the land preparation implements, utilization about ghamela was more, in case of sowing utilization of dibbler was less. For interculture operation utilization was highest in case of khurpi, in case of plant protection utilization level of knapsack sprayer and sickle for harvesting and threshing was highest. From study it is also concluded that there is a gap between the expected and existing knowledge level of the respondent farm women. Therefore, attention of the extension agencies needs to be diverted to this important aspect in order to boost up the knowledge level of farm women about the farm implements. This brings forward the need for launching a massive publicity campaign about farm implements. Besides this, there is a gap between the expected utilization level and existing utilization level of the respondent farm women about the improved hand tools and manually operated farm implements. Therefore, there is a need for campaigning, demonstrations and increase the subsidy for hand tools and manually operated farm implements.

Keywords: Knowledge, Utilization, Hand tools, Farm implements and Farm women

INTRODUCTION

Agricultural mechanization implies the use of various power sources and improved farm tools and equipment, for reducing the drudgery of the human beings, enhancing the cropping

intensity, precision and timelines of efficiency in utilization of various crop inputs and reducing the losses at different stages of crop production. Farm mechanization can help in 15-20 per cent saving in seeds, 15-20 per cent saving in fertilizers, 15-20 per cent increase in cropping

intensity, 20-30 per cent saving in time, 20-30 percent reduction in manual labour and 10-15 per cent overall increase in farm productivity (Gautam and Kumar, 2014).

Women as a farmer or farm workers participate in several activities and perform different agricultural tasks with the age-old traditional tools. However, all the farm women may not have sufficient knowledge about improved hand tools and manually operated farm implements and may not utilize the improved farm implements at the same time at the same rate. Therefore, this study was undertaken to know the knowledge and utilization of hand tools and manually operated farm implements by the farm women.

METHODOLOGY

The data was collected by interviewing 120 representative farm women of Rahuri, Newasa and Kopergaon tahsils of Ahmednagar district in Maharashtra State. Data were processed and analyzed by using appropriate statistical tools.

RESULTS AND DISCUSSION

1. Overall, Knowledge level of farm women about the hand tools and manually operated farm implements

The knowledge refers to the factual information possessed by an individual farm woman about hand tools and manually operated farm implements. The distribution of respondent farm woman according to knowledge level about the farm implements is given in Table 1.

Table 1. Distribution of the farm woman according to knowledge level about the hand tools and manually operated farm implements

SI.No.	Knowledge Level (Score)	Respondents (n=120)	
		Frequency	Percentage
1	Low (Up to 59)	16	13.33
2	Medium (60 to 74)	39	32.50
3	High (75 and above)	65	54.16
	Total	120	100.00
	Maximum value	88	-
	Minimum value	44	-
	Range	15	-

From Table 1 It is observed that, more than one half (54.16 per cent) respondent farm women had high level knowledge, 32.5 per cent respondent farm women had medium level knowledge and 13.33 per cent respondent farm women had low level knowledge.

The findings of the study are in line with the findings of Dhere (2012), Nagraj et al. (2013) and Patil (2015).

2. Operation-wise knowledge level of farm women about the hand tools and manually operated farm implements

Besides these categories of knowledge level, an attempt has been made to place the respondents as per the operation-wise knowledge level of respondent about the hand tools and manually operated farm implements. The operation-wise knowledge level of respondent is presented in Table 2.

Table 2. Distribution of the farm women according to Operation-wise knowledge about the hand tools and manually operated farm implements

Sr. No.	Name of Farm implements	No. of farm women using the implements		Knowledge of hand tools and manually operated farm implements (N= 120)				
				Complete		No knowledge		Avg. knowledge
		Freq.	%	Freq.	%	Freq.	%	%
A.	Hand tools and manually operated farm implements use for land development							
1.	Pic axe	119	99.10	119	99.10	0	0	96.07
2.	Spade	113	94.16	113	94.16	0	0	91.19
3.	Axe	119	99.10	119	99.10	0	0	95.83
4.	Iron bar	110	91.16	110	91.16	0	0	89.04
5.	Ghamela	120	100.00	120	100.00	0	0	98.04
B.	Hand tools and manually operated farm implements used for sowing							
6.	Manual seed drill	64	53.33	28	23.33	36	30.00	29.76
7.	Dibbler	70	58.33	26	21.66	44	36.66	35.59
C.	Hand tools and manually operated farm implements for interculture operation							
8.	Khurpi	120	100.00	115	95.83	5	4.10	99.40
9.	Hand hoe	76	63.33	72	60.00	4	3.33	59.16
10.	Cycle hoe	65	54.16	53	44.16	12	10.00	53.66
11.	Tooth hoe	72	60.00	70	58.33	2	1.66	50.47
12.	Crow bar for fertilizer application	90	75.00	90	75.00	0	0	71.42
D.	Hand tools and manually operated farm implements used for plant protection							
13.	Hand pump	98	81.66	96	80.00	2	1.66	79.52
14.	Knapsack sprayer	120	100.00	117	97.5	3	2.5	98.33
15.	Duster	67	56.32	44	36.66	23	19.66	38.45
E.	Hand tools & manually operated farm implements used for harvesting, threshing							
16.	Sickle	120	100.00	120	100.00	0	0	100.00
17.	Chaff cutter	120	100.00	115	95.83	5	4.16	99.40
18.	Maize sheller	92	76.66	89	74.16	3	2.5	73.09
19.	Bhendi plucker	104	86.66	100	83.33	4	3.33	84.28
20.	Fruit plucker	96	79.99	76	63.33	20	16.66	69.76

Table 2 depicted that; amongst knowledge level of hand tools and manually operated farm Implements used for land preparation ghamela was highest (98.04 per cent) followed by pick axe (96.07 per cent). In case of knowledge level of respondents for sowing dibbler was 35.59 per cent. Knowledge level for hand tools and manually operated farm implements for interculture operation was highest in khurpi (99.40 per cent), followed by hand hoe (59.16 per cent). About the plant protection implements used, knowledge level was highest regarding knapsack sprayer (98.33

per cent), followed by hand pump (79.52 per cent). About the hand tools and manually operated farm implements used for harvesting and threshing knowledge level was cent percent regarding the sickle (100.00 per cent), followed by chaff cutter (99.40 per cent), bhendi plucker (84.28 per cent), maize sheller (73.09 per cent) and fruit plucker (69.76 per cent). The findings of the study are in line with the findings of Dhere (2012) and Patil (2015).

3. Overall, Utilization level of farm women about the hand tools and manually operated farm implements

The utilization refers to the, "behaviour of the farm women with regard to type and number, nature of ownership, experience in using, extent and type of use, maintenance and repairs and storage of hand tools and manually

operated farm implements developed and recommended by the MPKV, Rahuri.

The distribution of respondent farm woman according to utilization level about the farm implements is given in Table 3.

Table 3. Distribution of the farm woman according to utilization level about the hand tools and manually operated farm implements

SI.No.	Utilization Level (Score)	Respondents (n=120)	
		Frequency	Percentage
1	Low (Up to 45)	17	13.34
2	Medium (46 to 63)	52	42.50
3	High (64 and above)	51	44.16
	Total	120	100.00
	Maximum value	80	-
	Minimum value	27	-
	Range	18	-

From Table 3 It is observed that, two fifth (44.16 per cent) of farm women utilized hand tools and manually operated farm implements to high extent followed by medium extent (42.50 per cent) and low extent (13.34 per cent). The findings of the study are in line with the findings of Aitwade (2012) and Patil (2015).

4. Operation-wise Utilization level of farm women about the hand tools and manually

operated farm implements

Besides these categories of Utilization level, an attempt has been made to place the respondents as per the operation-wise Utilization level of respondent about the hand tools and manually operated farm implements. The operation-wise Utilization level of respondent is presented in Table 4.

Table 4. Distribution of the farm women according to Operation-wise Utilization level about the hand tools and manually operated farm implements

Sr.No.	Name of Farm implements	No. of farm women using the implements		Implements Possession/ Ownership (N=120)				
				Owned		HiredAvg.		Utilization
		Freq.	%	Freq.	%	Freq.	%	%
A.	Hand tools and manually operated farm implements use for land development							
1.	Pic axe	119	99.10	119	99.10	0	0	93.00
2.	Spade	113	94.16	98	81.66	15	12.50	90.97
3.	Axe	119	99.10	115	95.83	4	3.33	92.26
4.	Iron bar	110	91.16	93	77.50	17	14.16	89.67
5.	Ghamela	120	100.00	120	100.00	0	0	93.47
B.	Hand tools and manually operated farm implements used for sowing							
6	Manual seed drill	64	53.33	23	19.16	41	34.16	22.63
7	Dibbler	70	58.33	38	31.66	32	26.66	30.23

Sr. No.	Name of Farm implements	No. of farm women using the implements		Implements Possession / Ownership (N=120)				
				Owned		HiredAvg.		Utilization
		Freq.	%	Freq.	%	Freq.	%	%
C.	Hand tools and manually operated farm implements for interculture operation							
8	Khurpi	120	100.00	120	100.00	0	0	93.56
9	Hand hoe	76	63.33	76	63.33	0	0	50.18
10.	Cycle hoe	65	54.16	65	54.16	0	0	48.23
11	Tooth hoe	72	60.00	63	52.50	9	7.50	19.76
12	Crow bar for fertilizer application	90	75.00	90	75.00	0	0	38.37
D.	Hand tools and manually operated farm implements used for plant protection							
13	Hand pump	98	81.66	98	81.66	0	0	8.24
14	Knapsack sprayer	120	100.00	120	100.00	0	0	92.68
15	Duster	67	56.32	13	10.83	54	45.00	17.91
E.	Hand tools & manually operated farm implements used for harvesting, threshing							
16	Sickle	120	100.00	120	100.00	0	0	93.24
17	Chaff cutter	120	100.00	120	100.00	0	0	86.43
18	Maize sheller	92	76.66	59	49.16	33	27.50	43.93
19	Bhendi plucker	104	86.66	76	63.33	28	23.33	56.38
20	Fruit plucker	96	79.99	67	55.83	29	24.16	44.72

Table 4 depicted that; amongst Utilization level of hand tools and manually operated farm Implements used for land preparation, utilization level of respondents about ghamela was highest (93.47 per cent), followed by Pic axe (93.00 per cent). The utilization of such implement was found higher may be due to easy and cheaper availability of such implements.

In case of hand tools and manually operated farm implements used for sowing utilization of dibbler was more (30.23 per cent) followed by manually operated seed drill (22.63 per cent). This is may be observed because of little awareness of such implements. In interculture operation Utilization level was highest in khurpi (93.56 per cent), for hand hoe (50.18 per cent), for cycle hoe (48.23 per cent), for tooth hoe (19.76 per cent), for crow bar for fertilizer application (38.37 per cent). This may be due to these operations are mostly performed by the women.

Regarding the plant protection, utilization of knapsack sprayer was highest (92.68 per cent) followed by hand pump (48.24

per cent) and duster (17.91 per cent). From table 4, it was also observed that, utilization of sickle used for harvesting and threshing was 93.24 per cent followed by chaff cutter 86.43 per cent, bhendi plucker 56.38 per cent, fruit plucker 44.72 per cent and maize sheller, 43.93 per cent. The findings of the study are in line with the findings of Patil *et al.* (2019), Patil and Nalawade, (2022).

CONCLUSIONS

Therefore, from the study it is concluded that, majority of the respondent farm women had medium knowledge level about farm implements. Therefore, attention of the extension agencies needs to be diverted to this important aspect in order to boost up the knowledge level of farm women about the farm implements. This brings forward the need for launching a massive publicity campaign about farm implements. There is also gap between the expected utilization level and existing utilization level of the respondents about the farm implements. Therefore, there is a need for campaigning, demonstrations and increase the subsidy for farm implements.

REFERENCES

- Aitwade, N. M. 2012. Constraints faced in utilization of improved farm implements by sugarcane growers. Unpublished M. Sc. (Agri.) thesis, MPKV, Rahuri, Maharashtra, India.
- Dhere, R. V. 2012. Knowledge and attitude of farmers towards farm mechanization in agriculture. Unpublished M. Sc. (Agri.) thesis, Dr. PDKV, Akola, Maharashtra, India. Gautam and Kumar, 2014
- Nagaraj, P.S., Swamy Dhananjaya, Madhushree A. and Vidyadhara, B. 2013. A study on knowledge and adoption of farm mechanization by paddy grower in Tungabhadra project area. Karnataka International Journal of Agriculture and Food Science Technology. 4 (4): 385-390.
- Patil S. D. and S. M. Nalawade. 2022. [Farm Mechanization Status of Farmers in Rainfed Area of Western Maharashtra in India.](#) Journal of Agricultural Mechanization Asia, Africa and Latin America. Volume 53: Issue Autumn, 2022. Page 07-11.
- Patil S.D., Gaikwad A. B. and S. S. Sadaphal. 2019. Farm Implements Utilization by the Farmers in Irrigated Area. Guj. J. Ext. Edu. Vol. 30. Issue 2. Pp. 114-119.
- Patil, S. D. 2015. Utilization of farm implements by the farmers. Ph.D. (Agri.) thesis, MPKV, Rahuri, Maharashtra, India.

RESEARCH ARTICLE

Constraints faced by goat farmers and their suggestions for enhancing goat entrepreneurship

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ABSTRACT

The present study was conducted in four villages of Trimbakeshwar and Peth tahasils in Nashik district of Maharashtra state to study the 'Constraint faced by Goat farmers and their suggestions for enhancing goat entrepreneurship'. The villages Behedpada and Nirgude were the study area in Trimbakeshwar tahasil, while the villages Kadawaipada and Hompada were the study area in Peth tahasil. From each village 30 goat farmers were selected where total tune of 120 farmers was selected for study. The ex-post facto research design was selected as an appropriate research design. The data were collected by personal interview method with the help of structured interview schedule. The data were tabulated, analysed and interpreted.

Key words: Goat Farming, Entrepreneurship, Constraints, Inbreeding.

INTRODUCTION

Goat has a tremendous economic importance in contributing milk, meat, household nutrition security and livelihood to the poor mass of the society. Goat can consume the waste agro based residues of the farm. It is ideally suited for the poorest of the poor, because of short gestation period, low risk capital investment and low cost of maintenance (Gopala *et al.*, 2010). India with 140 million goats is one of the largest goats owing country in the world which plays a significant role in livelihood and nutritional security. It's also providing supplementary income to nearly 70 million farmers, over the 0.5 million remote villages (Anonymous, 2016). Goat husbandry faces the problems like low body weight gain, small holding size and mass mortality which hinders their production potential. Many useful goat husbandry technologies have been evolved by research system and transferred to the field for improving the production and productivity of the enterprise in all agro-climatic zone of country. Keeping this

point in view, the study was planned with an objective to study the constraint faced by Goat farmers and their suggestions for enhancing goat entrepreneurship.

METHODOLOGY

The research study was carried out in Trimbakeshwar and Peth tahasils of Nashik district. From each tahasil two villages were selected randomly. The villages Behedpada and Nirgude were the study area in Trimbakeshwar tahasil, while the villages Kadawaipada and Hompada were the study area in Peth tahasil. From each village 30 goat farmers were selected where total tune of 120 farmers was occupied for study. The ex-post facto research design was selected as an appropriate design. The statistical methods and tests such as frequency, mean, percentage and standard deviation were used for the analysis of data.

1. Constraints experienced by Goat farmers in adapting scientific goat farming

Constraint is characterized as everything

that prevents goat farmers from adapting scientific goat farming, including socio-psychological, economic, technical, infrastructural and communicational elements. The following subheads are used to present the results.

1.1 Socio-psychological constraints

Table 1 revealed that the lack of information about goat farming business module was the most significant socio-psychological barrier. The majority of goat farmers rated it as serious (82.5%), some rated it as very serious (10.83%), or not serious (6.67%). It's possible that this is a result of low educational standards and the lack of institutional support for the spread of knowledge. These were similar to those noted by Rajkumar *et al.* in 2014. Majority of goat farmers (50.0%) reported it as very serious, although 40.83 per cent farmers experienced it as serious and 9.17 per cent farmers believed it to be not serious. Limited knowledge of adaptive strategies was the most serious limitation of this

constraint. This could be explained by factors including decreased access to credit, media attention and extension agencies mixed with unfavourable geographic conditions restricting the reach of various agencies. More over 70 per cent goat farmers (72.5 %) perceived it as a major constraint, 19.17 per cent considering very serious constraint and 8.33 per cent believing not a serious constraint. The explanation for the lack of knowledge among goat farmers can be attributed to the fact that they have less interest in goat farming, due to the low productivity. Higher number of goats per household that generates adequate income to meet their needs is the satisfactory fact. Lack of knowledge about scientific goat enterprise was rated as very serious by 10.83 per cent, serious by 82.5 per cent and not serious by the remaining 6.67 per cent farmers. This result is consistent with research from Shah *et al.* (2015). They listed ignorance of scientific issues as a key restriction in goat husbandry.

Table 1 : Distribution of respondents according to socio-psychological constraints (n=120)

Sr.No.	Constraints	Very serious (%)	Serious (%)	Not serious (%)
1.	Lack of information about scientific goat enterprise	13 (10.83)	99 (82.50)	8 (6.67)
2.	Lack of knowledge on feeding practices for goats	23 (19.17)	87 (72.50)	10 (8.33)
3.	Limited knowledge on adaptation measures	60 (50.00)	49 (40.83)	11 (9.17)

1.2 Economic constraints

From Table 2 it is depicted that, the High cost of concentrate was a serious economic constraint (53.33%) for the goat farmers. The constraint was very serious stated by 34.17 per cent farmers, whereas 12.5 per cent farmers not considering it as serious. Lack of credit facilities was also a serious issue for goat farmers (60.84%). The group of 28.33 per cent farmers considering the non-availability of credit constraint as very serious, while 10.83

per cent farmers have no issues for the same. Less financial support from the government was a serious issue stated by 42.5 per cent farmers. The remaining 17.5 per cent farmers considering it as very serious, while 40.0 per cent goat farmers had not problem with the issue. Lack of market access for inputs was a major barrier for 30.0 per cent of goat farmers while 57.5 per cent farmers had not thinking it as serious constraint. This result is in line with research from Jadhav *et al.* (2011).

Table 2: Distribution of respondents according to economic constraints**(n=120)**

Sr.No.	Constraints	Very serious (%)	Serious (%)	Not serious (%)
1.	Lack of market access for inputs	36 (30.00)	15 (12.50)	69 (57.50)
2.	Non-availability of credit facilities	34 (28.33)	73 (60.84)	13 (10.83)
3.	Less financial support from the government	21 (17.50)	51 (42.50)	48 (40.00)
4.	High cost of concentrate	41 (34.17)	64 (53.33)	15 (12.50)

1.3 Technical constraints

The results from Table 3 indicate that the lack of a government policy for growth of goat enterprise was the most significant technical challenge faced by farmers. The majority of the farmers reported it as very serious (78.38%) while very few farmers (3.33%) had no problem with this. The government may devise the ideal strategy, because of the issue. Again, more research is needed to develop adaption strategies, so that farmers can be exposed to a range of possibilities and choose the one that best fits their situation. The findings of Sharma GRK, Arya HP S. (2005) and Wani *et al.* (2009) confirmed the lack of government adaptation, are in agreement with the findings.

Most farmers reported extension service irregularities as 'very serious' (77.5%),

15.0 per cent as 'serious', while just 7.5 per cent of goat farmers not considering it as serious constraint. It might be a result of the extension workers being given different tasks, an ineffective supervision system, fewer incentives for field staff, ineffective transportation, a shortage of operational staff and needless political intervention. As a result, some sort of system for disseminating information is necessary. This result is in line with earlier studies, which discovered that poor/low extension services and the lack of extensions capacity to decrease farmer's ability to sustain in enterprise (Mohan B, Sagar, R L and Singh K. 2009). The majority of farmers found that insufficient government fund facility for expansion of the enterprise was a very serious constraint.

Table 3 : Distribution of respondents according to technical constraints**(n=120)**

Sr.No.	Constraints	Very serious (%)	Serious (%)	Not serious (%)
1.	Inadequate training aspect for scientific management	68 (56.67)	34 (28.33)	18 (15.00)
2.	Non skill work force on field level	57 (47.50)	43 (35.83)	20 (16.67)
3.	Insufficient funds from government for business expansion	19 (15.83)	92 (76.67)	9 (7.50)
4.	Irregularities of extension services	93 (77.50)	18 (15.00)	9 (7.50)
5.	Ineffectiveness of indigenous practises	84 (70.00)	31 (25.83)	05 (4.17)

1.4 Infrastructural constraints

The lack of pasture land was rated as the serious infrastructural constraint by goat farmers, with the majority of respondents (45%). Goat farmers with 38.33 per cent population assessing it as very serious, while 16.67 per cent farmers not valuing it as serious. It can be because extreme weather conditions are common and restrict growth and development. This could

also be a result of lack of interest of farmers for pasture development and uncontrolled grazing too. The limitation was also a lack of reliable sources of clean water. The development of water sources is hampered by insufficient rainfall impairing the level of ground water and geographical factors. Many goat farmers (56.66%) believed that the lack of a water harvesting structure was a major constraint,

while 34.17 per cent farmers felt that it was a serious constraint. However 9.17 per cent goat farmers reported that the constraint was not serious one. This might be the result of the high expense of cement-based water harvesting structures and the inadequacy of kachcha structures for the regions sandy soil for water retention. In addition, there rural farmers lack resources and are unable to make significant investments. Lack of proper irrigation facilities for growing fodder is a limitation that the majority of farmers (47.50%) perceiving

seriously, while 37.5 per cent considering it very serious issue. Small group of farmers (15.0%) experiencing the constraint as not-so-serious. The regions geography makes it difficult to install irrigation systems because the water level is so high. Poor housing and lack of good quality infrastructure was the serious constraint for 49.17 per cent farmers, while 42.5 per cent farmers reporting it as very serious and 8.33 per cent farmers were not seen it as serious matter.

Table 4 : Distribution of respondents according to infrastructural constraints (n=120)

Sr.No.	Constraints	Very serious (%)	Serious (%)	Not serious (%)
1.	Inadequate irrigation facilities for growing fodder	45 (37.5)	57 (47.5)	18 (15.0)
2.	Lack of pasture	46 (38.33)	54 (45.0)	20 (16.67)
3.	Lack of water harvesting structure	41 (34.17)	68 (56.66)	11 (9.17)
4.	Poor housing and infrastructure	51 (42.5)	59 (49.17)	10 (8.33)

1.5 Communicational constraints

The non-availability of quality and cheaper transportation facility was the most significant communicational challenge facing by goat farmers. The majority of farmers (67.5%) found this challenge to be extremely serious, 13.33 per cent farmers as serious, whereas 19.17 per cent did not recognise it to be a constraint. It might be because communication infrastructure hasn't developed as much. The result of Meganathan N, Selvakumar K N, Prabu M, Pandian A S and Senthil K G. 2010 were

comparable. Poor response to emergency crises related to health was perceived as a serious constraint by a majority of goat farmers (64.17%). It is very serious constraint for 23.33 per cent goat farmers, while 12.5 per cent goat farmers not considering it as serious issue. Poor access to scientific information source is again a serious constraint for majority of goat farmers (63.33%), while 29.17 per cent farmer population considering it as very serious where only 7.5 per cent farmers had not facing any problem with this.

Table 5 : Distribution of respondents according to communicational constraints (n=120)

Sr.No.	Constraints	Very serious (%)	Serious (%)	Not serious (%)
1.	Non-availability of quality and cheaper transportation facility	81 (67.50)	16 (13.33)	23 (19.17)
2.	Poor response to emergency crises related to health	28 (23.33)	77 (64.17)	15 (12.50)
3.	Poor access to scientific information source	35 (29.17)	76 (63.33)	09 (7.50)

1.6 Constraints related to Goat farming practices

Inbreeding in goats was the most serious

constraints, with majority of goat farmers (66.67%). The population of 20.0 per cent farmers feeling that the issue of inbreeding was

serious, while 13.33 per cent farmers not thinking so. Round the year Improved fodder not available always. Only 10.0 per cent of goat farmers thought it was not a serious constraint, compared to 69.17 per cent, who found it serious and 20.83 per cent who found it very serious. Absence of good quality vaccines for prevention of diseases in goats is a serious issue pursued by the 62.5 per cent farmers. The population of 21.67 per cent farmers reported it very serious issue, while 15.83 per cent goat farmers not considered it

serious one. A substantial portion of goat farmers (40.0%) viewed the lack of feed and fodder as a serious problem, compared to 30.83 per cent, who did not serious about this. Farmers with 29.17 per cent adapted it as a very serious constraint. Lack of pure goat breed availability was a very serious constraint for 31.67 per cent farmers. The majority of goat farmers (54.17%) not considering it a serious issue, while 14.16 per cent goat farmers considering it serious one again.

Table 6 : Constraints related to Goat farming practises (n=120)

Sr.No.	Constraints	Very serious (%)	Serious (%)	Not serious (%)
1.	Non-availability of improved fodder seeds	25 (20.83)	83 (69.17)	12 (10.00)
2.	Shortage of feed and fodder	35 (29.17)	48 (40.0)	37 (30.83)
3.	Inbreeding in goats	80 (66.67)	24 (20.0)	16 (13.33)
4.	Non-availability of pure goat breed	38 (31.67)	17 (14.16)	65 (54.17)
5.	Non-availability of good quality vaccines	26 (21.67)	75 (62.5)	19 (15.83)

2. Suggestions received from the respondents to overcome the constraint in goat farming

The recommendations made by goat farmers for overcoming the challenges faced for adapting the sustainable business, are listed below.

Table 7 : Suggestions received from respondents to overcome constraint in goat farming (n=120)

Sr. No.	Suggestions	Frequency	Percentage
a.	Breeding		
1.	Provision of pure quality buck for breeding	98	81.67
2.	Changing the breeding buck regularly after every 2 years	104	86.67
3.	Castration of own farm produced bucks to avoid in-breeding	78	65.0
b.	Feeding		
1.	Establishment of fodder banks to get fodder during drought situation/ scarcity period on reasonable price	82	68.33
2.	Growing of improved and drought resistant grasses on pasture land	107	89.17
3.	Development and protection of community pasture land	69	57.5
4.	In time supply of improved fodder seeds	91	75.83
5.	Supply of good quality water for drinking to goats and irrigation.	111	92.5
c.	Health care		
1.	Animal health services at nominal rate should be made available by the government agency	101	84.17
2.	Adequate availability of Veterinary medicine for goats should be assured	109	90.83
3.	Disease diagnosis and treatment support should be assured	64	53.33

Sr. No.	Suggestions	Frequency	Percentage
d.	Management		
1.	Organization of training program for goat farmers	102	85.0
2.	Organization of training program on selective up-gradation of local non-descript goats for accessing purity	68	56.67
e.	Market Linkages		
1.	Organized markets should be available	110	91.67
2.	Middlemen dominance should be absent	108	90.00

2.1 Breeding

Majority of goat farmers (81.67%) are suggested that, pure quality bucks must be provided for breeding. Again 86.67 per cent farmers also reported that, there is a need to change breeding buck after every 2 years. In both the opinions, some farmers are not aware about the replacement of pure quality new bucks for breeding after every 2 years. To avoid inbreeding the new born bucks have to be castrated is the suggestion by 65.0 per cent farmers.

2.2 Feeding

Improved and drought resistant grasses must be cultivated on pasture land, is the recommendation of 89.17 per cent goat farmers. The lack of rainfall, a hot environment, a high rate of evaporation and sandy soil, inhibited the growth of typical grasses. Supply of good quality water for drinking to goats and irrigation is a necessary step for the enterprise. Majorly 92.5 per cent of goat farmers suggested the same move through their reporting. The creation of fodder banks was recommended by 68.33 per cent goat farmers as a way to obtain fodder during times of drought or scarcity at a reasonable price. This was most likely caused by the shortage of feed and fodder, the lack of draught-resistant fodder varieties, the lack of suitable irrigation systems and the lack of improved fodder seeds throughout the year. In time supply of improved fodder seeds is also a recommendation from 75.83 per cent farmers.

2.3 Health care

According to suggestions provided by

the 84.17 per cent goat farmers, the government should provide animal health services at nominal rate. It was determined to be the most significant recommendation. Assurance of adequate availability of veterinary medicine in dispensary and disease diagnosis, treatment support should also be assured, is the demand of 90.83 per cent and 53.33 per cent goat farmers respectively.

2.4 Management

Data received from goat farmers reveals that, 85.0 per cent farmers recommended scientific training program for the development of enterprise.

2.5 Market linkages

Availability of organized markets for goat meat, milk, is the recommendation from almost 91.67 per cent farmers. The middleman dominance in market should be minimized, is also an important suggestion from 90.00 per cent farmers. This move can increase the profitability as well as socioeconomic status of farmer.

REFERENCES

- Anonymous, 2016. CIRG Annual Report 2015-16. Central Institute for Research on Goats, Makhdoom, Farah, Mathura -281122, U.P. (India)
- Gopala G.T., Veeranna K. C. and Shivakumar K. R. 2010. Constraints in goat farming in Bidar district of Karnataka state. Research Journal of Animal Husbandry and Dairy Science 1(2):80-82.
- Jadhav S.G., Ahire M.C. and S.D. Patil. 2011. Role perception of women members in Dairy cooperative societies, Mysore journal of

- Agriculture Science. 45 (4), 883-886
- Kumar S. and Pant K. P. 2003. Development perspectives of goat rearing in India: Status, issues and strategies. *Indian Journal of Agricultural Economics* 58(4): 752-67.
- Kumar S., Vihan V. S. and Deoghare R. P. 2003. Economic implications of disease in goats in India with special reference to implementation of a health plan calendar. *Small Ruminant Research* 47:159-64.
- Kumar V., Singh B. P., Dutt T. and Kumar R. Maousami. 2014. Perceived constraints and suggestions in adoption of goat husbandry technologies: A study in semi-arid zone of Uttar Pradesh. *Indian Journal of Animal Sciences* 84(8): 897-902.
- Meganathan N., Selvakumar K. N., Prabu M., Pandian A. S. and Senthil K. G. 2010. Constraint analysis of tribal livestock farming in Tamil Nadu. *Tamil Nadu Journal of Veterinary and Animal Sciences* 6(1): 12-18.
- Mohan B., Sagar R. L. and Singh K. 2009. Factors related to promotion of scientific goat farming. *Indian Research Journal of Extension Education* 9(3): 47-50.
- Rajkumar N. V. and Kavithaa N. V. 2014. Constraints in goat farming perceived by farm women in erode district of Tamil Nadu. *International Journal of Science, Environment and Technology* 3(1): 116-22.
- Shah I. A., Hussain K., Shah M. A. 2015. Suggestions for Amelioration of Perceived Constraints in the Adoption of Improved Goat Husbandry Technologies in Jammu and Kashmir. *International Journal of Livestock Research* 5(2): 54-63.
- Sharma G.R.K. and Arya H.P.S. 2005. Constraints in utilization of internet communication among livestock farmers. *Indian veterinary journal*, 82:56.
- Singh V. K., Suresh A., Gupta D. C. and Jakhmola R. C. 2005. Common property resources of rural livelihood and small ruminants in India: A review. *Indian Journal of Animal Science*, 75(8): 1027-36.
- Wani S. A., Wani M. H., Yusu S., Sajad A. and Ganai S. A. 2009. Constraints in rearing Changthangi goats in cold arid region of Jammu and Kashmir. *Indian Journal of Small Ruminants*, 15: 74-80.

RESEARCH ARTICLE

Relationship between profile characteristics of Krishi Vigyan Kendras scientists and their role performance

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ABSTRACT

The research study was carried out to know relationship between profile characteristics of Krishi vigyan kendras' scientists and their role performance. Total 140 scientists were selected for the study from total thirty Krishi Vigyan Kendras' of Gujarat state. The findings revealed that majority 63.57 per cent of the Krishi Vigyan Kendras'scientists had medium role performance , followed by 18.58 per cent of high and 17.85 percent low role performance respectively. This paper throws light on the profile characteristics of Krishi Vigyan Kendras' scientists and their role performance ,. Findings revealed that the independent variables viz. education, service experience, scientific orientation ,innovativeness and achievement orientation exhibited positively and significantly relationship at five per cent level of significance. Whereas source of information, training received, managerial ability, technical efficiency, communication ability, group motivation and decision making ability were highly significantly relationship with the role performance of scientists working at Krishi Vigyan Kendras' at one per cent level of significance. Whereas age and stress management were non-significantly related with role performance of Krishi Vigyan Kendras'scientists, while social participation and cosmopoliteness found negatively non-significantly related with the role performance the of scientists working at Krishi Vigyan Kendras'.

Keywords : Relationship, Profile, Role performance.

INTRODUCTION

Krishi Vigyan Kendra works as a knowledge and resource centre of agricultural technologies for supporting farmers in improving their agricultural production and livelihood. At present, KVK appears to be the important institutional system at the district level for technological backstopping in agriculture and allied sectors. (Anonymous, 2014a). Role performance are the important indicators of the success and health of any organization. The high relevance of individual performance is also reflected in work. Capable workforce in the organization greatly facilitates the task of the

administrators as it creates promising conditions for the overall process of the organization. The performance of the employees seems to be related with the satisfaction achieved after completion of the task. If workers are unsatisfied with their assigned task; it is insignificant to expect fruitful results. Progress of any organization greatly depends on role performance. In an organization attitude towards job is the main determinants that will interfere with the role performance of the employee. In each and every KVK, the scientists are the grass root level extension functionaries performing vital task of technology dissemination. Extension

person i.e. scientists does not only involve in delivering information to farmers, but should also effort to make farmers creative, self-confident and able enough to overcome their own problems and dilemmas (Sulaiman and Hall, 2003).

Hence, for accomplishing the organization's mission, scientists should have optimum level of role performance . (Boring *et al.*, 1961).

MATERIALS AND METHODS

The research study was conducted in Gujarat state. An Ex-post-facto research design was employed in the present investigation. One hundred and forty Krishi Vigyan Kendras'scientists were purposively selected for present study from all 30 Krishi Vigyan Kendras' of Gujarat state. Role performance was operationalised defined as a actual behaviour and expression of an individual occupying a role. Score was given to each response, viz., 3, 2 and 1

for always performed , Sometimes performed and Never Performed. The total score was obtained by summing up all the items and respondents were classified in to 3 categories based on mean and standard deviation. The data was coded, classified, tabulated and subjected to frequencies and percentages to meaningfully interpret the findings.

Profile characteristics of the post graduate students such as age, education, social participation, service experience, source of information, training received, managerial ability, technical efficiency, communication ability ,scientific orientation, group motivation, stress management, innovativeness, decision making ability, cosmopoliteness and achievement orientation were correlated with the role performance of the Krishi Vigyan Kendras'scientists to know the significant and non-significant relationship between the variables.

Table1:Distribution of scientists according to their role performance (n=140)

Sr.No.	Categories	Frequency	Percentage
1.	Low performance (up to 127)	25	17.85
2.	Medium performance (128 -158)	89	63.57
3.	High performance (above 159)	26	18.58
	Total	140	100.00
	Mean =142.96	SD=15.45	

Table 2: Relationship between personal profile of scientists of Krishi Vigyan Kendras' and their role performance (n=140)

Sr. No.	Personal profiles of scientists	Correlation coefficients
1.	Age	0.108452 ^{NS}
2.	Education	0.1860722*
3.	Social participation	-0.16449307 ^{NS}
4.	Service experience	0.183003*
5.	Source of information	0.358371**
6.	Training received	0.270682**
7.	Managerial ability	0.287652**
8.	Technical efficiency	0.31442**
9.	Communication ability	0.26205**
10.	Scientific orientation	0.210944*

Sr. No.	Personal profiles of scientists	Correlation coefficients
11.	Group motivation	0.332298**
12.	Stress management	0.017157 ^{NS}
13.	Innovativeness	0.213263*
14.	Decision making ability	0.358097**
15.	Cosmopoliteness	-0.0461969 ^{NS}
16.	Achievement orientation	0.176001801*

NS- Non significant

*** Significant at 5 per cent**

**** Significant at 1 per cent**

RESULTS AND DISCUSSION

The findings regarding role performance of Krishi Vigyan Kendras' scientists towards Krishi Vigyan Kendras. It was evident from Table 1 indicate that majority of the scientists (63.57 %) had medium perceived their role performance, followed 18.58 per cent had high and 17.85 per cent low level of role performance about their role respectively. This may be due to their length of service. The probable reason may be due to that the majority of scientists were from young age to middle age group, their low service experience, medium facility available and some of scientists had additional charge which may affected in the role performance of scientists working at KVK. Correlation analysis was employed to access the relationship between the role performance of Krishi Vigyan Kendras' scientists and their profile characteristics. The correlation coefficients were worked out and the significance was tested by comparing with the table values. The results are represented in Table 2.

It was revealed from the Table 2 that the calculated 'r' values of education, service experience, source of information, training received, managerial ability, technical efficiency, communication ability, scientific orientation, group motivation, innovativeness, decision making ability and achievement orientation was greater than table 'r' value at 0.01 level of probability. Whereas, the calculated 'r' values of variables education, service experience, scientific orientation, innovativeness and

achievement orientation exhibited positively and significant relationship at 0.05 level of cent level of probability. Hence, null hypothesis was partially rejected and partially accepted. Therefore, it could be concluded that there was a positive and significant relationship between the role performance of the Krishi Vigyan Kendras' scientists and variables education (0.186*), service experience (0.183*), scientific orientation (0.210*) and achievement orientation (0.176*).

On the other hand, calculated 'r' values between social partici age (0.108^{NS}), social participation (-0.164^{NS}) stress management (0.0171^{NS}) and cosmopoliteness (-0.0461^{NS}) were less than table 'r' value. Hence, null hypothesis was accepted and empirical hypothesis was partially rejected. Therefore, it could be concluded that there was no significant relationship between the role performance of the Krishi Vigyan Kendras' scientists and variables age, social participation, stress management and cosmopoliteness.

It can be observed that most of the scientists are well educated and well experienced about all important technical activities of Krishi Vigyan Kendras. They have gained good source of information through internet, television, radio, newspapers, agriculture farm literature and visit to farmers field. Scientists are well number of trainings received at different state and national level. Scientists have good management ability to manage all the activities of Krishi Vigyan Kendras. Scientists have best technical efficiency

about his subject. They have also best communication ability to understand another staff members and farmers Scientists have good scientific orientation about farmers farming methods. They also have better group motivation and decision making ability about progress and development of KVK activities.

CONCLUSION

The findings of this investigation showed that the source of information, training received, managerial ability, technical efficiency, communication ability, group motivation and decision-making ability found positively and highly significantly association with the role performance of the scientists. Further education, service experience, scientific orientation, innovativeness, and achievement orientation were significantly associated with the role performance of the scientists. On the other hand, age and stress management found nonsignificant correlation with role performance of the scientists. The social participation and

cosmopoliteness found negatively non-significant correlation with role performance of the scientists. Hence efforts could be directed in ways which can improve the role performance of KVK scientists towards Krishi Vigyan Kendras by more cooperativeness and stressful environment. Knowledge about stressful work should be given through meditation and yoga exercise.

REFERENCES

- Anonymous (2014a). Retrieved from <http://www.icar.org.in/en/krishi-vigyan-kendra.htm> on 18/11/14.
- Boring, E. G.; Longfield, H.S.; and Weld, H.P. Foundations of psychology. John Wiley and sons (IInd Ed.), New York. 1961.
- Sulaiman V. R. and Hall A. J. India: The emergence of extension-plus: Future for extension beyond technology transfer. In Rivera WM Gary Alex (eds.) extension and rural development. The World Bank, Washington DC plant production science [Volume. 8 \(2005\) Issue 3](#). 2003.

RESEARCH ARTICLE

Adaptation strategies followed by farmers of dryland agriculture to deal with climate change

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ABSTRACT

Climate change is a critical global issue, severely affecting agriculture, particularly dryland farming. It poses more challenges than benefits, making adaptation essential. The adoption of mitigation and adaptation strategies at the farm level depends on farmers' perceptions and attitudes toward climate change. This study aims to assess farmers' perceptions of climate change and the adaptation strategies they employ in dryland agriculture. Solapur district in Maharashtra, known for its extensive dryland farming, was selected for the study. Mangalwedha and Mohol tahsils, which receive the lowest rainfall, were purposively chosen. From each tahasil, 10 villages were randomly selected, and 130 respondents were chosen using a random sampling method. Data were collected using a structured interview schedule with a cross-sectional survey research design.

Farmers implement various adaptation strategies, including drought-resistant crops, water conservation techniques, agroforestry, crop diversification, and soil management practices. The majority adopted drought-tolerant (93.07%) and high-yielding (91.53%) varieties, contour farming (88.46%), reducing plant population in rabi sorghum (87.69%), early sowing (85.38%), ridges and furrows for water conservation (84.61%), deep ploughing every three years (81.53%), and multiple harrowings annually (73.84%). However, fewer farmers followed intercropping, crop rotation, contour bunding, broad-bed sowing, or sowing with a two-bowl ferti-seed drill. Some farmers cultivated drought-resistant legumes such as horse gram, black gram, green gram, and moth bean for in-situ soil and water conservation. Very few crop residue mulching is used for soil and water conservation during the rabi season. The study emphasizes the need to promote sustainable adaptation strategies to strengthen dryland agriculture against climate change.

INTRODUCTION

Climate change has emerged as one of the most critical global challenges of the 21st century, with far-reaching implications across ecosystems, economies, and human societies. Among the sectors most vulnerable to its effects, agriculture—particularly dryland farming—stands at the forefront. Characterized

by erratic rainfall patterns, prolonged droughts, and rising temperatures, dryland regions are increasingly exposed to climate-induced stresses that threaten both food security and rural livelihoods.

While climate change may present isolated opportunities, such as extended growing seasons in select areas, the overarching narrative

is one of increased risk and reduced agricultural productivity. The severity of these impacts is particularly pronounced in developing countries like India, where a significant portion of the rural population depends on subsistence farming and lacks the resources to buffer against environmental shocks.

Adaptation and mitigation strategies at the farm level have become vital in ensuring agricultural sustainability under changing climatic conditions. However, the effectiveness of these measures largely depends on farmers' perceptions, knowledge systems, and adaptive capacities. Understanding how farmers perceive climate change and the types of strategies they adopt in response is therefore crucial to formulating context-specific policies and interventions.

This study aims to assess the perceptions of farmers engaged in dryland agriculture regarding climate change and to explore the adaptation strategies they employ. By focusing on the socio-economic and ecological dimensions of farmer responses, the research seeks to contribute to a more nuanced understanding of resilience-building in climate-sensitive regions.

METHODOLOGY

This study adopts a descriptive research design to assess the adaptation strategies followed by farmers engaged in dryland agriculture in response to climate change. The

research was conducted in the Solapur district of Maharashtra, which is known for its semi-arid climatic conditions and predominantly dryland farming. Two talukas—Mohol and Mangalwedha—were selected for an in-depth study based on their vulnerability to climate variability and dependence on rainfed agriculture. From each taluka, five villages were purposively selected, resulting in a total of ten villages for the survey.

A structured questionnaire was developed to collect primary data from the respondents. The survey focused on farmers' perceptions of climate change, observed climatic impacts on agriculture, and the range of adaptation strategies they have adopted. A total of 150 respondents were selected using stratified random sampling, ensuring adequate representation across variables such as farm size, age, and education level etc. Data collection was supplemented with focus group discussions and key informant interviews to capture nuanced community-level insights. The collected data was then analyzed using descriptive and inferential statistical methods to identify patterns, trends, and key factors influencing adaptation behavior among dryland farmers

RESULTS AND DISCUSSION

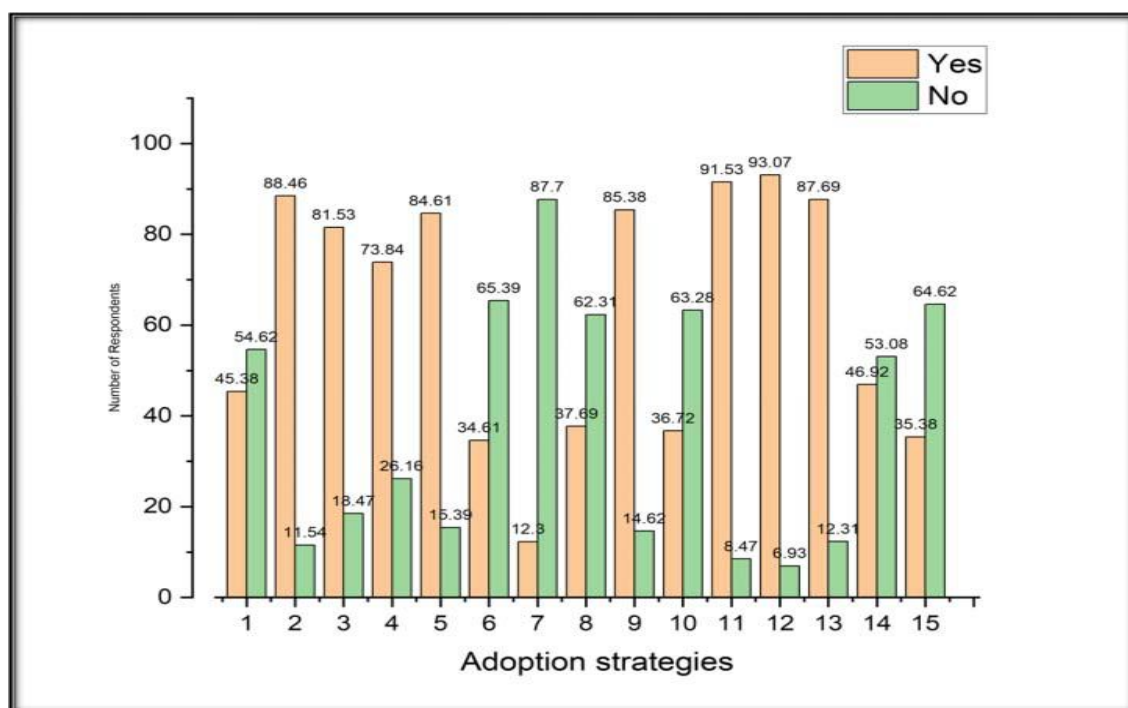
The data regarding adaptation strategies followed by farmers of dryland agriculture to deal

Table 1 : Distribution of respondents according to the adaptation strategies followed to deal with climate change

Sr. no.	Adaptation strategies	Respondent	
		Yes	No
1.	Contour bunding for effective soil and water conservation under	59 (45.38%)	71 (54.62%)
2.	Cultivation across slope for shallow and medium deep soils	115 (88.46%)	15 (11.54%)
3.	Soil and water conservation through deep ploughing once in three year	106 (81.53%)	24 (18.47%)
4.	2 to 3 harrowings every year as measure of water conservation	96 (7.84%)	34 (26.16%)
5.	Adoption of ridges and furrows to conserve water.	110 (84.61%)	20 (15.39%)

Table 1 : Distribution of respondents according to the adaptation strategies followed to deal with climate change

Sr. no.	Adaptation strategies	Respondent	
		Yes	No
6.	Cultivation of crops viz. Horse gram, Black gram, Green gram and moth bean for In-situ soil and water conservation	45 (34.61%)	85 (65.39%)
7.	Mulching with crop residue for soil and water conservation in rabi seasons.	16 (12.30%)	114 (87.70%)
8.	Broad bed method of sowing	49 (37.69%)	81 (62.31%)
9.	Early sowing for jowar	111 (85.38%)	19 (14.62%)
10.	Sowing with two bowl ferti seed drill.	48 (36.92%)	82 (63.08%)
11.	Use of high yielding varieties.	119 (91.53%)	11 (8.47%)
12.	Use of Drought tolerant varieties.	121 (93.07%)	9 (6.93%)
13.	One third reduction in plant population for drought management in rabi sorghum	114 (87.69%)	16 (12.31%)
14.	Change in cropping system ie adoption of intercropping/ crop rotation etc.	61 (46.92%)	69 (53.08%)
15.	Soil organic matter enhancement practices like organic recycling of crop residues and green manuring etc.	46 (35.38%)	84 (64.62%)



The data presented in Table revealed that majority of respondent farmers were found to follow adaptation strategies like use of drought tolerant varieties, use of high yielding varieties, cultivation across slope for shallow and medium soils, one third reduction in plant population for

drought management in rabi sorghum, early sowing for sorghum, adoption of ridges and furrows to conserve water, soil and water conservation through deep ploughing once in three year, 2 to 3 harrowings every year as measure of water conservation to deal with

climate change, Soil organic matter enhancement practices like organic recycling of crop residues and green manuring etc. Significant respondent found to use adaptation strategies like change in cropping system ie adoption of intercropping/ crop rotation etc, contour bunding for effective soil and water conservation under dry land conditions, broad bed method of sowing, sowing with two bowl ferti seed drill, cultivation of crops viz. horse gram, black gram, green gram and moth bean for in-situ soil and water conservation as measure to deal with climate change. 42 Very few respondents were found to use mulching with crop residue for soil and water conservation in rabi seasons ; three weeks after rabi as sowing adaptation strategies to deal with climate change. The finding is in line with the findings of Dhaka et. al. (2010)

CONCLUSION

The study reveals that a significant proportion of respondent farmers have adopted a range of climate adaptation strategies to cope with the adverse effects of changing weather patterns in dryland agricultural systems. Among the most commonly reported practices are the adoption of drought-tolerant and high-yielding crop varieties, which help maintain productivity under erratic rainfall conditions. Farmers also employ various soil and water conservation techniques such as deep ploughing, ridges and furrows, and contour bunding to improve water retention and reduce soil erosion.

In addition to these, changes in cropping systems—notably intercropping and crop rotation—have gained increasing importance as adaptive measures that enhance soil fertility, diversify risk, and stabilize yields. Despite the recognition of their potential, more advanced techniques such as mulching and delayed sowing are found to be less frequently adopted, possibly

due to lack of awareness, resources, or institutional support.

These findings underscore the need to promote sustainable and context-specific adaptation strategies that are both accessible and effective for smallholder farmers. Strengthening extension services, improving access to climate-resilient technologies, and building farmers' adaptive capacity are critical to ensuring the long-term resilience and productivity of dryland agriculture under the growing threat of climate variability.

REFERENCES

- Ashok kumar bennur, 2011. A study on entrepreneurial qualities and adoption behavior of banana growers. M.sc.(Agri.) thesis, UAS, Dharwad
- Borate, H. V. 2015. Perception of the banana growers of middle Gujarat about good agricultural practices. Ph. D. Thesis (Unpublished), A.A.U., Anand.
- Dhaka et. al. (2010) Analysis of farmers' perception and adaptation strategies to climate change. Agriculture Research Center Journal International, 1(6): 388- 390
- Gbetibuo (2009). Understanding farmers' perception and adaptation to climate change and vulnerability. International Food Policy Research Institute (IFPRI) Discussion Paper 00849
- Kudale et al. (2019) Farmers perception about climate change in marathwada region, M.Sc. thesis (Unpublished), V.N.M.K.V. Parbhani.
- Sharnagat, P.M. (2008) Attitude of Beneficiaries towards National Horticulture Mission. M.Sc (Agri.) Thesis (Unpub.), Dr. P.D.K.V, Akola (M.S).
- Zunjar, R.P. 2011. Constraints faced by cotton growers in adoption of Integrated Pest Management. M.SC. (Agri.) Thesis, MKV, Parbhani.

RESEARCH ARTICLE

Evaluation of the key challenges faced by the migrant laborers in Kerala's Agricultural Sector: A study of Ernakulam district, Kerala

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ABSTRACT

This study examines the multifaceted challenges faced by migrant laborers in the agricultural sector of Ernakulam, Kerala. An ex post facto approach was employed, focusing on four blocks with the highest populations of migrant laborers: Kothamangalam, Muvattupuzha, Vazhakulam, and Angamaly. A sample of 240 migrants from diverse backgrounds, including West Bengal, Assam, Odisha, and Bihar, was selected through simple random sampling, with data collected via semi-structured interviews. The Analytical Hierarchy Process (AHP) was utilized to systematically rank the constraints impacting their livelihoods. Housing emerged as the most significant constraint, with a criterion weight of 0.51, followed by income (0.25), social security (0.12), and employment-related issues (0.08). Predominant challenges included overcrowded housing, high rent, wage deductions, language barriers, and job uncertainty. The AHP results demonstrated high consistency, emphasizing the reliability of the ranking process. The findings underscore the need for targeted policies addressing affordable housing, income security, and social welfare for migrant laborers, promoting an inclusive approach to labor rights and well-being in Kerala's agricultural sector.

Keywords: In-migration, middlemen, constraints, AHP, policy intervention, solution

INTRODUCTION

India, a nation characterized by its rich diversity and dynamic landscapes, boasts a long and intricate migration history. The phenomenon of migration has been deeply ingrained in India's socio-economic fabric for centuries, playing a pivotal role in shaping the demographic and cultural landscape. With a population exceeding 1.4 billion and a kaleidoscope of cultural, linguistic, and geographical variations, India witnesses diverse migration patterns that significantly influence both the regions of origin and destination. Kerala, a state in India, exemplifies this migratory trend, experiencing a notable influx of labourers not only from neighbouring states like Tamil Nadu and

Karnataka but also from distant states such as West Bengal, Odisha, Bihar, Uttar Pradesh, Uttarakhand, and Assam, as reported by the Economic Review in 2021. The allure of higher wages for unskilled labour, abundant employment opportunities, and a shortage of local labour act as compelling factors drawing individuals to Kerala. The state's flourishing economy, particularly in infrastructure and construction sectors, further fuels in-migration, with expectations of sustained growth in the years to come (Kumar, 2011). Despite this narrative of economic promise, the vast tapestry of migration stories often intertwines with threads of constraint, shedding light on the challenges and vulnerabilities faced by those

venturing into new territories. This research embarks on a comprehensive exploration to delve into the constraints encountered by in-migrants who choose to establish a new home, utilizing the Analytical Hierarchy Process (AHP) as a robust tool to systematically assess and prioritize these constraints (Nikhil et al, 2024).

METHODOLOGY

This research study is motivated by a crucial acknowledgement of the necessity to understand the challenges faced by migrant labourers engaged in farm work. It utilizes an ex post facto approach and was conducted in September 2023 in Ernakulam district, known for its diverse population of labour migrants from states such as West Bengal, Assam, Odisha, and Bihar (GOK, 2021). With Kerala having the highest in-migrant population, reaching 6 lakhs, the study specifically focuses on four blocks with the maximum concentration of in-migrants: Kothamangalam, Muvattupuzha, Vazhakulam, and Angamaly. Employing a simple random sampling method, 60 in-migrants were selected from each block, resulting in a total sample size of 240. The data collection process involved conducting semi-structured interviews.

To evaluate constraints, the research employed the Analytical Hierarchy Process (AHP) (Wind & Saaty, 1980). AHP entails organizing the decision-making problem in a hierarchical structure, starting with the goal and progressing to criteria, sub-criteria, and alternatives. Pairwise comparisons were then conducted to establish the relative significance of criteria, generating a matrix based on these evaluations. In the final stage, computations were carried out to determine the priority vector (weights) and assess the consistency of judgments. The Consistency Index (CI) serves as an indicator of pairwise comparison consistency. Meeting the required standards for CI renders the decision acceptable; otherwise, evaluations must be revisited until the desired consistency level is attained (Kumar and Pant, 2023). AHP proves

valuable for examining decisions with multiple criteria, involving participants in comparing paired objectives and assessing their relative importance (Morgan, 2017). Furthermore, the utilization of pairwise comparison in AHP alleviates the cognitive load associated with prioritizing decision-making (Himes, 2007).

$$\text{Consistency index (CI)} = \frac{\lambda_{\max} - n}{n - 1}$$

$$\text{Consistency ratio (CR)} = \frac{\text{CI}}{\text{Random index}}$$

In these formulas, 'n' represents the number of compared elements. The consistency of AHP is determined by the CI value, and if it exceeds a certain threshold, the comparison needs to be redone. The calculation of $\lambda_{\max}$ involves multiplying the judgment matrix right by the priority vector and then dividing the elements of the weighted sum matrices or the new vector. The average of these values is $\lambda_{\max}$, and the consistency ratio compares the consistency index to the random index.

RESULTS AND DISCUSSION

Ranking of constraints faced by in-migrants

Following pairwise comparisons and the ranking process, housing constraints emerged as the primary challenge for migrants, carrying a criteria weight of 0.51, as detailed in Table 1. Income constraints (C1) came next as the second most substantial, with a criteria weight of 0.25, while social security constraints (C4) secured the third position with a criteria weight of 0.12. Employment constraints and other constraints were ranked fourth and fifth, with criteria weights of 0.08 and 0.05, respectively. The overall $\lambda_{\max}$ was 5.39, and the consistency index was 0.098. Importantly, the resulting consistency ratio, derived from these parameters, was 0.08, falling below the threshold of 0.1, indicating the reliability and consistency of the ranking results.

Table 1. Criteria for constraints faced by labour in-migrant

Goal	Ranking of constraints faced by in-migrant labourers			
Criteria	Income (C1)	Housing (C2)	Employment (C3)	Social security (C4)
Sub criteria	Low payment (C11)	High rent (C21)	Job uncertainty (C31)	Language barrier (C41)
	Delayed payment (C12)	Housing conditions are abysmally poor (C22)	Long working hours (C32)	Social insecurity faced by children and women (C42)
	Sub-contractor illegal wage deduction (C13)	Overcrowded stay (C23)	Insecure hazardous work (C33)	Less enrolment of children in school (C43)
	Unequal wage (C14)	Limited sanitation facility (C24)	Owner dominance (C34)	Lack of awareness of labour rules (C44)
	–	–	Lack of identity proof (C35)	–

Table.2 Ranking of major constraints faced by labour in-migrant

Criteria rank	Major constraints	Priority vector/Criteria weight	Test values
1	Housing constraint (C2)	0.51	$\lambda_{\max} = 5.39$
2	Income constraints (C1)	0.25	Consistency index (CI) = 0.098 Consistency ratio (CR) = 0.088
3	Social security constraints (C4)	0.12	
4	Employment constraints (C3)	0.08	

Table 3. Ranking of major constraints and sub-constraints faced by labour in-migrant

Criteria rank	Major constraints	Priority vector/Criteria weight	Test values
Ranking of housing constraints			
1	Overcrowded stay (C23)	0.428	$\lambda_{\max} = 4.13$ Consistency Index (CI) = 0.044 Consistency Ratio (CR) = 0.049
2	Housing conditions are abysmally poor (C22)	0.38	
3	High rent (C21)	0.12	
4	Limited sanitation (C24)	0.06	
Ranking of income constraints			
1	Sub-contractor illegal wage deduction (C13)	0.48	$\lambda_{\max} = 4.23$ Consistency Index (CI) = 0.076 Consistency Ratio (CR) = 0.084
2	Delayed payment (C12)	0.30	
3	Low payment (C11)	0.12	
4	Unequal wages (C14)	0.10	
Ranking of social security constraints			
1	Language barrier (41)	0.65	$\lambda_{\max} = 4.04$ Consistency Index (CI) = 0.014 Consistency Ratio (CR) = 0.015
2	Social insecurity faced by children and women (C42)	0.18	
3	Less enrolment of children in school (C43)	0.17	
4	Lack of awareness of labour rule (C44)	0.05	
Ranking of employment constraints			
1	Job uncertainty (C31)	0.51	$\lambda_{\max} = 5.16$ Consistency index (CI) = 0.040 Consistency Ratio (CR) = 0.03
2	Long working hours (C32)	0.23	
3	Insecure hazardous work (C33)	0.13	
4	Owner dominance (C34)	0.08	
5	Lack of identity proof (C35)	0.04	

The primary housing limitation, as outlined in Table 3, was an overcrowded living situation, following the substandard quality of houses for migrants in Ernakulam district (Jane, 2016). The third significant obstacle was the high cost of rent, followed by a scarcity of sanitation facilities. The overall consistency in ranking outcomes, reflected in the consistency ratio of 0.049 (less than 0.1), underscores the coherence in the findings. The calculated $\lambda_{\max}$ was 4.13, and the consistency index (CI) was 0.044.

The primary constraints related to income, as presented in Table 3, reveal that the most noteworthy limitation is the illegal deduction of wages by sub-contractors. Following closely, delayed payment emerges as a second critical constraint. The third major constraint is the insufficient payment made by owners to in-migrants. Finally, unequal wages due to discrimination rank as the fourth constraint. In the overall analysis, the $\lambda_{\max}$ value was 4.23, and the consistency index (CI) was relatively low at 0.076. The computation of the consistency ratio (CR) based on these parameters yielded a value of 0.084, which falls below the threshold of 0.1. This emphasizes a high level of consistency in our ranking results.

Table 3 delineates a predominant constraint that has come to the forefront - language barriers faced by in-migrants at their destination places. The second most critical constraint, as identified by stakeholders, pertains to the heightened vulnerability of children and women to sexual exploitation. The third social constraint involves the lower enrolment of children in schools. A lack of awareness about labour rules emerges as the fourth constraint contributing to the aforementioned issues. The comprehensive analysis resulted in an overall $\lambda_{\max}$ value of 4.04, accompanied by a low consistency index (CI) of 0.014, falling below the threshold of 0.1. This underscores the high level of consistency in our ranking results.

Regarding employment constraints, the primary constraint is job uncertainty, followed by

long working (Mathew, 2014). Insecure hazardous work ranks third as a contributing sub-criterion. Owner dominance emerges as the fourth constraint contributing to the above, followed by a lack of identity proof, which is placed last. The overall $\lambda_{\max}$ is 5.16, with a low consistency index (CI) of 0.04. The consistency ratio (CR) derived from these parameters is 0.03, below the acceptable threshold of 0.1. This signifies a reliable and consistent set of rankings for employment constraints, providing a robust foundation for further analysis and decision-making.

The study underscores critical challenges faced by in-migrants after migration to Kerala, notably the housing challenge. In-migrants in Kerala are facing housing challenges due to overcrowded stays, poor sanitation facilities, poor housing conditions, and high rent. The majority of the in-migrants were sharing houses with five or more than five members (Mathew, 2014) and faced problems like compromised privacy, and heightened risk of disease spread. Utilization of substandard material and poor roofing led to poor sanitation facilities and housing conditions, due to which in-migrants are facing health problems. The hygiene around such settlements is pathetic and the settlements are littered with waste (Manoj and Viswanath, 2015). Migrant workers in the low-wage sector face challenges in securing housing that is both affordable and suitable (Kumar 2001; Desai, 2017). Nowadays, urban areas with job opportunities often experience higher demand for housing, driving up rent prices. Hence, migrants are also facing the challenges of high rent. Tackling these concerns necessitates a comprehensive strategy, encompassing elements such as rural and urban planning and initiatives to provide affordable housing. Also, the government should enrol every migrant in the "Apna Ghar" project.

In income constraints due to the absence of a legal framework unscrupulous subcontractors illegally deduct the wages of in-

migrants which exacerbates their economic vulnerability. Implementing and enforcing stringent laws against illegal wage deductions will safeguard the rights of in-migrant workers. Due to the cumbersome payment process, the lack of awareness about market price, willingness to compromise for a relatively better life, and discrimination by the owner, employers led to challenges like delayed payment, low payment, and unequal wages.

In-migrants in Kerala are also suffering through challenges of social insecurity majorly including, a language barrier due to the dominance of the Malayalam language. It was evident that healthcare providers faced several challenges in managing care for migrants, which included not only language and cultural barriers, but also resource constraints within their workplaces, and disharmony between the law and their professional norms (Suphanchaimat *et al.*, 2015). It led to unavailing themselves from various basic amenities and provisions given by the government. In-migrant women and children face the issue of social insecurity at their workplace. And also, there is less enrolment of children in school. They are considered outsiders and seasonal migration of parents is also one of the significant reasons for children less enrolment in school. In-migrants are unaware of their labour rules because of this they always become a victim of discrimination by middlemen.

Labourers migrate to Kerala due to the high employment rate. But, they faced many issues after migrating to Kerala at their workplace. Job uncertainty is the major issue faced by in-migrants which is followed by long working hours, insecure hazardous work, middleman dominance, and lack of identity proof. Migrants, reliant on these intermediaries for information, often find themselves engaged in low-end, low-value, strenuous manual labour, and are consistently vulnerable to exploitation. Also, to address the challenge of middlemen there should be a transparent hiring process. The

provision of identity becomes a core challenge for impoverished migrants when they arrive in a new location. The government should implement rules to register details about in-migrants and also provide assistance to obtain necessary documents.

CONCLUSION

This study identifies the pressing socioeconomic challenges faced by migrant labourers in Kerala's agricultural sector, with housing, income security, social safety, and employment stability as primary concerns. The Analytical Hierarchy Process (AHP) provided a reliable ranking of these issues, highlighting overcrowded housing, high rent, wage deductions, language barriers, and job uncertainty as significant constraints. To address these challenges, comprehensive policy interventions and cohesive action among stakeholders—including government, local authorities, and employers—are essential. Strategies should encompass rural and urban planning, affordable housing programs like "Apna Ghar," stringent laws to prevent wage deductions, and streamlined payment systems. Moreover, addressing social insecurities involves language and healthcare support, education access, transparent hiring, and identity documentation. A holistic and integrated strategy is imperative to improve the living conditions, social security, and rights of migrant laborers, fostering a more equitable and resilient agricultural labor force in Kerala.

REFERENCES

- Desai, R. (2017): "Entitlements of Seasonal Migrant Construction Workers to Housing, Basic Services and Social Infrastructure in Gujarat's Cities: Back-ground Policy Paper," CUE Working Paper 35, Ahmedabad
- Desai R (2017). Entitlements of Seasonal Migrant Construction Workers to Housing, Basic Services and Social Infrastructure in Gujarat's Cities: Back-ground Policy Paper. Centre for Urban Equity Working Paper 35,

Ahmedabad.

- GOK [Government of Kerala] (2021). Economic review 2021. State Planning Board, Thiruvananthapuram, Kerala, India, 63-88 [online]. Available: <http://spb.kerala.gov.in/economic-review/ER2021/index.php>.
- Kumar S (2001). Social Relations, Rental Housing Markets and the Poor in Urban India. *London School of Economics & Political Science, London*, pp 1–150.
- Kumar N A (2011). Vulnerability of migrants and responsiveness of the state: The case of unskilled migrant workers in Kerala, India. *Centre for Socio-Economic and Environmental Studies, Kochin*, 1p.
- Manoj P K and Viswanath V (2015). Socio-economic conditions of migrant laborers- An Empirical study in Kerala. *Indian J Appl Res* 5(11): 88-93.
- Morgan R (2017). An investigation of constraints upon fisheries diversification using the analytic hierarchy process (AHP). *Marine Policy* 86: 24-30.
- Nikhil K S, Radhakrishnan A, Sathyan A R, Thomas A and Dileepkumar, R (2024). Unveiling constraints in banana value chain: A holistic analysis in Palakkad district, Kerala. *Indian J of Extension Education* 60(1): 132-136.
- Suphanchaimat R, Kantamaturapoj K, Putthasri W and Prakongsai P. (2015). Challenges in the provision of healthcare services for migrants: a systematic review through providers' lens. *BMC Health Services Research* 15: 1-14.
- Wind Y and Saaty T L (1980). Marketing applications of the analytic hierarchy process. *Management Science* 26(7): 641-658.

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