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-Editor

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CONTENTS

Assessing the Competency Level of Graduate Students: A Gender Perspective

Neethu B Nair[1], Saravanan Raj[2], S. Raahalya[3]

ABSTRACT

This study assesses competency levels among graduate students in agriculture, horticulture, and forestry disciplines in various states of India from a gender perspective. A total of 402 student respondents participated, with 215 responders through a Google forms survey and 187 from training programs organized by the National Institute of Agricultural Extension Management (MANAGE), Hyderabad. Competency was evaluated across four key constructs: cognitive, interpersonal, self-leadership, and digital, using a 13-group competency framework. Results indicated that while students demonstrated strengths in areas like self-leadership and interpersonal skills, significant gaps were found in digital competencies and certain cognitive skills. Gender-based analysis using the Mann-Whitney Test revealed that male students outperformed female students in critical thinking, mental flexibility, entrepreneurship, goal achievement, and digital skills. However, no significant gender differences were observed in planning, communication, teamwork, or self-awareness. The findings underscore the need for targeted educational interventions to bridge these competency gaps and enhance employability among graduates in the agricultural sector.

Keywords: Competency Assessment, Agricultural Graduates, Gender Gap, Digital Skills, Employability

Introduction

Improving the quality of higher education remains a global priority, particularly in developing countries, as the competencies gained during academic studies play a decisive role in students' employability (Smekalova, 2024). Challenges such as unemployment, existing alarming poverty, and labor market inequalities disproportionately impact youth and women, demanding urgent attention (ILO, 2019). These issues are linked to the United Nations Sustainable Development Goal 8 (SDG 8), which advocates for inclusive and sustainable economic growth, full employment, and decent work for all (UN, 2023). However, the International

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Labour Office continues to report significant deficits in decent work, especially among young people and women. The COVID-19 pandemic has exacerbated these challenges, leading to an unprecedented rise in the number of young people not engaged in employment, education, or training (ILO, 2022).

In the contemporary job market, particularly within the agricultural sector, it is imperative that students acquire a comprehensive set of competencies to enhance their employability and achieve successful career trajectories. Employers increasingly prioritize candidates who possess skills aligned with industry demands, highlighting the critical role of universities in facilitating the acquisition and development of these essential competencies. By integrating such opportunities within the academic framework, educational institutions not only strengthen the employability of graduates but also ensure their preparedness to navigate the dynamic job market.

Theoretical Framework

The concept of competencies is multifaceted and challenging to define, with various interpretations existing in the literature. Competencies are broadly understood as the integration of experiences, knowledge, skills, values, and attitudes acquired over time. Woodruffe (1993) defines competencies as the behavioural patterns necessary to perform tasks effectively, while Klemp and McClelland (1986) emphasize their contextual nature. According to the OECD (2005), competency involves the ability to meet complex demands by mobilizing psychosocial resources in specific contexts.

The effectiveness of undergraduate programs is closely correlated with the employability of their graduates (Andelt et al., 1997). Scholars such as Higgins and Kram (2001) underscore the necessity of adaptable mentoring relationships to help students navigate the evolving career landscape. They identify key factors—such as employment contracts, technological advancements, organizational structures, and diversity—that influence career development. This necessitates that mentoring and career guidance in higher education remain responsive to current job market trends, ensuring that students are equipped not only with academic knowledge but also with the technical and soft skills essential for workforce success.

Addressing employability challenges requires a comprehensive approach, including curriculum revisions, alignment of course content with industry needs, provision of experiential learning opportunities, and implementation of effective mentoring programs. Universities must systematically design their programs to meet workforce demands (Knight & Yorke, 2003). Faculty members responsible for curriculum development should incorporate feedback from

stakeholders-including students, researchers, practitioners, and the community-into program design and implementation (Hurst et al., 2015; Maiga et al., 2013). Regular evaluation of agricultural curricula, ideally every two to five years, is recommended to ensure that programs adequately prepare students for the workforce (Andelt et al., 1997; Morgan, 2010, 2012; Morgan & Rucker, 2013). Engaging with industry leaders to identify the competencies expected of entry-level employees allows educational institutions to align their curricula and program objectives with industry demands (Maiga et al., 2013; Morgan, 2010, 2012; Zubović et al., 2009).

Businesses increasingly expect college graduates to possess the competencies necessary for workforce success (Knight & Yorke, 2003; Sargent et al., 2003). Sleezer and Denny (2004) emphasize the critical role of human capital—particularly knowledge and innovation capacities-in the evolving economy. The decline in the availability of highly qualified workers underscores the need for college-educated individuals who can advance and apply new technologies. To address the shortage of skilled workers, the creation of a robust workforce development infrastructure is essential, with educational institutions playing a pivotal role in aligning educational resources with industry needs (Sleezer & Denny, 2004). Holzer (2012) further identifies a disconnect between the labour market and educational systems, contributing to the shortage of middle and highly skilled workers for well-paying jobs.

Morgan (2010) found that many competencies valued by employers in the agricultural sector, such as the ability to meet deadlines and reliability, are often indirectly taught through university structures rather than explicitly included in the curriculum. Sargent et al. (2003) evaluated a 15-week capstone course designed to develop leadership skills, concluding that leadership development should be integrated throughout the curriculum rather than concentrated in a single course. Hurst et al. (2015) conducted a comprehensive examination of factors contributing to the development of a productive agricultural workforce. Additionally, Easterly et al. (2017) emphasize the importance of personal and leadership competencies for leaders in agriculture and natural resources, highlighting the value of dependability, problem-solving, and critical thinking.

Handayani et al. (2019) stress the need for further research to integrate green skills alongside essential competencies to enhance the overall skill set of agricultural vocational students. Meanwhile, the increasing inclination toward entrepreneurship in agriculture, particularly in supportive environments, reflects a growing preference for establishing personal ventures over seeking traditional employment (Lesaane and Akintunde, 2020).

Dondi et al. (2021) found that proficiency in certain digital and cognitive skill groups was below average among respondents. Additionally, Ghimire et al. (2022) identified significant differences between male and female faculty in their perceptions of the relevance of technical and employable skills, as well as in students' use of career guidance and mentoring to enhance their job prospects.

In this regard, it is important to examine the competence of students. Therefore, a study has been formulated to assess the competency levels of students at agricultural and allied universities in India from a gender perspective. This research aims to contribute to a deeper understanding of how these competencies are developed and perceived within this vital sector.

Methodology

This study aimed to assess competency levels among graduate students in agriculture, horticulture, and forestry disciplines across various states in India. A survey research design was used for the study, with a total sample size of 402 students. Data collection was done through a Google Forms survey. Out of 402 respondents, 215 students responded through the Google Form, from students enrolled in different agricultural and forestry colleges, and 187 responses were obtained from students participated in training programs organized by the National Institute of Agricultural Extension Management (MANAGE), Hyderabad, India. The survey was conducted during November to December 2023.

To have a comprehensive understanding of competency, 13 distinct competency groups were selected based on review of relevant literatures. These groups were categorized under four key constructs: cognitive, interpersonal, self-leadership, and digital. Each competency group was assessed individually, with an index score for each category of competency to quantify proficiency levels.

Competence index = (Actual score / Maximum score) x 100

Following data collection and index score calculation, statistical analysis was conducted using SPSS to study gender-based differences in competency levels among the students. The Mann-Whitney Test was administered to evaluate significant differences in competency levels between male and female students, providing valuable insights into potential gender-related variations in competency level.

Result

Profile of the students

The study involved a sample of 402 students from agricultural and allied universities in India. Of these participants, 172 were male and 230 were female (Table 1) reflecting a balanced representation of both genders. The inclusion of a larger number of female participants also highlights the growing presence and importance of women in the agricultural field, enabling a detailed evaluation of gender-specific competencies and challenges.

Table 1: Gender distribution of students

Category	Numbers
Male	172
Female	230
Total	**402**

Statement wise distribution of competency

Table 2 shows the competencies across four major constructs: Cognitive, Interpersonal, Self-Leadership, and Digital, with results indicating varying levels of proficiency among the participants.

In the cognitive construct, students displayed strong capabilities in decision-making (77.35%) and seeking relevant information (79.84%), yet struggled with logical reasoning, where 39.29% fell into the "Weak to Average" category. Similarly, while a majority showed competence in developing work plans (74.86%) and time management (71.14%), agile thinking remained a challenge for 38.30% of students. Communication skills were mixed, with active listening (80.83%) being a notable strength, but a significant portion of students exhibited weaker abilities in storytelling and public speaking (47.01%) and asking the right questions in different contexts (45.76%). Mental flexibility also varied, as most students excelled in learning from experiences (87.80%) and adapting to different perspectives (74.61%), though the ability to translate knowledge across contexts was underdeveloped for 36.06% of participants.

The interpersonal competencies revealed that while students had potential in understanding organizational dynamics (63.43%) and being role models (55.46%), their win-win negotiation skills were lacking for 43.77% of them. Developing relationships appeared to be a strength, with high levels of empathy (79.10%) and the ability to inspire trust (82.82%). Teamwork effectiveness was also robust, particularly in collaborating with team members (80.34%) and

fostering inclusiveness (75.12%). However, there was a noticeable need for improvement in resolving conflicts (28.10%) and empowering team members, where 50.99% of students fell short.

In the self-leadership construct, a substantial majority demonstrated strong self-awareness (88.55%) and an understanding of personal strengths (85.06%), yet areas like self-control and emotional regulation required further development, with 23.87% of students rated as "Weak to Average." Entrepreneurial competencies were generally positive, with students showing a willingness to embrace challenges (73.38%) and innovation (73.87%), though many were cautious in risk-taking (70.14%) and breaking traditional norms (67.65%). When it came to achieving goals, students were highly driven, with 79.36% showing strong goal orientation. However, persistence (50.05% weak) and coping with uncertainty (31.83% weak) were identified as areas needing attention.

Finally, in the digital competencies, students excelled in digital collaboration (76.86%) and ethical digital practices (63.92%), but foundational digital literacy and citizenship were areas of concern, with nearly half rated as "Weak to Average." Technical skills, particularly in programming and coding (76.35% weak) and data analysis (69.39% weak), were notably deficient. Additionally, students' understanding of digital systems, including data management (62.18% weak) and cyber security literacy (64.92% weak), highlighted a critical gap in digital education.

Overall, while students demonstrated strengths in several key areas, significant gaps were identified, particularly in digital competencies and certain cognitive and interpersonal skills, underlining the need for targeted educational interventions.

Table 2. Statement wise distribution of students competency

Statements	Category	Percentage
	Good to Excellent	Weak to average
Cognitive		
Critical thinking		
Problem-solving	62.17	37.80
Logical reasoning	74.86	39.29
Decision-making	77.35	22.63
Seeking relevant information	79.84	20.14
Planning and ways of working		
Developing work plans	74.86	25.12
Time management and prioritization	71.14	28.85
Agile thinking in work	61.68	38.30

Communication		
Storytelling and public speaking	53.07	47.01
Right questions in different contexts	54.22	45.76
Synthesize messages effectively	64.67	35.31
Active listening	80.83	19.14
Mental flexibility		
Creative and imaginative in problem-solving	67.65	32.33
Adapt to different perspectives and contexts	74.61	25.34
Learn and grow from experiences	87.80	11.94
Translating knowledge to different contexts	63.92	36.06
Learn and adapt within a cognitive web	69.64	30.34
Interpersonal		
Mobilising systems		
Role model for others	55.46	43.28
Win-win negotiations	54.96	43.77
Crafting an inspiring vision	61.43	39.05
Understanding of organizational dynamics and awareness	63.43	37.06
Developing Relationships		
Empathy in my interactions with others	79.10	20.59
Inspire trust in others	82.82	17.16
Humility in interactions with others	70.64	29.34
Sociable and building positive relationships with different individuals	77.60	22.38
Teamwork Effectiveness		
Fostering inclusiveness within a team	75.12	24.87
Motivate individuals with different personalities	72.88	27.11
Resolving conflicts within a team	71.88	28.10
Collaborating with team members	80.34	19.64
Coaching and support to team members	72.87	25.81
Empowering individuals in a team	61.43	50.99
Self-leadership		
Self-awareness and Self-Management		
Understanding own emotions and triggers	88.55	11.41
Self-control and effective emotional regulation	74.86	23.87
Understanding of personal strengths and weaknesses	85.06	14.91
Integrity in all actions and decisions	75.11	24.61
Self-motivated and prioritize wellness in life	79.35	20.64
Self-confidence	76.35	23.55

Entrepreneurship		
Courage and willingness to take calculated risks	70.14	29.85
Change and innovation in various aspects of life	67.65	31.09
Approaching challenges with energy, passion, and a positive outlook	73.38	25.39
Open to break traditional norms and explor-ing new, unconventional ideas	73.87	24.86
Goals Achievement		
Ownership and make decisive decisions to achieve goals	79.34	20.64
Highly oriented towards achieving goals	79.36	19.44
Grit and persistence when working towards goals	72.62	50.05
Cope effectively with uncertainty in pursuing my goals	68.15	31.83
Digital		
Digital fluency and citizenship		
Digitally fluent and practice digital citizenship	56.95	43.02
Strong foundation in digital literacy	50.98	47.75
Digital learning and skill development	60.94	39.05
Collaborate in digital environments	76.86	23.13
Ethical standards in digital practices	63.92	36.06
Software use and development		
Programming and coding	23.38	76.35
Data analysis and statistics	30.59	69.39
Applying algorithms effectively	48.08	72.88
Understanding digital system		
Data literacy and data management	37.80	62.18
Smart systems and their applications	46.01	53.97
Cybersecurity literacy and online security practices	35.07	64.92
Translate and enable technology for different purposes	43.07	56.96

Component wise competency of the students

Analysing the components within each construct, the cognitive domain displays varied competency levels. Mental flexibility stands out with the highest index value (0.75), followed by critical thinking (0.72), communication (0.70), and planning and ways of working (54.94%). Interpersonal skills exhibit proficiency, with developing relationships leading (77.86%), followed by teamwork and effectiveness (0.75) and mobilizing systems (67.69%). Self-leadership showcases

robust competency in self-awareness and self-management (79.20%), followed by goal achievement (0.74) and entrepreneurship (0.74). In the digital realm, digital fluency and citizenship display the highest index value (0.67), followed by understanding digital systems (0.59) and software use and development (0.37). (Table 3)

Table 3. Component wise distribution of students competency

Competency	Index
Cognitive	
Critical thinking	0.72
Planning and ways of working	0.54
Communication	0.70
Mental flexibility	0.75
Interpersonal	
Mobilising systems	0.67
Developing relationships	0.77
Teamwork effectiveness	0.75
Self-leadership	
Self-awareness and self-management	0.79
Entrepreneurship	0.73
Goal achievement	0.74
Digital	
Digital fluency and citizenship	0.67
Software use and development	0.37
Understanding digital system	0.59

Construct wise competency of the students

Regarding the construct-wise competency of the students, self-leadership appears with the highest index value (0.75), followed closely by interpersonal skills (0.73) and cognitive skills (0.68), (Table 4)

Table 4. Construct wise index

Competency	Index
Cognitive	0.68
Interpersonal	0.73
Self-leadership	0.75
Digital	0.54

Test of Normality

The test of normality suggests that the data is not normally distributed, (p value <0.05) necessitating the use of nonparametric tests.(Table 5).Using the Mann-Whitney test, a comparison of competency levels between male and female students reveals significant differences in seven components—critical thinking, mental flexibility, entrepreneurship, goal achievement, digital fluency and citizenship, software use and development, and understanding digital systems (P<0.01) with male students by demonstrating higher competence. On the other hand, competencies such as planning and ways of working, communication, developing relationships, teamwork and effectiveness, and self-awareness and self-management showed non-significant differences between male and female students. (P<0.01) (Table 6&7).

Table 5. Test of normality

Test of Normality		
Variables	**Statistic**	**Sig.**
Critical thinking	.111	<.001
Planning and ways of working	.124	<.001
Communication	.096	<.001
Mental flexibility	.096	<.001
Mobilising systems	.105	<.001
Developing relationships	.104	<.001
Teamwork effectiveness	.067	<.001
Self-awareness and self- management	.099	<.001
Entrepreneurship	.083	<.001
Goal achievement	.100	<.001
Digital fluency and citizenship	.079	<.001
Software use and development	.164	<.001
Understanding digital system	.106	<.001

Table 6. Mann-Whitney Test

Variables	Gender	N	Mean Rank
Critical thinking	Male	172	221.51
	Female	230	186.53
	Total	402	

Planning and ways of working	Male	172	209.59
	Female	230	195.45
	Total	402	
Communication	Male	172	206.64
	Female	230	197.66
	Total	402	
Mental flexibility	Male	172	193.41
	Female	230	212.31
	Total	402	
Mobilizing systems	Male	172	219.93
	Female	230	187.72
	Total	402	
Developing relationships	Male	172	207.12
	Female	230	197.30
	Total	402	
Teamwork effectiveness	Male	172	210.15
	Female	230	195.03
	Total	402	
self-awareness and self-management	Male	172	204.52
	Female	230	199.24
	Total	402	
Entrepreneurship	Male	172	224.11
	Female	230	184.59
	Total	402	
Goal achievement	Male	172	214.79
	Female	230	191.56
	Total	402	
Digital fluency and citizenship	Male	172	224.67
	Female	230	184.17
	Total	402	
Software use and development	Male	172	223.31
	Female	230	185.19
	Total	402	
Understanding digital system	Male	172	232.38
	Female	230	178.41
	Total	402	

Table 7. Test statistics

Test Statistics[a]													
	Critical thinking	Planning and ways of working	Communication	Mental flexibility	Mobilizing systems	Developing relationships	Teamwork effectiveness	self-awareness and self-management	Entrepreneurship	Goal achievement	Digital fluency and citizenship	Software use and development	Understanding digital system m
Mann-Whitney U	16337.500	18388.000	18896.500	17920.000	16610.000	18813.000	18293.000	19260.000	15890.500	17494.500	15794.000	16029.000	14469.500
Z	-3.017	-1.222	-.773	-1.623	-2.772	-.846	-1.295	-.453	-3.402	-1.999	-3.475	-3.298	-4.639
Asymp. Sig. (2-tailed)	.003	.222	.440	.002	.006	.398	.195	.650	<.001	.046	<.001	<.001	<.001

a. Grouping Variable: gender

Discussion

Students demonstrate a commendable level of competency across various constructs within the cognitive, interpersonal, self-leadership and digital domains.

In the cognitive domain, students exhibit proficiency in critical thinking, planning and ways of working, communication and mental flexibility. This proficiency may stem from the educational curriculum's focus on these skills and the adoption of teaching methodologies that promote active learning and problem-solving. Additionally, exposure to real-world scenarios and practical exercises likely enhances students' abilities to apply theoretical knowledge practically, fostering deeper understanding and critical thinking.

Within the interpersonal domain, students display strong communication skills, particularly in active listening and synthesizing messages effectively. This proficiency reflects the collaborative learning environment supported within the educational institution, where students engage in discussions, debates, and group activities to refine their communication abilities. Furthermore, assignments and projects emphasizing communication may provide ample practice opportunities.

In the self-leadership domain, students demonstrate resilience, adaptability, and problem-solving skills, indicative of a growth mind-set nurtured within the educational environment. Encouragement of embracing challenges, learning from failures, and self-directed learning initiatives likely contribute to students' development of essential self-leadership skills.

Regarding the digital domain, students exhibit proficiency in leveraging technology for learning and innovation. This proficiency may result from the integration of digital tools and platforms within the curriculum, alongside emphasis on digital literacy development. Resources such as online courses and educational apps facilitate students' engagement with digital technologies, preparing them for the digital-centric landscape.

Cognitive Skills

The higher competency in mental flexibility suggests exposure to diverse learning environments, adaptability to change, and the ability to think creatively in dynamic situations. Enhanced critical thinking skills may result from rigorous academic training, problem-solving exercises, and exposure to analytical frameworks. Effective communication skills may stem from pedagogical methods emphasizing communication techniques, group discussions, and interactive learning sessions.

Interpersonal Skills

The higher competency in developing relationships implies a strong emphasis on fostering interpersonal connections, possibly through team-building activities, peer-to-peer interactions, and mentorship programs. The equitable distribution of competency in teamwork and effectiveness may reflect collaborative learning environments, where students work together towards common goals.

Self-Leadership

The emphasis on self-awareness and self-management could result from initiatives promoting self-reflection, personal development workshops, and psychological support services. Cultivated goal achievement skills might be a result of goal-setting exercises, mentorship programs, and extracurricular activities encouraging students to pursue their aspirations.

Digital Competency

The higher competency in digital fluency and citizenship may stem from the integration of technology-enhanced learning methodologies, digital literacy initiatives, and exposure to digital citizenship concepts. Weaknesses in software use and development may be attributed to the complexity of technical subjects, limited practical exposure to programming languages, and the need for specialized training in software development. Challenges in understanding digital systems may arise from the rapid evolution of technology, gaps in curriculum alignment with industry demands, and the need for continuous updates in digital literacy education.

Gender Disparities

Observed higher competency levels among male students in critical thinking, mental flexibility, entrepreneurship, goal achievement, digital fluency and citizenship, software use and development, and understanding digital systems could result from various factors:

Socialization Patterns: Traditional gender roles and societal expectations may influence skill development, with men historically encouraged to engage in problem-solving and technical fields.

Educational Opportunities: Male students may have had greater access to resources and opportunities promoting critical thinking, digital fluency, and software development.

Cultural Norms: Societal norms prioritizing technical proficiency and leadership qualities in men may influence skill development.

Perceived Gender Stereotypes: Stereotypes may affect self-perception and career

aspirations, with men more encouraged to pursue technical fields.

Role Models and Mentorship: Presence of male role models in leadership positions may inspire and mentor male students, contributing to skill development.

Digital Divide: Gender disparities in access to technology and digital resources may impact digital competency levels.

Educational Pedagogy: Teaching methods may favour the learning styles of male students, impacting skill acquisition.

Addressing gender disparities requires systemic efforts to promote inclusivity, challenge stereotypes, provide equal access to resources, and foster supportive learning environments.

Conclusion

The current job market requires more than mere academic qualifications; employers seek candidates who possess a diverse skill set encompassing technical expertise, critical thinking, problem-solving abilities, effective communication and adaptability. In the agricultural sector, these competencies extend to proficiency in agricultural techniques, data analysis, sustainability practices, project management, and entrepreneurship.

As competition intensifies, students must acquire practical experiences, hands-on training, and industry-relevant knowledge to distinguish themselves. Universities play a pivotal role in facilitating such opportunities through internships, experiential learning programs, industry partnerships and tailored curriculum enhancements designed to meet evolving workforce demands.

Disparities in competency between male and female students may stem from societal norms, cultural biases, and differential resource access. Factors like confidence levels, socialization patterns, and gender stereotypes can impact skill acquisition and application. The varied competency levels across constructs underscore the multifaceted nature of skill development in agricultural extension education, emphasizing the need for customized pedagogical approaches, mentorship initiatives, and lifelong learning opportunities to address individual needs and bridge competency disparities.

By addressing gender inequalities and ensuring equitable access to resources and support, universities can empower all students to realize their potential and make meaningful contributions to the agricultural workforce.

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Factors Influencing Participation of Producers in Farmers' Market – An Analysis of Siddipet Rythu Bazaar (Telangana)

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ABSTRACT

Developing local food system by providing market access to farmers close to the production area has the potential to overcome various challenges faced by farmers in effective marketing of their produce mainly smallholder cultivating perishables. The Government has recognised the potential of local element in agriculture as suggested by the introduction of various reforms including farmers' market. The concept has been experimented in various states with different names like Rythu Bazaars in Telangana. The concept has so many dimensions to be analysed to understand its effective implementation. However, an attempt has been made in the present paper to understand the factors influencing the participation of producers in farmers' market by taking a case of Siddipet Rythu Bazaar. The analysis is based on the results of Probit Regression Model run on the primary information collected from 200 sample farmers. The analysis reveals that variables like gender, family size, production of vegetable and availability of transport facility have significant and positive influence on the participation of farmers in Rythu Bazaar. However, factors like market orientation and age had significant but negative influence suggesting that youth with better market orientation tends to explore market opportunities outside such models. Rythu Bazaars have the potential to serve as an effective market access tools for smallholders mainly cultivating perishables and acquiring certain characteristics in terms of family size and presence of women to contribute. Though, youth are observed to be inclined to participate in models other than Rythu Bazaars.

Keywords: Farmers' Market, Rythu Bazaar, Factors Influencing Participation, Probit Regression Model

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Introduction

Vocal for local has been the focus of the Government in recent past to promote local industries and local consumption, having its implications for agriculture production as well. Developing local food system by providing market access to farmers close to the production area has the potential to overcome various challenges faced by farmers in effective marketing of their produce mainly smallholder cultivating perishables. Local food systems offers various benefits like higher share in consumer price, local economic development, positive influence on health and nutrition, environmental benefits, food security and market opportunities for small and medium size farmers as compiled by USDA (2009) and Burnett (2011). Local food is the food that is locally produced, marketed and consumed (Hand and Martinez, 2010). The concept may also be influenced by other physical, psychological and cultural factors (Marry, 2018, Martinez et al., 2010, Darby et al., 2008 and Durham, et al., 2009). Higher per unit price than other channels is another benefit of direct interaction between farmers and consumers (Willis et al., 2016). The Government has recognised the potential of local element in agriculture as suggested by the introduction of various reform measures including farmers' market.

The concept of farmer-consumer market or farmers' market has been experimented in various states with different names like Apni, Raitha Santhe, Uzhavar Santhai and Krushak Bazzar (GoI, 2017). The concept has been implemented in Telangana with the name Rythu Bazaars. As the concept suggests, these markets facilitate direct contact of farmers with consumer without the involvement of any middlemen leading to better realisation of price. These markets in Telangana facilitate participation of farmers by providing various services like sheds for display of produce, safe water, electronic weighting machines, ATM, etc. The markets also ensure fixation of price by following a scientific and transparent system and also share the same through display boards installed in the markets. These markets also ensures prompt payment. These markets are operating with temporary / semi-permanent structures created by respective Agricultural Produce Market Committees (APMCs). Farmers and consumers are not expected to pay any service charges or market fee for participation in these markets. A total of 39 markets are operating successfully in Telangana. These markets have shown their effectiveness in encouraging local food system in terms of their ability to capture more than 20 percent of the total vegetables produced in the districts of Telangana State.

There are so many aspects to be analysed to understand the successful implementation of the concept related to location, structure, administration, facilities, flow of activities, price discovery mechanism and perception of different

stakeholders on benefits and challenges. Equally important is to understand the factors influencing the participation of farmers in Rythu Bazaars. With this background, an attempt has been made in this paper to analyse the factors responsible for participation of farmers in Rythu Bazars (farmers' market). Study has examined these factors by taking the case of Siddipet Rythu Bazaar operating successfully in Telangana.

Methodology

Probit regression model was used to analyse the factors determining the participation of farmers in a particular market type i.e. traditional marketing channels characterized by long chain of intermediaries viz-a-viz Rythu Bazaar facilitating direct contact of farmers with consumers. The decision to participate either in the farmers' market or traditional market was considered in Probit regression model as variable dependent on various independent variables, as explained in Table-1. The analysis is based on primary information collected from a sample of 200 farmers. As the paper is based on the Siddipet Rythu Bazaar as a case, 100 farmers visiting specifically the Siddipet Rythu Bazaar operating in Siddipet District of Telangana have been considered for collection of primary information. Another 100 farmers participating in market other than Rythu Bazaars identified randomly from the influence area of Siddipet Rythu Bazaar have also been considered under the study. Such a mix group of farmers was considered under the study to analyse the factors determining the participation of farmers in Rythu Bazaar viz-a-viz other markets.

Table 1: Description of the Variables of the Model Developed to Analyze Factors Responsible for Participation of Farmers in Rythu Bazaar

Variable	Variable Name	Variable type	Variable measurement
Dependent Variables			
MPD_{RB}	Market Participation Decision in Rythu Bazaar (RB)	Dummy	1 if farmer participated in Rythu Bazaar (RB), 0 otherwise
Quantitative Variables			
WKMEM	Working members	Continuous	Number of working members in the family of respondents
AGE	Age of the respondents	Continuous	Number of years
PRVG	Production of leading vegetables	Continuous	Quantity in Quintals

Qualitative Variables			
GEN	Gender of sample farmer	Dummy	1 if farmer is female, 0 otherwise
MKTOR	Market orientation of sample farmers as captured through their understanding of different marketing aspects	Dummy	1 if sample farmer is oriented, 0 otherwise
TRNS	Access to transport facilities	Dummy	1 if farmer enjoy good access to transportation means, 0 otherwise
DIS	Closeness measured in terms of distance	Dummy	1 if distance is less than 15 kms, 0 otherwise

Source: Author's definitions

Probit Regression Model

The Probit model to analyse the Market Participation Decision (MPDRB) of the farmer in Rythu Bazaar can be computed from the standard normal cumulative distribution function (Egbetokun and Omonona, 2012). This model is a statistical probability model with two categories in the dependent variables. That is, the binary dependent variable, MPDRB takes on the values of zero and one. The Probit analysis provides statistically significant findings of which variable increase or decrease the probability of participation of farmers in farmers' market. In this binary Probit model, the preference of the farmer to participate in Siddipet Rythu Bazaar was taken as '1', while preference to participate in other marketing channel was considered to be as '0'. It is assumed that the ith farmer obtains maximum utility, if transaction is completed by participating in Rythu Bazaar in comparison to other markets.

The probability (Pi) of choosing any alternative over not choosing it can be expressed as follows –

$$Pi = prob[Y_i = 1 \mid X] = \int_{\infty}^{xi'} (2\pi)^{-1/2} \exp(-t^2/2)dt$$

$$= \Phi(x_i'\beta)$$

Where φ represents the cumulative distribution of a standard normal random variable

Model used in the Paper

Considering the variables selected (Table-1), the Probit model formulated for this study is as given below –

$P(0,1) = MPDRB = \beta 0 + \beta 1MKTOR + \beta 2AGE + \beta 3GEN + \beta 4WKMEM + \beta 5TRNS + \beta 6DIS + \beta 7PRVG + \varepsilon i$

Where, MPDRB = Market Participation Decision of the farmer to participate in farmers' market, which will take the value of '1' if the farmer participated or '0' if not.

The relationship between a specific variable and the outcome of the probability is interpreted by means of the marginal effect, which accounts for the partial change in the probability. The marginal effect associated with continuous explanatory variables Xk on the probability P(Yi = 1 | X), holding the other variables constant, can be derived as follows:

$(\partial P\_i)/(\partial x\_ik) = \Phi(x\_i\hat{}' \beta)\ \beta\_k$

Where φ represents the probability density function of a standard normal variable.

The marginal effect on dummy variables should be estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived from the following –

$\Delta = \Phi(\bar{x}\beta, d = 1) - \Phi(\bar{x}\beta, d = 0)$

The marginal effect provide insights into how the explanatory variables shift the probability of participation in Rythu Bazaar. The marginal effect were calculated for each variable, while holding other variables constant at their sample mean values.

In order to analyse the factors influencing MPDRB, Binary Probit Model was employed. This model has been estimated by the maximum likelihood method. The estimated coefficients and Standard Errors (SEs) reveal the major factors influencing the decision of the farmer to participating in Rythu Bazaar (MPDRB). A statistically significant coefficient suggests that the likelihood of farmer's participation in farmers' market will increase/ decrease as the response of the explanatory variable increases/ decreases. The likelihood ratio statistic as indicated by $\chi 2$ is significant ($P < 0.00$), suggesting that all the model parameters were jointly significant in explaining the dependent variable. The McFadden's Pseudo R2 was 0.30 which suggest a moderate fit as highlighted by various studies on evaluating Pseudo-R2's for Binary Probit Models (Veall, M and Zimmermann, K, 1990).

Results

The results of the Probit model analysis suggesting the influence of the selected explanatory variables on the decision of the farmers to participate in Rythu Bazaar is presented in Table-2. The table reveals that the influence of variables like gender (GEN), family size (WKMEM), production of vegetable (PRVG) and availability of transport facility (TRNS) have significant and positive influence on the participation of farmers in Rythu Bazaar (MPDRB). This suggests that women-farmers are more likely to participate in Rythu Bazaar. The participation in the market is not influenced by the distance but by the availability of transport facility. The number of working members in the family (WKMEM) also influences the decision to participate as a lot of time is required to clear-off the commodities brought to the market. The availability of vegetable surplus is also having positive impact suggesting smallholders with some minimum quantity of vegetable production (PRVG) are more likely to participate in such farmer oriented direct marketing models.

Factors like market orientation (MKTOR) and age (AGE) had significant but negative influence suggesting that youth with better market orientation tends to explore market opportunities outside such models. However, factors like distance from the market (DIS) had no significant effect on the decision of farmers to participate in the Rythu Bazaar.

Table 2: Probit Model Results for Factors Influencing MPDRB

Variables	Coefficient	SE	Marginal effect (dy/dx)	Z	P > |z|
MKTOR	- 1.0853	0.234	- 0.2680*	- 4.63	0.000
AGE	- 0.0337	0.011	- 0.0083*	- 3.00	0.003
GEN	1.3663	0.337	0.3373*	4.05	0.000
WKMEM	0.4360	0.100	0.1076*	4.36	0.000
TRNS	0.008	0.225	0.1015**	1.83	0.068
DIS	0.4113	0.221	0.0829	1.52	0.130
PRVG	0.3359	0.003	0.0020*	2.72	0.007
Constant	- 0.4585	0.599		- 0.76	0.444
LR χ^2 (10) = 102.75					
Prob > χ^2 = 0.0000					
Log likelihood = - 87.255696					
Pseudo R^2 = 0.37					

Note: (*) and (**) denote significance at the 1% and 10% levels, respectively

The presence of female-member (GEN) in the family influenced the decision (at 1% level). This may be an indication of better participation of female in such market as a lot of time is required to clear off the entire produce and male taking care of production aspects. The marginal effect (0.3373) revealed that presence of women in the family to participate would increase the probability of market participation by 33.73 percent. Participation is also influenced by availability of working members (WKMEM) in family (at 1% level) for requirement of working members to clear-off the produce in farmers' market. The marginal effect (0.1076) revealed that increase of one working member in the family to take care of post-production activities would increase the probability of market participation by 10.76 percent.

The decision to participate is also influenced significantly by the availability of vegetables surplus depicted through production (PRVG) at 1% level. The marginal effect (0.0020) imply that every increase of one quintal in production of vegetables will improve the possibility of the farmer to participate in the Rythu Bazaar by 0.20 percent. The decision to participate is also influenced by availability of transportation mean (TRNS) at 10 percent level but not by the distance of farm (DIS) from the market. The marginal effect suggest that availability of transportation means increases the probability to participate by 10.15 percent.

Orientation of the farmers on market (MKTOR) and age of the farmers (AGE) has also influenced the decision to participate in the market but negatively (both at 1% level). The negative association of farmers with age and market orientation to participate may be an indication that youth having better understanding of markets are keen in exploring other marketing options available in the region. Though, the farmers-market offers an important option to farmers mainly smallholders involved with cultivation of fresh vegetables but there are alternatives marketing models emerging in present time because of various reforms initiatives of the Government which are suitable for different kind of crops and stakeholders. The marginal effect of market orientation (0.2680) suggests that possibility of a farmer having better market orientation to participate in Rythu Bazaar would decrease by 26.80 percent. Whereas, in case of age, the marginal effect (0.0083) suggests a decrease of 0.83 percent in probability to participate with an increase of one year in age.

Conclusion

The analysis suggests that the decision to participate in the Rythu Bazaar is influenced by the gender and availability of working members in the family. The model provides direct contact with the consumers but a lot of time is required to clear-off the produce and therefore, the participation is influenced by the size of the family and gender. The decision is not influenced by the distance but transportation facilities available to farmers. The farmers having access to transport facilities are more likely to participate in Rythu Bazaar. Vegetable production is also an important factor influencing the participation in farmers' market. The farmers mainly the smallholders with surplus above a minimum level are more likely to participate in such marketing models. Age and market orientation of the farmers also influences the decision to participate in the market but negatively which may be an indication that such young farmers with a better understanding of marketing are keen in exploring other options available for marketing of their produce. The youth are observed to be inclined to participate in marketing models other than Rythu Bazaars. Capacity building of youth on the skills required to explore different marketing models can help them get linked effectively with various new marketing models emerging because of reforms and various other changes experienced in the system. The participation in the market is not influenced by the distance but by the availability of transport facility. There is need to provide transportation facilities to the farmers interested in visiting market by creating appropriate provisions in public transport so as to maintain the quality of the fresh produce. The Government may consider running exclusive buses/ other means mainly during morning hours to help farmers reach market on time with fresh produce. Rythu Bazaars have the potential to serve as an effective market access tools for smallholders mainly cultivating perishables and acquiring certain characteristics in terms of family size and presence of women to contribute. The production agencies can also take these factors into consideration while working with the farmers on market strategies for effectively integrating the higher production with the market.

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Venturing into Agri-entrepreneurship: A Study on Enablers and Constraints

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ABSTRACT

Agriculture sector is critical to the growth and development of India as majority rely on agriculture. With the changing landscape of agriculture and the way it is shifting from subsistence to commercial farming, the role of private extension service providers is assuming greater significance. This trend is alluring the private individuals to engage into Agripreneurship activities. Even many involved in farming are showing interest to shift to Agripreneurship by diversifying their activities and income sources. Becoming the seller of agri-inputs and information to the farmers in varying scale is a new agribusiness opportunity for many in different regions of the country. The Diploma in Agricultural Extension Services for Input Dealers (DAESI) is a scheme of Agriculture Ministry of Government of India to train and enable the candidates aspiring to become agripreneurs to embracing agri-input business. However, venturing into such untraversed road without enablers is likely to cause disruptions to the livelihood of small agripreneurs. Such ventures are also likely to encounter several constraints for which necessary policy facilitation may be put in place. The present study identifies such enablers and constraints encountered by the candidates completing the DAESI program based on the data collected from 600 respondents in 10 different states of India. The study also suggests policy recommendations to give impetus to aspiring agripreneurs to take up Agripreneurship activities and support farming community in India.

Keywords: Agri-Enterpreneurship, Agriculture Extension, Constraints, Input Dealer, Technical Competency.

Introduction

Agricultural extension in India is predominantly public funded and is targeted to provide farmers with suitable and relevant technologies in agriculture. But Public extension alone is not enough to fulfil demand for technical knowledge and agricultural inputs among farming community. Therefore, private players

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such as agribusiness companies, agripreneurs, NGOs, input dealers, etc., are also playing a major role in technology and information dissemination to the farmers. Among various players, input dealer is one of the important sources of information to the farmers in India. Farmer's prosperity and standard of living is determined by the profitability of their allocation. To make agriculture profitable, efficient dissemination of latest agriculture technology is very critical. This role is mainly determined by Agri Input Dealers in India. Their role as para-extension professionals by providing requisite knowledge to farmers, they can professionalize extension services and contribute to bring a paradigm shift in Indian Agriculture.

With this idea, the National Institute of Agriculture Extension Management (MANAGE) has designed one year Diploma program "Diploma in Agricultural Extension Services for Input Dealers (DAESI)" to impart relevant agricultural knowledge to the dealers to transform them into para-extension professionals and enable them to address the field level problems of farmers. The DAESI Program is in operation since 2003. Realizing the growing importance of the program, Govt. of India has made DAESI as Central Sector Plan Scheme since 2015, implying that the government will bear part of the (50%) program fee to incentivise agri input dealers to enrol in the DAESI program.

Interestingly, a large number of people from different occupations and industries are taking admission to the DAESI program with an idea to venture into agri input business opportunities. This provides for an interesting case of willingness of the people to take up agri-input dealership as an entrepreneurial activity without any financial assistance from the government. Having decided to trudge this path after paying the 100% course fee, how the DAESI course helped them was also important to be understood. In this connection, the research study was carried out to identify the enablers and constraints encountered by members in setting up of their own agri ventures.

Methodology

DAESI Scheme Operational Structure: MANAGE is implementing the programme with the help of State Agricultural Management and Extension Training Institute (SAMETIs). In turn, SAMETIs organize the program through various Nodal Training Institutes (NTIs), such as agriculture colleges, Krishi Vigyan Kendras (KVKs), Agricultural Technical Management Agency (ATMA), and Non-Government Organizations (NGOs), etc., at the district level with the help of resource persons drawn from universities, research organizations, departments, and freelancers.

Research Design: Ex Post Facto research design was adopted for the study as the

researcher had no opportunity to influence the independent variables and the sample population has completed the program atleast two years before.

Sampling Plan: The study was carried out in 10 states (Bihar, Chattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, UttarPradesh and West Bengal) with highest number of candidates enrolled under self-finance scheme of the DAESI program. The data was collected exclusively from the trainees of the self-finance DAESI batches completed during 2018-21 by purposively selecting the candidates not having agri-input license at the time of their enrolment in the DAESI program.

Sample size: A sample of 600 trained DAESI candidates constituted the respondents of the study. The data of this study was collected through personal interview.

Statistical analysis: Frequency and percentage were used for classifying the data. The collected data were classified, tabulated, analyzed and interpreted in order to make the findings meaningful.

Results and Discussion

Table 1.1 Reasons (More severe) for not establishing agri-input enterprise by the respondents trained under DAESI

S.no	Reasons (Most severe)	f	%	Rank
1	Lack of financial support from banks and financial institutions	137	72.87	I
2	High credit business	121	64.36	II
3	Business is capital intensive	107	56.91	III
4	Non-supportive government policies	93	49.47	IV
5	Inability to proper market planning	88	46.81	V

Lack of financial support from banks and financial institutions was ranked as main reason for not establishing their own enterprise. The other most severe reasons are also mostly related to the financial requirement of the business indicating the nature of agribusiness landscape becoming more capital intensive. Therefore, the respondents should be supported with the schemes and incentives to encourage them to take agripreneurship. The department officials must utilize the services of the trained input dealers to serve the farming community by giving them preference.

Table 1.2 Reasons (Moderate severe) for not establishing agri-input enterprise by respondents trained under DAESI

S.no	Reasons (Most severe)	f	%	Rank
6	Fear of competition	87	46.28	VI
7	Inaccurate evaluation of project (DPR)	79	42.02	VII
8	Bottlenecks in obtaining license from the department to start the business	76	40.43	VIII
9	Complex legal issues	75	39.89	IX
10	Problems of partnership and team work	72	38.30	X

One of the psychologically rooted reason among respondents is fear of competition which prevents them from establishing agri-input enterprises. To overcome this, topics related to entrepreneurship, innovative business management and marketing techniques need to be included. Inaccurate evaluation of the project ranked seventh in place. This constraint points out to the need for including technical topics like creation of detailed project reports, methods of project management. The respondents also reported operational reasons such as bottlenecks in obtaining license from departments to start business and complex legal issues. Policy support by respective departments can be provided. Further, simplifying the rules and procedures for the same can ease the process. Problems of partnership and team work is another psychological reason stated by the respondents. According to changing dynamics of business, there is need for cooperation for commercial success.

Table 1.3 Reasons (Less severe) for not establishing agri-input enterprise by respondents trained under DAESI

S.no	Reasons (Most severe)	f	%	Rank
11	Lack of professional advice to run the enterprise	70	37.23	XI
12	Lack of related experience, expertise and good work relationships	64	34.04	XII
13	Problems in product or service supply	51	27.13	XIII

14	Inadequate training under DAESI	51	27.13	XIV
15	Non-Supportive attitude by the family members	49	26.06	XV
16	Lack of interest and dissatisfaction in work or work place	47	25.00	XVI

Around 37.23 per cent of respondents stated lack of professional advice to run the enterprise. The Nodal Training Institutes who are organizing the DAESI programs under self-finance mode should identify the willingness of the candidates to establish the shops and to serve the farming community as Para-extension worker. The identified candidates should be provided support by the MSME development agencies, Entrepreneurship Development Institutes should work in coherence/ collaboration to channelize these positive proactive entrepreneurial behaviour components of rural agri entrepreneurs to encourage them to establish agro-based enterprises. Problems in product supply can be combatted by having proper knowledge of domain.

Table 2 Constraints faced by the respondents

No.	Constraints	Yes	
		f	%
Personal constraints			
1	Fear of failure due to risk involved	206	34.33
2	Lack of support from family members	199	33.17
3	Difficulty to keep records/ bookkeeping	192	32.00
4	Lack of interest in business	185	30.83
5	Lack of skills related to input dealing	185	30.83
Marketing Constraints			
6	Fluctuations in market demand for input and seasonality	445	74.17
7	Frequent market price fluctuation	409	68.17
8	Unavailability of inputs including fertilizer, insecticides and pesticides at the right time	362	60.33
9	Middleman malpractices in the supply chain	287	47.83

Situational constraints			
10	Highly competitive business environment	432	72.00
11	Lack of policy support	255	42.50
12	Lack of departmental/ government cooperation	253	42.17
13	Local political pressure/ influence	252	42.00
14	Unavailability of storage facility in the area	245	40.83
15	Delayed renewal of license	224	37.33
Economic/ financial constraints			
16	High cost of inputs (fertilizers/ manures/ plant protection chemicals)	394	65.67
17	Lack of investment capital	369	61.50
18	High transportation cost	354	59.00
19	High credit business	344	57.33
20	Poor returns to capital	336	56.00
Extension constraints			
21	Lack of consultancy and counselling service	291	48.50
22	Lack of technical knowledge of new product and Cultivation practices.	245	40.83
23	Lack of knowledge about modern technology	234	39.00
24	Lack of business management training	230	38.33
25	Lack of motivation	215	35.83

The various constraints faced by the respondents are listed under personal constraints, marketing constraints, situational constraints, economic constraints and extension constraints. The details of the constraints faced by the respondents is presented in Table 2. Among the personal constraints faced by the respondents it was revealed that one-third (34.33%) of the respondents perceived fear of failure due to risk in business as major constraint. Lack of support from family members (33.17%), difficulty to keep records (32.00%), lack of interest in

business (30.83%) and lack of skills related to input dealing (30.83%) were the other personal constraints perceived by the respondents. From the results it can be observed that nearly one-third of people have perceived them as constraints in establishing and running business. In this regard Rahul (2020) in his study on An analytical study on Transforming Agri Input Dealers into Para Extension Professionals had reported that majority of the respondents stepping back because of fear of failure and lack of support from family members.

Out of the marketing constraints listed, fluctuations in market demand for inputs and seasonality (74.17%) was the major constraint perceived by the respondents, followed by frequent market price fluctuation (68.17%), unavailability of inputs during right time (60.33%) and middleman malpractices in the supply chain (47.83%).

Situational constraints are factors that limit the extent to which attitudes, personal characteristics, and motivation translate into behavior and performance. Highly competitive business environment was faced by majority (72.00%) of the respondents, lack of policy support (42.50%), lack of departmental/ government cooperation (42.17%), local political pressure/ influence (42.00%), unavailability of storage facility in the area (40.83%) and delayed renewal of license (37.33%). This findings was in agreement with the finding of Mubeena et.al (2021) in her study on Constraints encountered by Rural Youth for establishing Agri Enterprises where she stated that lack of support from government was the major constraint faced by the respondents.

Economic constraints are external factors that limit entrepreneur, the freedom to do whatever it wants, and they are usually beyond the individual control. Nearly two-third of the respondents (65.67%) felt high cost of inputs as major constraint. Lack of investment capital (61.50%), high transportation cost (59.00%), high credit business (57.33%) and poor returns to capital (56.00%) were other constraints faced by them. This is in line with the findings of Patel, N et al. (2023) in her study on Field problem analysis approaches after DAESI Program stated that lack of capital is one of the biggest constraint faced by agro-input dealers.

Extension constraints are those factors which limits the entrepreneurs to reach large number of farmers in their agri-input business. Lack of consultancy and counselling service (48.50%) was the major extension constraint perceived by the respondents, followed by lack of technical knowledge of new product and cultivation practice (40.83%), lack of knowledge about modern technology (39.00%), lack of business management training (38.33%) and lack of motivation (35.33%) respectively. This is in line with the findings of Shrishailam, B (2021) in which he revealed that the major extension constraint was untimely reaching of message and lack of technical knowledge.

Conclusion

The study sort to make an appraisal of the constraints faced by the respondents in setting up of the agribusiness. A number of constraints were identified, topping the list being the typical one, which is fluctuating in market demand for inputs. This is the most nagging small business challenge. The next major constraint was competition in market. Agri enterprises get overwhelmed by the level of competition from market and it is advised to ward off mainly through high quality products/services and DAESI trained input dealers must be given preference by agriculture department in sale of subsidized inputs such as seeds, fertilizers through these shops which increase the visibility of their business. Many competent input dealers trained under DAESI may be supported with agri infrastructure fund to pursue agri consultancy, procurement and processing centres, storage infrastructures etc.

Agricultural department should place the inputs as per the cropping season in order to avoid black marketing and to avoid middleman in the supply chain. The DAESI trained input dealers should be given a preference for renewal of license and should promote their enterprises for better consultancy services. The respondents those who were not able to establish shops and who were facing difficulty in running their shops shall be made aware and shall be linked to various other schemes for running their business.

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Impact of Climate Resilient Technologies in Nandyal District of Andhra Pradesh

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ABSTRACT

Climate change refers to a significant and lasting alteration in the statistical distribution of weather patterns over periods ranging from decades to millions of years. In developing countries, crop yield declines are expected in several important crops, with South Asian nations projected to be particularly hard hit. Climate-smart agricultural technologies proved to be the best adaptation strategies followed by farmers for achieving sustainable crop yields. A study on Impact of climate resilient technologies (CRTs) and factors associated in adoption of the technologies was conducted in Nandyal district of Andhra Pradesh. The results of the study indicated that conservation furrows helped in increasing the yield of setaria by 28% (1,418 kg/ha) and castor by 32% (1,332 kg/ha) and in cotton it was 51% higher and in red gram it was 44% higher (1,024 kg/ha). With micro-irrigation yield was enhanced by 35% in sweet orange (27 t/ha), tomato 32% (64 t/ha) and in brinjal, it was 41 % higher than control. In the intercropping system of setaria with red gram in 5:1 ratio 28% more yields was recorded. In case of groundnut and red gram intercropping in 7:1 ration the yield recorded was 30% more than the control. Drought tolerant varieties of castor, Bengal gram and groundnut recorded enhanced yield by 25%, (1,330 kg/ha), 23% (1,513 kg/ha) and 50% (1,020 kg/ha) respectively along with additional net returns. Short duration varieties of setaria, groundnut and green gram yielded 32%, 58% and 9% more, respectively, than traditional varieties. Certain characteristics viz., mass media exposure, capacity building programmes attendance, extension contact, perception on climate change and perception on climate resilient technologies had a significant correlation with the adoption of CRTs among the farmers.

Keywords: Climate resilient technologies (CRTs), Economic Impact and Personal Characteristics.

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Introduction

Climate change is a significant and lasting alteration in the statistical distribution of weather patterns over periods ranging from decades to millions of years. The fact that climate influences the development and development influences the climate has come to be known universally during recent times. In developing countries, declines in crop yields are expected and South Asian countries will be particularly hard-hit. Studies in the past have indicated that India is likely to face the highest agricultural productivity losses in accordance with observed climate change patterns and projected scenarios. Projections of climate change made up to 2100 for India reveal an overall increase in temperature by 2–4°C without a substantial change in precipitation quantity (Kavi Kumar, 2009). Climate-smart agricultural technologies have proven to be effective adaptation strategies adopted by farmers for sustainable crop yields (Nayak et al., 2023). It was also recorded that some personal characteristics are associated with the adoption of the technology. In this context, it is necessary to evaluate the impact of climate resilient technologies and factors associated with the adoption of these technologies in the scarce rainfall zone of Andhra Pradesh. Hence, the study is designed with the following objectives.

- To study the economic impact of adopting climate-resilient technologies in agriculture.
- To understand the factors affecting the adoption of climate-resilient technologies by farmers in rainfed areas.

Methodology

The study was conducted in the Nandyal district of Andhra Pradesh, India, with 180 respondents, to assess the economic benefits of adopting crop production technologies and to identify the factors influencing their adoption in three villages adopted under the NICRA Project. Data on farmers were obtained from KVK records, and response data were collected using a structured interview schedule. The t-test was used to analyze the results pertaining to yield and economic returns, and the correlation coefficient was used to examine the factors influencing the adoption of climate-resilient technologies. Sample farmers who had adopted each technology and implemented it during the reference year (2021–22) were considered to assess changes in net returns and yield levels. Therefore, the number of farmers who adopted each technology varied from one technology to another.

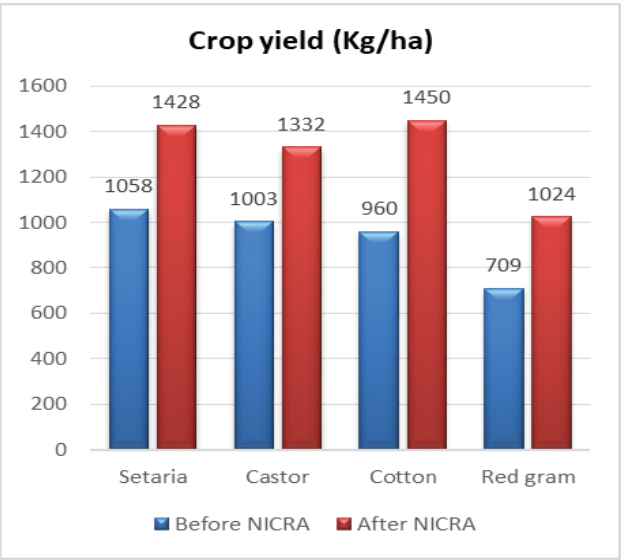
Results and Discussions

I. Economic Impact of Climate Resilient Technologies in Crop Production

1. In-situ Moisture Conservation Measures:

It was noted (Table 1) that a conservation furrow was created after every six rows at 35 days after sowing (DAS) using a blade harrow, which helped shorten the effect of dry spells on the Setaria crop. The yield obtained was 1,418 kg/ha, representing a 28% increase over the control, with incremental net returns of ₹11,955/ha. The t-value was significant at the 1% probability level.

In the case of Castor, conservation furrows were formed after every two rows planted at 90 cm spacing using a blade harrow at 35 DAS. Adoption of this drought management practice resulted in a yield of 1,332 kg/ha, which was 32% higher than the control, with incremental net returns of ₹13,263/ha. For Cotton, cultivation without in-situ moisture conservation practices resulted in a yield of 960 kg/ha and negative net returns. However, with conservation furrows, the yield increased to 1,450 kg/ha, a 51% improvement over the control, accompanied by incremental net returns of ₹13,150/ha. Regarding conservation furrows in Red gram, the yield recorded was 1,024 kg/ha, which was 44% higher than the control, with incremental net returns of ₹11,153/ha. The observed increases in yield and income were significant at the 1% probability level, as indicated by the t-values.



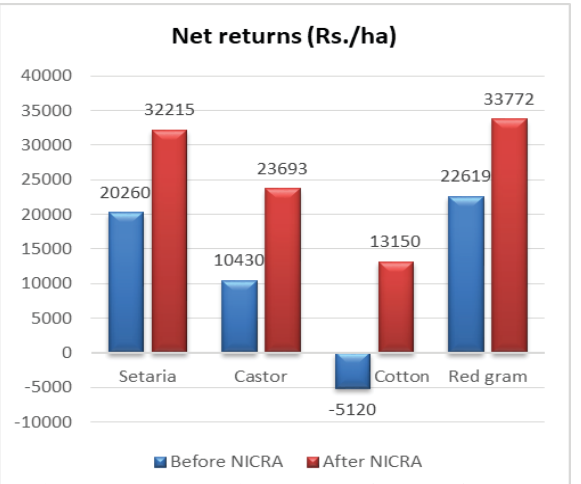
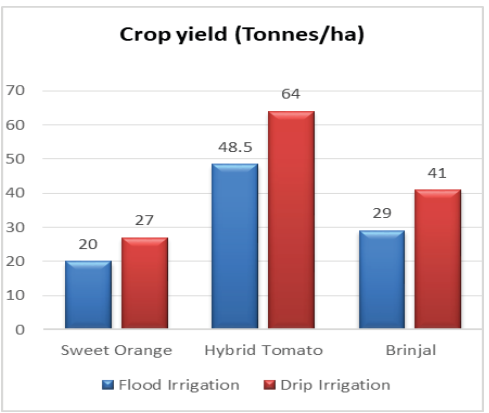


Figure 1. Yield and Net Returns due to In-situ Moisture Conservation in Different Crops

Micro-Irrigation:

With the installation of micro-irrigation, the yield of Sweet orange was 27 tonnes/ha, which was 35% higher than under control conditions, and the incremental net income was ₹143,873/ha. The changes were significant at the 1% probability level, as indicated by the t-values.

The hybrid tomato crop under drip irrigation recorded a yield of 64 tonnes/ha, which was 32% higher than under flood irrigation. The net returns obtained were ₹2,96,583/ha, which was 42% (₹88,999) higher than under flood irrigation. In brinjal cultivation (traditional variety), the yield under drip irrigation was 41 tonnes/ha, which was 41% higher than under flood irrigation. The net returns under the drip system were ₹137,273/ha, which was 44.7% higher than under flood irrigation.



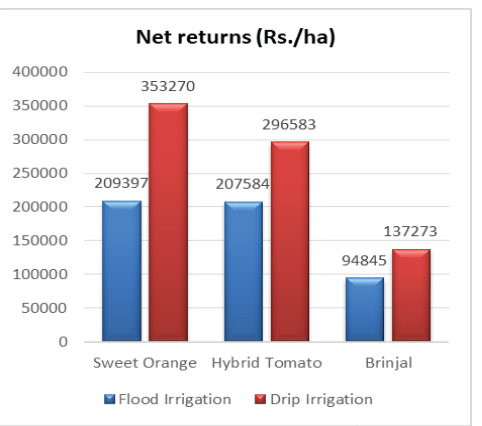


Figure 2. Changes in Yield and Net Returns per Hectare due to Drip

Intercropping

In the intercropping system, after every five rows of Setaria, one row of Red gram was sown (5:1). Sowing was done using a bullock-drawn seed drill. As Setaria was the main crop, its equivalent yield was considered for yield calculation. With this intervention, the yield recorded was 1,830 kg/ha, which was 28% higher than the control. The net returns stood at ₹21,973/ha, representing a 42% increase over the control. The differences were significant at the 1% probability level, as indicated by the t-values. Similar results were reported by Latha et al. (2012).

In another intercropping system, seven rows of Groundnut and one row of Red gram were sown using a bullock-drawn seed drill. As Groundnut was the main crop, its equivalent yield was considered for yield calculation. The yield recorded in this intercropping system was 1,123 kg/ha, which was 29.52% higher than the control, with incremental net returns of ₹12,800/ha. The differences were significant at the 1% probability level.

Farmers opined that crops grown under intercropping experienced lower pest incidence due to crop diversity, reduced weed problems, and improved soil nutrient status through the inclusion of legumes. The system also acted as a form of crop insurance, ensuring that farmers could reap at least one crop even under adverse conditions. This practice proved beneficial for dryland farmers, as it utilized the bimodal distribution of rainfall and enabled more efficient soil utilization through a combination of shallow- and deep-rooted crops.

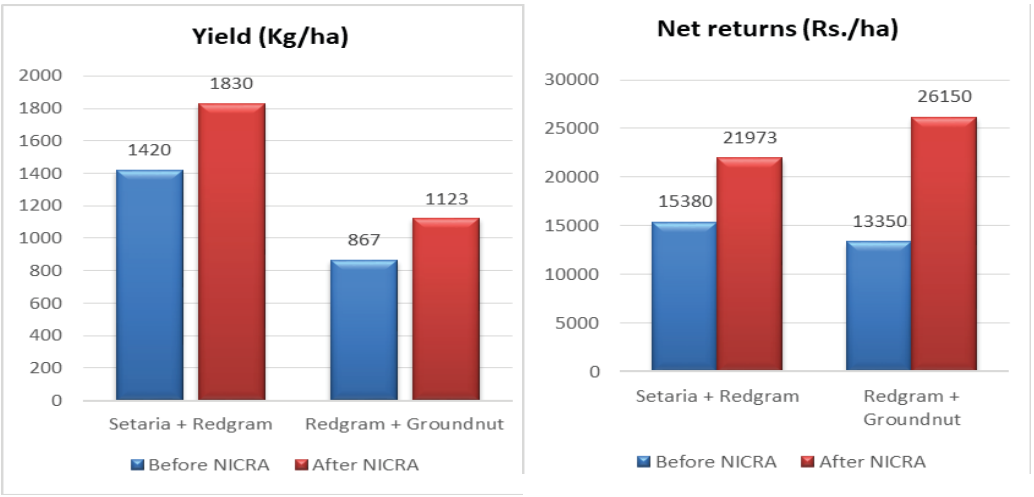
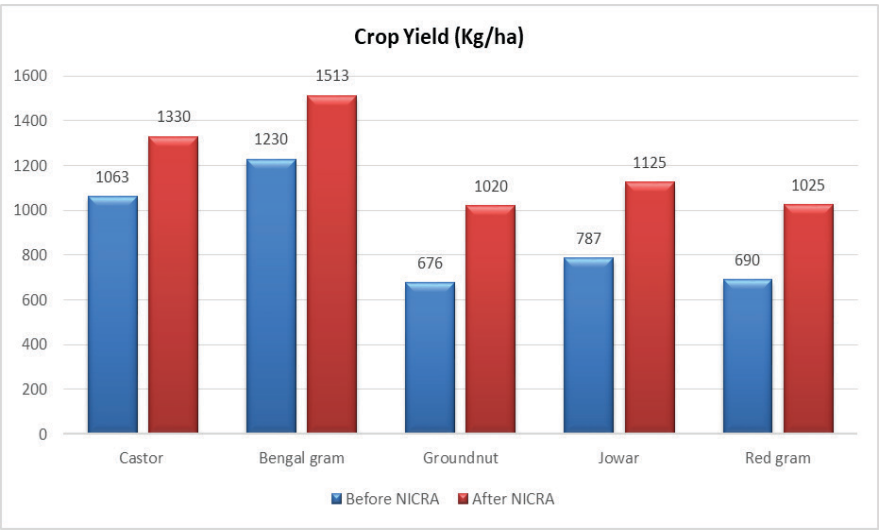


Figure 3. Yield and Net Returns of Crops under Intercropping Systems

Drought Tolerant Varieties

With the cultivation of drought-tolerant varieties of Castor, the yield recorded was 1,330 kg/ha, representing a 25% increase over the control conditions, with an incremental net return of ₹10,082/ha. In the case of Bengal gram cultivation, drought-tolerant varieties yielded 1,513 kg/ha, which was 23% higher than the control, with an incremental net return of ₹8,720/ha. Drought-tolerant varieties of Groundnut produced a yield of 1,020 kg/ha, which was 50% higher than the control, with an incremental net return of ₹15,200/ha.



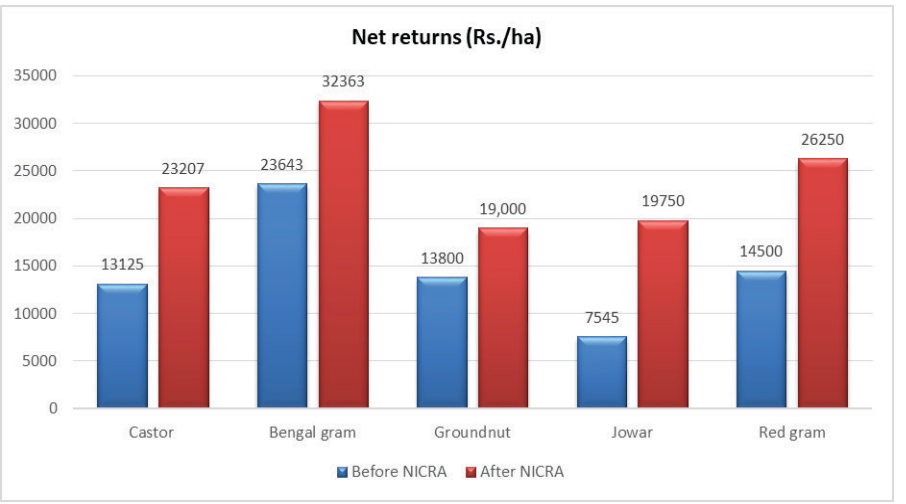


Figure 4. Yield and Net Returns of the Drought Tolerant Varieties

Short Duration Varieties

Short-duration varieties of Setaria yielded 1,423 kg/ha, with an incremental net return of ₹14,412/ha. Red gram produced 1,040 kg/ha, which was 31.8% higher than the long-duration variety, with an incremental net return of ₹12,550/ha. Groundnut recorded a yield of 948 kg/ha, representing a 58% increase over the traditional variety, with a net additional income of ₹14,900/ha. Green gram yielded 957 kg/ha, which was 9.3% higher than the traditional variety.

Short-duration varieties of Setaria (Garuda, Suryanandhi), Red gram (PRG 176), Groundnut (TCG-1704, Narayani), and Green gram (WGG-42) were made available for cultivation. The adoption of these varieties is increasing as farmers choose them based on crop duration, soil type, and rainfall. Some farmers prefer these varieties to grow a second crop of pulses during the Rabi season under rainfed conditions. Short-duration Setaria and Green gram are particularly suitable for intercropping and double-cropping systems.

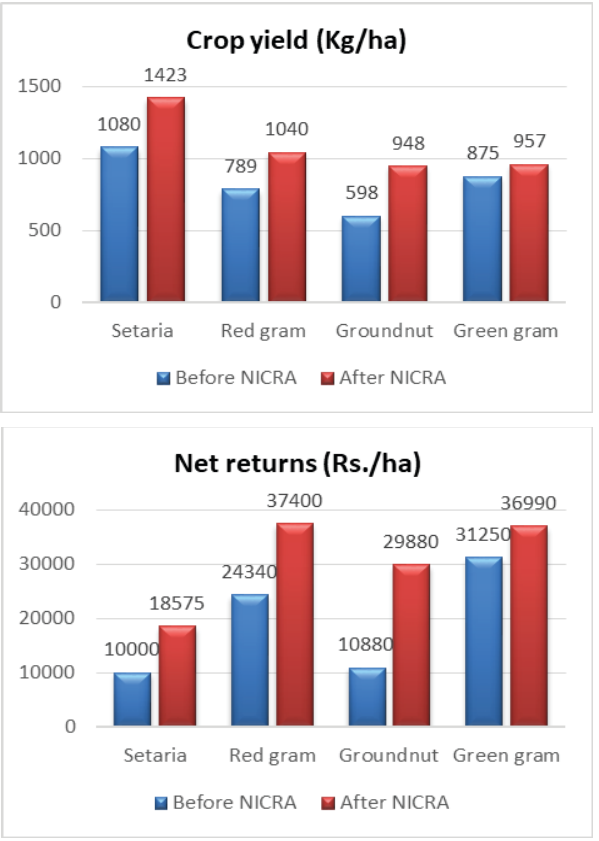


Figure 5. Yield and Net Returns of Short Duration Varieties

Table I. Yield and net returns of various crops due to In-situ moisture conservation measures

In-situ moisture conservation measures							
Crop/ System	No. of Farmers	Crop Yield (Kg/ ha or tonnes/ha)		t-statistic	Net returns (Rs./ha)		t-statistic
		Before NICRA	After NICRA		Before NICRA	After NICRA	
Setaria	33	1058	1428**	11.648**	20260	32215	16.021**
Castor	11	1003	1332**	13.922**	10430	23693	27.136**
Cotton	29	960	1450**	15.102**	-5120	13150	138.593**
Red gram	47	709	1024**	74.504**	22619	33772	23.766**
Micro irrigation							
Sweet Orange	15	20	27	7.646**	209397	353270	60.704**
Tomato Hybrid	19	48.5	64	24.508**	207584	296583	6.640**
Brinjal (Poluru variety)	25	29	41	16.803**	94845	137273	15.373**
Intercropping systems							
(Setaria + Red-gram) Setaria equiva-lent yield	94	1420	1830	38.133**	15380	21973	16.165**
(Red-gram + Ground-nut) ground-nut equiva-lent yield	56	867	1123	22.831**	13350	26150	137.413**

Drought tolerant crop varieties							
Castor	16	1063	1330	19.612**	13125	23207	48.772**
Bengal gram	72	1230	1513	15.421**	23643	32363	31.188**
Ground-nut	17	676	1020	23.540**	13800	19,000	35.949**
Jowar	17	787	1125	18.066**	7545	19750	66.073**
Red gram	42	690	1025	18.13**	14500	26250	35.407**
Short duration varieties							
Setaria	66	1080	1423	23.356**	10000	18575	89.552**
Red gram	78	789	1040	18.110**	24340	37400	72.692**
Ground-nut	84	598	948	27.371**	10880	29880	33.810**
Green gram	42	875	957	4.486**	31250	36990	18.281**

*** Significant at 1per cent probability level.*

II. Adoption of CRTs and personal characteristics of Sample farmers

To examine whether there is any relationship between the adoption of CRTs and the personal characteristics of sample farmers, correlation test was used. Adoption of CRTs is reflected by an Index computed for the sample farmer by considering the combined score obtained for the selected variables, based on the nature of their adoption (non-adoption = 0, partial adoption =1, full adoption =2):

The characteristics such as mass media exposure, capacity building programmes attended, extension contact, perception on climate change and perception on CRTs for the sample farmers are reflected by the combined score obtained based on their responses to specific variables under the respective characteristic.

Table II reflects the results of correlation test between the adoption of climate resilient technologies and the personal characteristics of the sample farmers. It may be noted that certain characteristics, viz., mass media exposure, capacity building programmes attendance, extension contact, perception on climate change and perception on climate resilient technologies had a significant correlation with the adoption of CRTs among the sample farmers, as indicated by r value, which is significant at 1 per cent probability level. Other personal characteristics such as age, farming experience, education and landholding size had no significant correlation with the adoption of CRTs among the sample farmers

Thus, it becomes clear that the adoption of CRTs is positively correlated only with those personal characteristics such as mass media contact, capacity building, perception of climate change and CRTs, which have been influenced by interventions made under NICRA project, and not with age, education, farming experience and land holding size. Vijayasarathy (2015), Ashok (2022) reported similar results.

Table II: Results of Correlation test between the Adoption of climate resilient technologies Index and personal characteristics of Sample farmers

S. No.	Personal characteristics	Correlation Co-efficient (r value)
1	Age	0.051
2	Education	0.102
3	Farming Experience	0.122
4	Landholding size	0.123
5	Mass Media exposure Score	0.326**
6	Capacity Building Programmes Attendance Score	0.540**
7	Extension Contact Score	0.459**
8	Perception on Climate Change Score	0.405**
9	Perception on Climate Resilient Technologies Score	0.520**

Note: ** Significant at 1per cent probability level. Other values are not significant.

Policy Implications

Climate resilient seed material is available in the Research Institutes, Universities and KVKs. With the availability of seed material, a greater number of farmers come forward to cultivate the climate resilient varieties. Research Institutes should identify proper nodal agencies at the district level and facilitate seed production by the farmers for horizontal spread of the technology. For reaching a greater number of farmers, the climate resilient varieties should be brought into seed chain and supplied to farmers on subsidy basis. To make availability of the varieties at the mandal or village level, the varieties should be multiplied in seed village programme being organized by state department of agriculture by involving trained farmers in seed production. Involvement of NGOs and FPOs may also be promoted in spread of the technology.

As the country is endowed with rich biodiversity, collection and safe storage of accessions of crops grown in rainfed situation for capturing the diversity in

plant should be prioritized at the University and National Agriculture Research System, which would help in further breeding programmes.

As there is a positive and significant relationship between Mass media exposure, capacity building programmes attendance, extension contact perception on climate change, and perception on climate resilient technologies (independent variables) and the adoption of climate resilient technologies among the farmers, these variables should be taken into consideration while planning future programmes

From the above study it can be concluded that adoption of climate resilient technologies have positive impact on yield and income of the farmers. As the adoption is positively related with mass media exposure, capacity building attendance score, extension contact score, perception on climate change score and perception on climate resilient technologies score, farmers capacities should be enhanced to adopt the resilient practices in agriculture continuously.

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An Analysis of Products and Services Delivered by Agri-input Dealers trained under DAESI

Tanya Saklani[1], B. Shilpa[2], Mahantesh Shirur[3], G. Naveen Kumar[4]

ABSTRACT

Agricultural input dealers, also known as agri-input dealers, play a critical role in the agricultural ecosystem as vital intermediaries between agricultural technology providers and farmers. This research paper aims to explore the product and services being offered by the DAESI trained agri-input dealers. By exploring the products and services offered by them to the farmers, this paper aims to understand the current trend of products and services to provide a comprehensive analysis of these offerings. Ex-post facto research design was used for the present study. Based on Census method, all the 20 states where DAESI is being implemented were selected. Selection of respondents was done using Simple Random Sampling method. The data was collected physically during July-December 2022. Only fully filled responses were selected for analysis of data which brought rendered the final sample size to be 166.The results revealed that majority (94.58%) of the respondents were male, the average age of the respondents was 37.26 years, about(42.78%) possessed a Graduation degree, more than half of the respondents (56.63%) had business as their prime occupation, maximum number of the respondents (75.90%) sold fertilizers, 69.88 per cent of them dealt in pesticides/insecticides while 65.66 per cent of the respondents offered seeds as agri-inputs to the farmers. About 65.06 per cent of the respondents have established Extension Corners in their shops after going through DAESI diploma course. The services they provided consultancy/advisory services (42.78%), market-support (32.53%), soil-testing (27.11%) and water-testing (12.05%).

Key words: Agri-Input Dealers, Agricultural Extension, Agricultural Products, DAESI, Extension Services

Introduction

Agriculture plays a pivotal role in the sustenance and growth of economies worldwide. Agricultural input dealers emerge as vital stakeholders, bridging

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the gap between innovative farming solutions and the hands that cultivate the land. The success of agricultural practices largely depends on the knowledge and expertise of both agri-input dealers and farmers. Keeping in mind a low extension worker to farmer ratio, DAESI program was envisioned in 2003 by the National Institute of Agricultural Extension Management (MANAGE), Hyderabad. The Diploma in Agri Extension Services for Input Dealers program holds immense significance for both input dealers and the farming community. This specialized diploma equips input dealers with in-depth knowledge and skills related to agricultural extension services. Input dealers are educated about the latest agricultural technologies, sustainable farming practices, pest management, and market trends. By enhancing their expertise, DAESI aims to transform agri-input dealers into para-extension workers who would strengthen the agri-extension scenario in India.

In the ever-evolving realm of agriculture, knowledge is akin to fertile soil — the foundation upon which prosperous harvests are built. Agricultural input dealers armed with comprehensive and up-to-date knowledge are equipped to provide farmers with valuable insights into cutting-edge technologies, crop management practices, and environmental sustainability. In an era where climate change and resource scarcity challenge traditional farming methods, informed input dealers serve as beacons of expertise, guiding farmers towards resilient and sustainable agricultural practices. Dealers with higher education are better equipped to disseminate relevant and up-to-date agricultural information to farmers, leading to improved farming practices and enhanced productivity (Kadam and Deshmukh, 2018). The agri-input dealers with formal agricultural education are more adept at providing specialized advice and technical information to farmers, leading to increased knowledge and adoption of best agricultural practices. In this way, their knowledge encompasses a myriad of fields, from the latest advancements in seeds, fertilizers, and pesticides to precision farming techniques, enabling farmers to optimize yields and minimize environmental impact. Adesina and Zinnah (1993) highlighted that both farmers and dealers with higher education exhibit greater knowledge and competence in managing crop diseases, pest control, and soil health. Thus, numerous research findings have also underscored the potential of education to enhance agricultural productivity.

Agri- input dealers are not just business-minded individuals; they are visionaries who recognize the intrinsic value of agriculture in society. Entrepreneurial input dealers do not merely sell products; they cultivate rapport with the farmers, foster trust, and contribute significantly to the socio-economic fabric of farming communities. Agri-input dealers, in this context, are community builders,

educators, and facilitators, connecting farmers with transformative knowledge and resources.

The role of agricultural input dealers as extension workers extends far beyond the transactional realm. By acting as conduits between agricultural research institutions, governmental initiatives, and local farming communities, these dealers play a pivotal role in disseminating best practices and innovative techniques. Research studies have highlighted their crucial function in bridging the gap between farmers and agricultural experts, especially in remote areas where direct access to extension services is limited. These dealers serve as key intermediaries, providing farmers with essential information about modern farming techniques, crop varieties, pest management strategies, and the proper use of fertilizers and pesticides. Their proximity to the farming community allows for personalized guidance, addressing the specific needs and challenges faced by individual farmers. Therefore, their capacity to effectively communicate complex agricultural concepts in a manner accessible to farmers ensures the democratization of knowledge, empowering even the most remote agricultural practitioners. The agri-input dealers, thus, enhance the agricultural acumen of farmers, enabling them to make informed decisions that elevate their livelihoods and agricultural productivity. Consequently, they serve as indispensable para-extension personnel, playing a vital role in the agricultural extension system and contributing significantly to the overall development of the farming community. Therefore it becomes imperative to explore and understand the current trend of products and services to provide a comprehensive analysis of these offerings. Keeping this in mind, the current study was undertaken to comprehensively evaluate the range of products and services provided by agricultural input dealers, including seeds, fertilizers, pesticides, machinery, equipment, and advisory services after completing DAESI diploma course.

Research methodology

For the present study, an Ex post facto research design was followed. The study was conducted in 20 states across the country. Based on Census method, all the 20 states where DAESI is being implemented were selected. The respondents were the input dealers who were trained under DAESI between years 2018 and 2021. Selection of respondents was done using Simple Random Sampling method. The data was collected physically during July-December 2022. A total of 200 responses were collected by administering a structured questionnaire but only fully filled responses were selected for analysis of data which brought down the final sample size to 166.

Results and discussion

Frequency, percentage and mean were used to enumerate the personal profile of the respondents and to ascertain the products and services delivered by them. The results have been presented as follows:

Gender: The demographic profile of the respondents revealed that majority (94.58%) of the respondents were male while 5.42 per cent of them were female. This points at the huge gender gap in the DAESI enrolments. The fair sex still does not have much representation when it comes to business ventures or enterprises.

Age: The average age of the respondents was 37.26 years. Maximum age for agri-input dealers was 69 years while the minimum age was 18.

Table 1: Distribution of the respondents according to age:

S. no.	Category	Frequency (n)	Percentage (%)
1.	Young (18-35 years)	78	46.99
2.	Middle (36-53 years)	66	39.76
3.	Senior (54-69 years)	22	13.25
Max= 69 years Min= 18 years	Total	166	100

It is evident from Table 1 that maximum number of the respondents (46.99%) belonged to the young age category, 39.76 per cent of them belonged to middle age category while only 13.25 per cent belonged to senior age category. This data reveals that youth is venturing into agri-enterprises in the prospect of self-employment. The broad range of age is due to DAESI diploma being synonymous to adult-education which has no upper age limit.

Education: As displayed in the Figure 1, majority of the respondents (42.78%) possessed a Graduation degree, 33.13% of them held a Highschool certificate while 16.87% of the respondents had an Intermediate certificate. Only 11 per cent of the respondents had a post-graduation degree with only 0.60 per cent having a diploma.

To meet the present competition in agri-input market as well as the entry of innovative products in different agri-inputs in the recent past, the importance of education for the success of agri-input dealers might have become imperative. This condition might have encouraged for educated people as agri-input dealers.

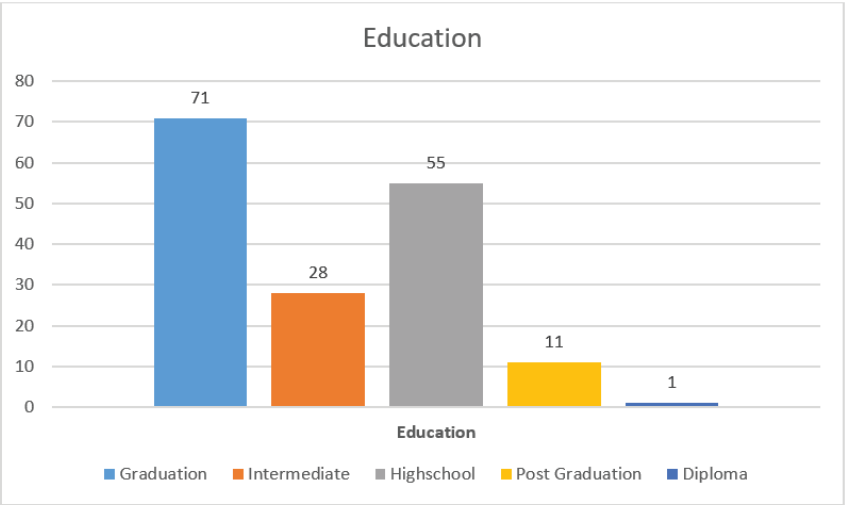

Figure 1: Education level of the respondents

These results are similar to the findings of Reddy et al. (2020) and Ganiger (2012) which reveal the trend of people with higher education going for self-employment ventures instead of routine jobs.

Occupation: More than half of the respondents (56.63%) had business as their prime occupation while 42.17 per cent had farming as their prime occupation. DAESI has been made mandatory by the Government of India for possession and renewal of agri-input licenses. This might be the reason why a lot of candidates come from a prior business background.

Agri-based products offered: There are a variety of products that are offered by the agri-input dealers through their shops to the farmers. The results are presented in the Figure 2. Maximum number of the respondents (75.90%) sell fertilizers, 69.88 per cent of them deal in pesticides/insecticides while 65.66 per cent of the respondents offering seeds as agri-inputs to the farmers. Around 25.30 per cent of the respondents offered small machinery/ equipment while only 8.43 per cent of them dealt in large agricultural machinery. As DAESI trained input dealers are better equipped to cater to the needs of the farmers by providing timely and quality agri-inputs with appropriate application dosage. The input-dealers are yet to explore the contract based agro-machinery rental services and very few of them offer heavy agricultural equipment. The results are similar to the findings of Panja et al. (2021) who revealed that most of the input dealers dealt in fertilizers and pesticides.

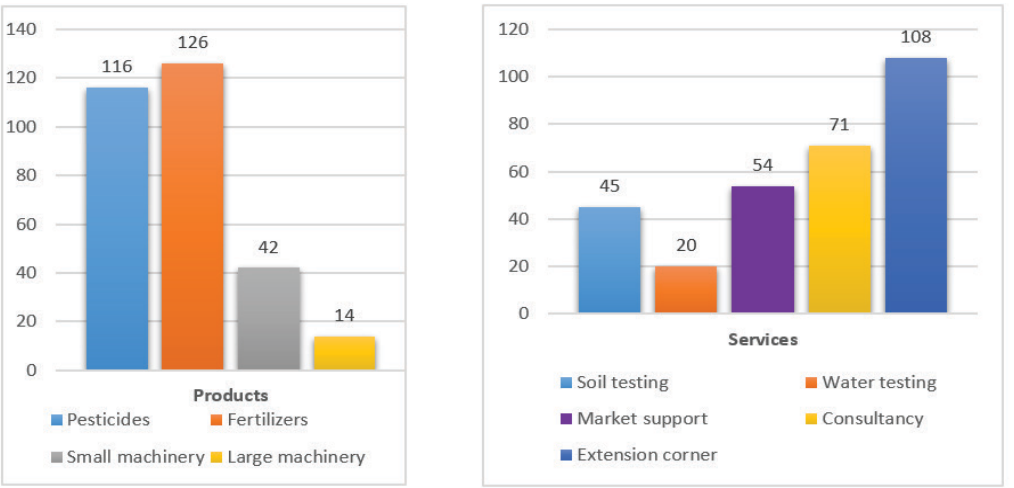

Figure 2: Products and services offered by agri-input dealers

Agri-based services offered: The main objective of DAESI is to establish agri-input dealers as para-extension agents at the grassroot level capitalizing on their proximity to the farmers. In addition to the sale of agri-input products the services provided by the agri-input dealers helps the farmers in optimum utilization of the agri-inputs, resources, schemes, policies, etc. One of the ways through which service delivery is ensured in DAESI is by the establishment of dedicated 'Extension Corners' in the agri-input shops. This serves as the point of information dissemination in input shops. It is evident from the Figure 2 that 65.06 per cent of the respondents have established Extension Corners in their shops. Other agri-based services provided to the farmers by the input dealers include consultancy/advisory services (42.78%), market-support (32.53%), soil-testing (27.11%) and water-testing (12.05%). The data reveals that there is still so much that the input-dealers can do in terms of the agri-services provided to the farmers. Figure 3 indicates various sources of information which the input dealers place in the Extension Corners. As evident from the data, most of the agri-input dealers keep newspapers, posters and books in the extension corners. It may be because these can be easily sourced and are an effective means of quick display of information. Adesina, A. A., & Zinnah, M. M. (1993). Technology characteristics, farmers' perceptions and adoption decisions: A Tobit model application in Sierra Leone. Agricultural economics, 9(4), 297-311.

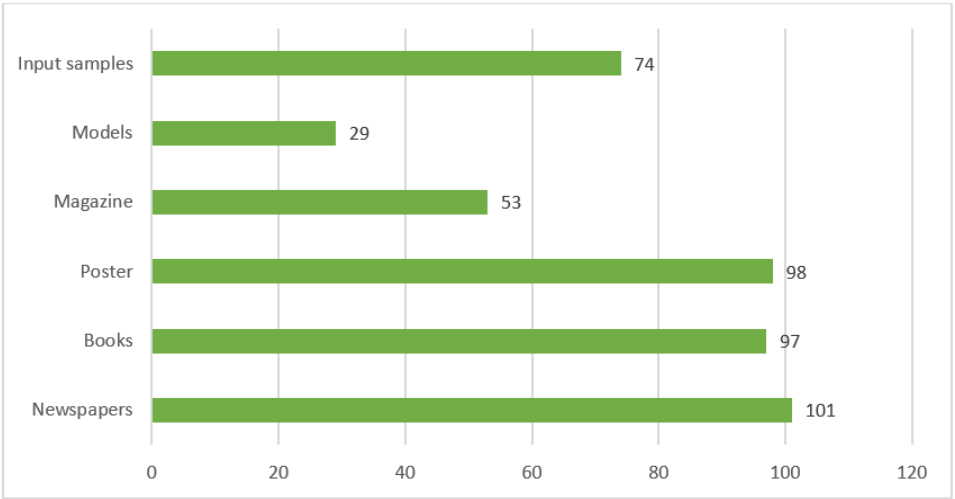

Figure 3: Sources of information in Extension Corner

Conclusion

In conclusion, the products and services offered by agricultural input dealers play a pivotal role in shaping the success and sustainability of farming practices worldwide. From seeds and fertilizers to machinery and advisory services, these dealers form the backbone of the agricultural industry, empowering farmers with the tools and knowledge necessary to optimize their yields while minimizing environmental impact. Although they deal mostly in chemical inputs and fertilizers, agri-input dealers can play a major role in warming farmers up for organic/natural farming practices. The comprehensive support in the form of extension corners provided by agricultural input dealers will have several positive effects on farming practices and outcomes. By continually innovating and adapting to the evolving needs of farmers, agri-input dealers not only contribute to the growth and prosperity of agricultural communities but also foster a more resilient and sustainable future for global food production. Overall, the effect of the products and services offered by agricultural input dealers is to support farmers in achieving higher yields, greater efficiency, and long-term sustainability in their agricultural practices.

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Women's Land Ownership in Bihar: An Analysis of Socio-Legal Barriers and Structural Challenges

Amrit Warshini[1], Veenita Kumari[2], Sugandha Munshi[3], Aman Verma[4]

ABSTRACT

Women's land ownership still remains limited in Bihar, despite legal reforms to enhance gender equality in property rights. This study investigates barriers to land ownership for women farmers in Bihar's Tirhut division, focusing on three districts: West Champaran, Muzaffarpur, and Sheohar. Using a mixed-methods approach, structured interviews and focus group discussions, captured quantitative and qualitative data from 120 farmers selected through a multi-stage sampling process. Findings reveal that only 7.5% of the surveyed women possess land titles, primarily obtained through inheritance. Barriers to ownership include financial constraints (63.1%), restrictive socio-cultural norms (18.0%), and limited awareness of land rights (18.9%). Correlation analysis indicates that 'access to legal services' (r=0.497) and 'participation in community meetings' (r=0.239) are significantly associated with land ownership, suggesting that legal support and community engagement are critical enablers. However, demographic factors like age, education, and income show no significant impact on ownership, underscoring the complex socio-legal landscape influencing women's land rights. These results suggest empowering women through legal aid, enhanced community involvement, and targeted financial support could mitigate barriers, fostering greater land ownership and economic stability for women farmers in Bihar.

Keywords: Women's Land Ownership, Bihar, Gender Equality, Barriers, Agricultural Land, Legal Empowerment, Socio-Cultural Norms, Economic Stability

Introduction

In India, women's land ownership still remains low, despite legal reforms aimed at gender equality. Nationally, women represent about 13.9 percent of land owners (Agarwal et al., 2021). The situation is more critical in Bihar, with only 13.31 percent of landholdings registered under women's names, while

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men own 87.27 percent (Singh et al., 2019). Agriculture forms the backbone of Bihar's economy, employing 77.0 percent of the workforce and contributing 35.0 percent to the State's GDP. It is essential for rural livelihoods, with 88.0 percent of the population residing in rural areas. Key crops include rice, wheat, maize, and sugarcane (Singh et al., 2015). Despite showing a growth rate of 7.1 percent in recent years, agriculture in Bihar faces challenges like low productivity and poor infrastructure (Ranjan, 2020), making agricultural growth vital for poverty reduction. Women comprise 70.0 percent of the agricultural labour force and are critical to Bihar's agriculture. However, they face severe constraints, with only 13.31 percent holding land titles, which limits their access to credit, inputs, and technology.

Women's wages are also 7.04 percent less than men's, and their contributions to allied sectors, such as dairying and poultry, are often under-valued (Singh et al., 2019). Land ownership profoundly impacts women, providing financial security, empowerment, and higher social status within households and communities. Land-owning women are more likely to access credit, make agricultural investments, and benefit from reduced vulnerability to social exploitation.

Methodology

This study investigates the barriers to land ownership for women farmers in Bihar, employing a mixed-methods research design to comprehensively capture the quantitative and qualitative factors influencing access to land ownership conducted in Bihar's Tirhut division, a significant agricultural region, the research strategically selected three districts—West Champaran, Muzaffarpur, and Sheohar—based on their diverse geographical characteristics to represent the region's agricultural landscape. A multi-stage sampling method was used, beginning with purposive sampling to identify the districts. One block per district and two villages per block were selected using random sampling. Hence, there were a total of 120 respondents, proportionally distributed across the districts. Data collection incorporated structured interviews and focus group discussions. Interviews, guided by a detailed schedule with closed and open-ended questions, were conducted in the local language to ensure clarity and authentic responses. Focus group discussions were carefully designed to capture community dynamics and collective insights on women's land ownership.

Quantitative data were analyzed using descriptive statistics and correlation analysis to identify predictors of land ownership, while demographic and socio-economic variables were subjected to percentage analysis. A structured database was developed to ensure data quality, incorporating systematic data entry protocols and regular validation checks. Demographic characteristics, including district-specific sex ratios, provided a contextual foundation for understanding

the gender-based disparities in land ownership throughout the study area.

Results and Discussion

According to Table 1, the maximum number of respondents were from West Champaran, with the majority falling into the middle age category (31-46 years), suggesting a workforce that balances family responsibilities with agricultural roles. More than half of the women farmers had completed high school, while only 1.67 percent were graduates, highlighting limited access to higher education. Approximately 75.83 percent of the respondents were married and belonged to joint families, reflecting a reliance on extended family support for resources and labor. A majority engaged in farming alongside other occupations, with medium-income levels, indicating the need for diversified income sources to sustain their livelihoods.

In terms of financial inclusion, most women had access to credit, but primarily through informal sources such as family and friends. This finding underscores that women farmers are still unable to fully benefit from formal financial institutions or banks, largely due to their low levels of land ownership. Nearly half of the respondents were engaged in commercial farming, often relying on mechanized, power-operated machinery, where decision-making was commonly shared with spouses. Regarding legal knowledge, most respondents (60.83%) were only somewhat aware of land rights, while detailed legal awareness was limited. Only 7.5 percent of the respondents owned land, with financial constraints cited as the most significant barrier. Inheritance was the most common means of acquiring land, while cultural norms and economic limitations further restricted ownership opportunities.

Table 1: Demographic, Socioeconomic, and Land Ownership Characteristics of Women Farmers in Bihar's Tirhut Division

	Category	Frequency	Percentage
Districts	West Champaran	50	41.67%
	Muzaffarpur	40	33.33%
	Sheohar	30	25.00%
Age	Young (<30)	33	27.5%
	Middle (31-46)	70	58.33%
	Senior (≥47)	17	14.17%

Education	Illiterate	4	3.33%
	Primary	22	18.33%
	Middle	20	16.67%
	High School	63	52.50%
	Graduate	2	1.67%
Marital Status	Unmarried	28	23.33%
	Married	91	75.83%
Family Type	Nuclear	36	30.00%
	Joint	84	70.00%
Occupation	Farming only	24	20.00%
	Homemaker	17	14.17%
	Farming and others	69	57.50%
Annual Income	Low Income (≤59,013 INR)	16	13.33%
	Medium Income	86	71.67%
	High Income	18	15.00%
Access to Credit	Yes	112	93.33%
	No	8	6.67%
Primary Sources of Credit	Banks	10	08.33%
	Microfinance institutions	8	06.66%
	Self-help groups (SHGs)	12	10.00%
	Family/Friends	40	33.33%
	Informal lenders	30	25.00%
	NGOs/ Development Organizations/ International Orgs	12	10.00%
Types of Farming	Subsistence	25	20.83%
	Commercial	57	47.50%
	Mixed	33	27.50%
Agricultural Technology	Hand machines	45	37.50%
	Power-operated machinery	54	45.00%
	Both hand machines and power operated	21	17.50%

Decision-Making Power	Self	35	29.17%
	Jointly with spouse	65	54.17%
	Spouse	14	11.67%
	Other family members	6	5.00%
Awareness of Land Rights	Very much aware	19	15.83%
	Somewhat aware	73	60.83%
	Not aware at all	28	23.33%
Access to Legal Services	Yes	11	9.17%
	No	109	90.83%
Land Ownership	Yes	9	7.50%
	No	111	92.50%
Land Acquisition Method	Inherited	4	03.33%
	Purchased	1	0.83%
	Purchased and inherited from mother	2	1.66%
	Purchased by husband	1	0.83%
	Other	1	0.83%
Barriers to Land Ownership	Financial constraints	70	58.34%
	Cultural norms	20	16.66%

Table 2: Women's Participation and Socio-Cultural Factors in Land Ownership

Aspect	Findings
Participation in Local Meetings	• 49.17% participate sometimes, 20.83% always attend. • Most women maintain some engagement in community affairs.
Influence of Community Organizations	• NGOs like Samakhya enhance women's participation and decision-making capabilities. • Self-help groups like Jeevika provide financial support, promoting economic empowerment.

Socio-Cultural Attitudes	• 86.67% agree that women should have equal rights to land ownership. • 82.5% accept women's land ownership in their communities.
Inheritance Practices	• 60% believe family inheritance favors sons over daughters, indicating strong patriarchal norms.
Challenges in Land Ownership	• 75.83% acknowledge women face more challenges than men in obtaining land ownership. • Limited access to financial resources and legal knowledge are key barriers.
Perceived Benefits of Land Ownership	• 89.17% believe land ownership would improve women's social status, highlighting its empowering potential.

The Table 2 summarises the critical insights into women's involvement in local meetings and the socio-cultural factors affecting their land ownership rights in Bihar. The findings highlight the progress made in terms of participation and acceptance of women's rights to land, but at the same time, the persistent challenges rooted in traditional practices and societal norms.

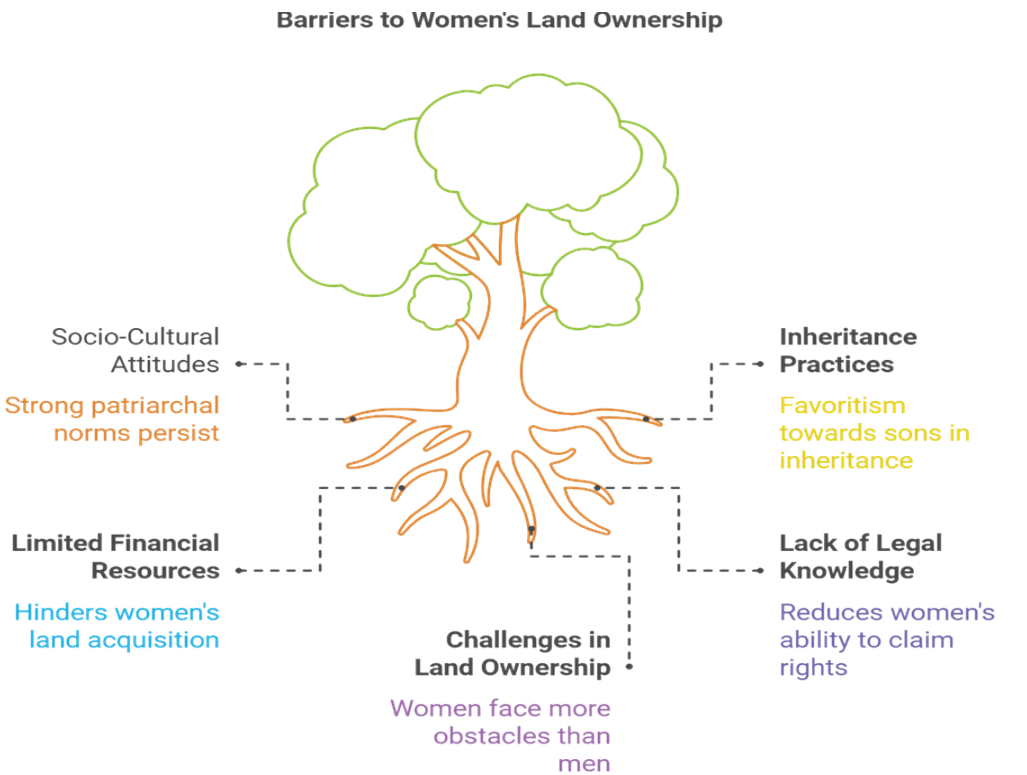

Figure 1 : Barriers to Women Land Ownership

Table 3: Correlation Analysis between Characteristics of Land Ownership and Land Ownership Status

S. No.	Variables	Coefficient of Correlation (r)
1	Age	0.118 NS
2	Education	0.138 NS
3	Marital Status	0.181*
4	Family Type	0.150 NS
5	Occupation	0.218*
6	Annual Income	0.109 NS
7	Access to Credit	0.119 NS
8	Types of Farming	0.229*
9	Practices and Technologies Used in Agricultural Activities	-0.034 NS
10	Decision-Making about Agricultural Practices	-0.003 NS
11	Participation in Local Meetings	0.239**
12	Awareness of Laws regarding Women's Land Ownership Rights	0.213*
13	Access to Legal Services related to Land Rights	0.497**
14	Socio-cultural Factors Related to Women's Land Ownership	0.039 NS

*NS: Non-significant at 0.05 level, **Significant at 0.01 level.*

Table 3 provides insights into the relationship between women's demographic, socioeconomic, and socio-legal characteristics and their land ownership status. The strongest positive correlations emerged for access to legal services (r=0.497**) and participation in local meetings (r=0.239**), both significant at the 0.01 level. This highlights the centrality of institutional and community support in strengthening women's claims to land.

Among demographic and socioeconomic factors, marital status (r=0.181*) and occupation (r=0.218*) were significant at the 0.05 level, indicating that women's family position and engagement in multiple income-generating activities enhance their likelihood of land ownership. By contrast, age, education, and income were not significantly associated with land ownership, suggesting that these individual-level characteristics alone may not translate into ownership

gains in the face of entrenched cultural and financial barriers. This pattern underscores that demographic influences are selective rather than uniform. While being married and having diversified occupations may provide women with stronger social and economic leverage, other characteristics such as age or education do not guarantee ownership. Instead, ownership prospects are more strongly shaped by structural factors such as inheritance practices, financial constraints, and cultural norms. This reveal that women's land ownership in Bihar remains constrained by financial, legal, and cultural barriers, despite growing awareness of land rights and increasing participation in community forums. Legal services and community participation appear to be transformative factors, but demographic factors exert uneven effects: marital status and occupation matter, while age, education, and income do not. This nuanced result challenges simplistic assumptions that demographic progress (e.g., higher education or income) automatically leads to ownership.

Conclusion

This research sheds light on the persistent barriers to women's land ownership in Bihar's Tirhut division, revealing a complex interplay of socio-legal factors that hinder progress toward gender equality in property rights. Despite legal reforms aimed at promoting women's land ownership, only 7.5 percent of the women surveyed possess land titles, predominantly acquired through inheritance. The findings indicate that financial constraints (63.1%) and restrictive socio-cultural norms (18.0%) significantly impede women's ability to acquire and control land. The analysis further highlights that access to legal services (r=0.497) and participation in local meetings (r=0.239) are critical enablers of land ownership for women, underscoring the importance of legal and community support systems. Among demographic factors, marital status and occupation showed modest but significant correlations with land ownership, while age, education, and income did not. This suggests that socio-cultural attitudes and institutional support play a more pivotal role than individual demographic attributes in determining women's access to land.

Importantly, the study reveals a notable shift in community attitudes, with 86.67 percent of the respondents acknowledging the need for equal rights to land ownership for women. This widespread acceptance signals an emerging social foundation upon which policy reforms and advocacy initiatives can build. If strategically leveraged, this progressive sentiment can accelerate legal enforcement, enhance community-driven reforms, and normalize women's ownership of land as a legitimate and widely supported practice. In conclusion, addressing the barriers to women's land ownership in Bihar requires a multi-dimensional approach that integrates legal reforms, community engagement,

and socio-economic support. By aligning policy measures with the growing acceptance of gender equality in land rights, interventions can gain stronger community legitimacy, thereby enhancing women's economic stability and social standing and contributing to the broader goals of gender equality and sustainable development in the region.

Recommendations

Focused interventions should address legal and socio-cultural barriers to enhance women's land ownership in Bihar. Increasing access to legal aid and awareness programs can empower women with knowledge of their land rights, while community engagement initiatives encourage collective action and foster support networks. Financial support tailored to women, such as low-interest loans, could be a useful strategy to address economic barriers, and targeted cultural sensitization programs could help shift restrictive gender norms. Crucially, the finding that 86.67 percent of respondents support equal rights to land ownership presents a unique opportunity for policymakers, NGOs, and local leaders to act on a favorable public mindset. This acceptance can be leveraged to strengthen policy advocacy, as reforms framed in terms of community-supported initiatives are likely to face less resistance and enjoy broader legitimacy. Community-led programs and self-help groups can build on this sentiment by showcasing women landowners as role models and creating platforms where female ownership is normalized. Similarly, public awareness campaigns should now move beyond persuading communities about the importance of women's land rights and instead focus on practical strategies for ensuring these rights are realized. With communities already receptive, NGOs and legal service providers can expand training sessions, legal literacy workshops, and property rights campaigns that will resonate more deeply and achieve faster adoption. Finally, consistent policy enforcement and continuous research to monitor the effectiveness of these strategies are essential to create a supportive environment that enables women's land ownership and ensures long-term economic security.

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Transforming Common Service Centers into Village Knowledge Centers for effective delivery of Agricultural Extension Services to Farmers

Gujji Bhaskar

ABSTRACT

The policy paper explores the potential of transforming Common Service Centers (CSCs) into Village Knowledge Centers (VKCs) to address critical agricultural challenges faced by rural farmers in India. The CSCs, established under National E-Governance Plan (NeGP), currently serve as digital hubs providing government-to-citizen (G2C) services, including financial transactions, e-governance, and limited agricultural services. However, with over 596,000 operational CSCs (4.67 lakhs at Gram Panchayats), there remains significant untapped potential to expand their role in rural agricultural empowerment. By transitioning CSCs into VKCs, these centers can deliver tailored agricultural extension services such as crop advisory, soil testing, pest management, and real-time market linkages, directly contributing to the socio-economic development of rural communities.

The study identifies several barriers that limit the effectiveness of CSCs in agricultural service delivery. These include a lack of specialized agricultural training for Village Level Entrepreneurs (VLEs), insufficient infrastructure such as internet connectivity and digital tools, and low awareness among farmers about existing CSC services. Farmers report moderate satisfaction with services like government scheme applications but express dissatisfaction with agricultural advisories, citing them as untimely and inadequate. Additionally, financial constraints and limited access to real-time market and price information remain significant challenges for small and marginal farmers.

To address these issues, the policy brief proposes a comprehensive roadmap for transforming CSCs into VKCs. Key recommendations include expanding agricultural services to cover agriculture, horticulture, livestock, and fisheries, strengthening VLE capacity through targeted training programs, efficient market linkages, upgrading infrastructure to support advanced tools like soil testing kits and IoT devices and leveraging digital platforms for precision agriculture. These measures aim to make

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VKCs a one-stop solution for farmers, providing them with the knowledge, tools, and resources to enhance productivity and income.

The paper presented the VKC model, the key inputs will enhance the performance of VKCs for the benefit of farming community. The VKC model operates on a clear Theory of Change that links assumptions, inputs, activities, outputs, and outcomes. It assumes that farmers are willing to adopt VKC services if they are accessible, relevant, and affordable, and that VLEs can be trained to deliver high-quality services. The paper also presents an implementation plan for short-term, medium-term and long-term for effective operationalisation of VKCs for effective delivery of agricultural services to farmers in rural India.

Keywords: Common Service Centers (CSCs), Village Knowledge Centers (VKCs), Village Level Entrepreneurs(VLEs), National e-Governance Plan (NeGP)

Introduction

India's agricultural sector is a cornerstone of its economy, employing nearly 60% of the population and contributing significantly to rural livelihoods. However, despite its importance, the sector continues to face persistent challenges, including low productivity, fragmented supply chains, limited access to markets, and inadequate dissemination of critical agricultural information. To connect the rural India, the Government of India established Common Service Centers (CSCs) under the National E-Governance Plan (NeGP) to bring digital services closer to rural communities. Currently, over 4.67 lakhs CSCs (5.96 lakh CSCs operate across India) established at Gram Panchayats level, delivering services such as government-to-citizen (G2C) transactions, financial inclusion, and limited agricultural services.

CSCs, which currently serve as digital gateways for government-to-citizen (G2C) services, financial transactions, and educational initiatives, are ideally positioned to bridge the critical gaps in agricultural extension services. However, their current agricultural offerings are limited to agricultural scheme applications, financial services and inputs. This lack of focus on tailored agricultural solutions has led to dissatisfaction among farmers, who often rely on informal sources of information and face challenges like crop management, crop advisory, price volatility, climate change impacts, and insufficient access to modern farming techniques. Though CSCs have successfully showcased to deliver a wide range of G2C services, but their potential to provide specialized agricultural support remains underutilized.

The proposed transformation of CSCs into Village Knowledge Centers (VKCs) aims to address these gaps by reimagining them as hubs for agricultural

innovation and support. VKCs would provide farmers with real-time data on weather and market prices, expert advice on crop management and pest control, and access to modern technologies like precision agriculture tools and e-commerce platforms. This initiative is not only crucial for enhancing farm productivity but also aligns with broader national goals of rural development and fostering sustainability in agriculture. By bridging the digital and informational divide, VKCs have the potential to revolutionize rural agricultural practices and uplift millions of small and marginal farmers across the country.

Background and Context

Current Role of Common Service Centers (CSCs)

Common Service Centers (CSCs) were established under the National E-Governance Plan (NeGP) as digital service delivery gateways, aimed at improving rural access to essential services. Operating as a Public-Private Partnership (PPP) model, CSCs are designed to act as a one-stop solution for delivering a wide range of Government-to-Citizen (G2C), Business-to-Citizen (B2C), and financial services at the grassroots level. These centers play a pivotal role in bridging the urban-rural divide by providing affordable and convenient access to services such as utility bill payments, birth and death certificates, Aadhaar enrolment, and insurance schemes. CSCs have also contributed significantly to digital inclusion through initiatives like digital literacy programs and telemedicine services.

Despite their success in improving access to digital and government services, the current role of CSCs in agriculture remains limited. While they offer basic agricultural services such as facilitating applications for government schemes like the Pradhan Mantri Fasal Bima Yojana (PMFBY), banking services, very limited services in agricultural marketing, crop management and these services are not comprehensive or widely adopted. Additionally, Village Level Entrepreneurs (VLEs), who operate the CSCs, often lack specialized training to provide expert agricultural guidance. This limited focus on agriculture leaves significant potential untapped, particularly given the large rural population reliant on farming. By expanding the scope of CSCs to function as Village Knowledge Centers (VKCs), their role can evolve into a more targeted and impactful solution for addressing the pressing needs of India's agricultural sector.

Rural Agricultural Challenges

India's agricultural sector is the backbone of rural livelihoods but is fraught with persistent challenges that hinder productivity, profitability, and sustainability. These challenges span across financial, infrastructural, technological, and

informational dimensions, creating barriers for small and marginal farmers who constitute the majority of the farming community. The key challenges faced by farmers are;

- Lack of Access to Reliable Information: Farmers often lack timely and accurate information on weather forecasts, pest control, crop management, and market prices. Dependence on informal sources like fellow farmers or input dealers often leads to suboptimal decisions.
- Market Linkages and Price Volatility: Limited access to reliable market linkages results in farmers relying on intermediaries, reducing their profit margins. Additionally, volatile market prices for crops increase financial uncertainty and risk.
- Climate Change and Environmental Issues: Irregular rainfall, extreme weather events, and soil degradation pose significant threats to agricultural productivity. Farmers often lack the knowledge or resources to adopt climate-resilient practices.
- Infrastructure Deficits: Poor connectivity, lack of storage facilities, and limited access to farm machinery further exacerbate challenges, especially for smallholders who cannot afford individual investments in these areas.
- Digital Divide: While digital tools and platforms have immense potential in agriculture, many farmers lack the literacy or resources to leverage these technologies effectively.

Addressing these challenges and meeting farmers' needs through targeted initiatives on agricultural services from Common Service Centers, that will acts as Village Knowledge Centers for creating a resilient and productive agricultural ecosystem

With this background, the study was undertaken with the following objectives

- To study the I.T. enabled Agricultural and allied Services (ITeAS) that delivered through CSC to cater the needs of farmers at village level.
- To study the satisfaction level of farmers on agricultural services available through CSCs and other needy agricultural services to be available at CSCs.
- To study the training needs of Village Level Entrepreneur (VLE) to operate the agricultural services through CSCs.
- To suggest a mechanism to deliver efficient I.T. enabled Agricultural Services (ITeAS) by VLEs to farmers through CSCs.

Methodology

The Research Project was highly process oriented and used participatory approach to understand the agricultural services available through CSCs gateway

and satisfaction level of farmers on the services. The CSCs operationalised in Telangana also implementing agricultural services for the benefit of farmers. The study confines to two districts Siddipet and Suryapet of Telangana where CSCs are operationalized with agricultural services. Four mandals/blocks of Siddipet and Suryapet district are selected for the study purpose. A total of 120 farmers taken as sample from these two districts. From each block 2/3 CSCs were randomly selected for the study. 12 farmers from each CSC taken as sample and interviewed, data collected in a structure questionnaire. Thus the sample size was 120 (10 CSCs x 12 farmers = 120 farmers covered).

The methodology includes:

A. Data collection using Structured Questionnaire.
B. The data compiled from online resources as secondary sources for data collection.
C. Group discussions with farmers and CSC operators.
D. Discussions with the stake holders of service providers.

Details of the Sample size selected from Telangana

S.No	District/Block	No. of CSC	No. of Farmers selected in each CSC area	Sample size
1	Suryapet/ Nadgudem	2	12	24
2	Siddipet/Munagala	3	12	36
3	Siddipet/Bejjanki	2	12	24
4	Siddipet/ Chinnakodur	3	12	36
	Total	10		120

Key Findings from the Study

CSC Agricultural Service Gaps and Satisfaction of Farmers

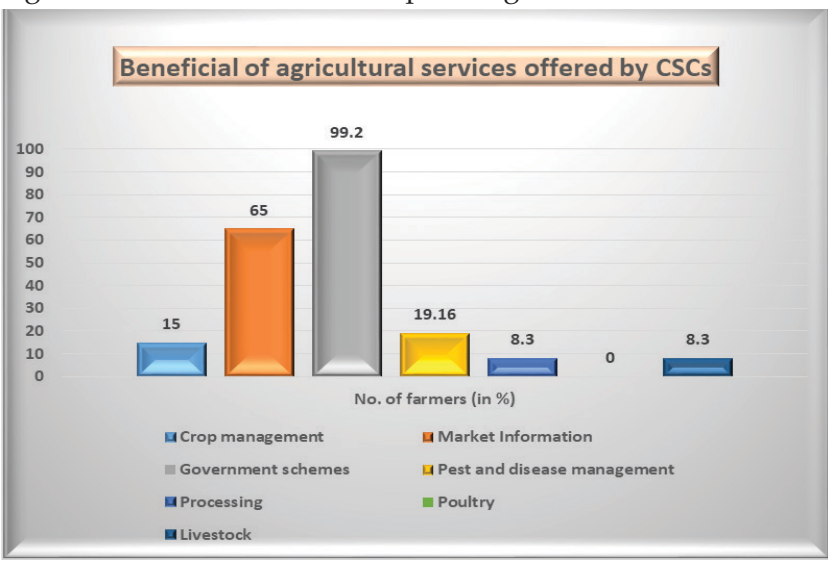
The prioritization of information services by farmers reflects their practical needs, with crop management and pest and disease control being the most essential, followed by information on subsidies, market prices, and weather forecasts. Farmers' reliance on these services highlights areas where information can significantly enhance decision-making and productivity. A moderate level of agreement among farmers on these priorities emphasizes that a well-rounded

approach is essential, integrating financial support, market transparency, and targeted advisory services. Such improvements could empower farmers to navigate contemporary agricultural challenges, improve productivity, and ensure equitable market access, thus fostering sustainable rural development.

While general awareness of and accessibility to CSCs is high, certain agricultural services particularly those related to pest management and market information remain underutilized. While farmers frequently turn to CSCs for government schemes, there is comparatively less engagement with the agricultural advisory services available. This imbalance suggests the need for targeted promotional efforts and educational programs to increase awareness about these agricultural resources, enabling farmers to maximize the benefits that CSCs can provide.

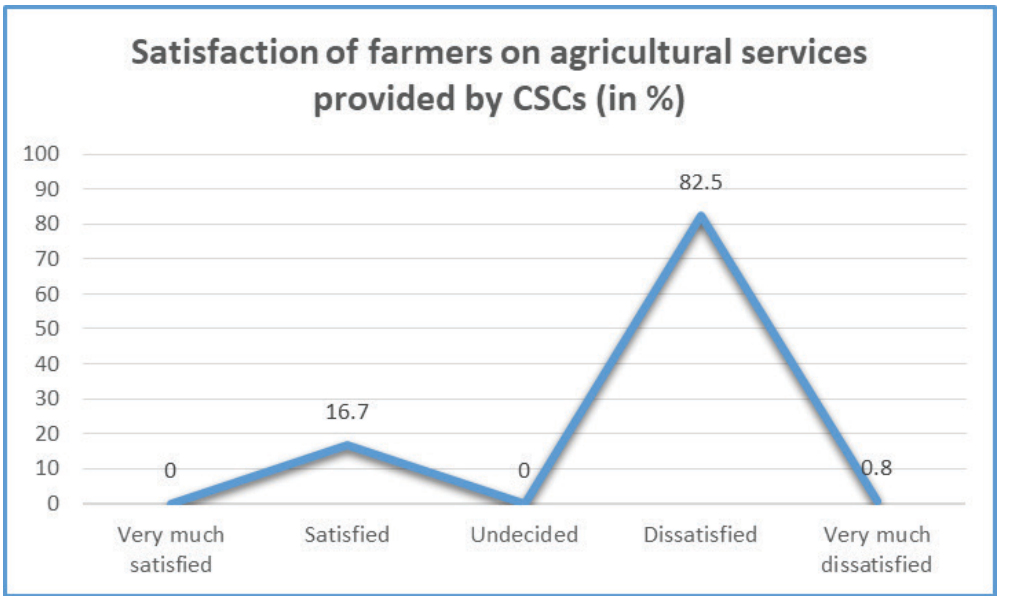
The scheme Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) is highly utilized and valued by farmers, with most finding it both useful and timely. Banking services, Kisan e-Mart, and the Pradhan Mantri Kisan Maandhan Yojana (PMKMY) also receive positive responses regarding utility and timeliness. Conversely, agricultural advisory services, such as teleconsultations and soil health testing, show significant dissatisfaction, with high ratings of poor satisfaction due to perceived ineffectiveness. Additionally, low usage and limited satisfaction with services like Farm Machinery on Rent and protected cultivation indicate areas where CSCs could enhance support. Financial services, notably the KCC and PMFBY schemes, reflect mixed satisfaction levels, while banking services enjoy a relatively higher approval rate, signalling key areas for improvement in CSC agricultural service offerings.

The findings reveal that while farmers express high satisfaction with financial and



support schemes like PM-KISAN, Banking Services, Kisan e-Mart, PMKMY, and PMFBY, they show significant dissatisfaction with advisory services. Protected Cultivation & Organic Farming had no positive ratings, and services such as Agricultural Tele Consultation and Soil Testing Center received predominantly very poor ratings, indicating areas needing substantial improvement to better meet farmers' needs through CSCs.

The findings indicate that while there is some agreement among farmers regarding the affordability and time-saving benefits of agricultural services provided by Common Service Centres (CSCs), concerns remain about the quality of information and the adequacy of services offered. A notable percentage of farmers expressed dissatisfaction with the knowledge of Village Level Entrepreneurs (VLEs), highlighting a critical area for improvement. To enhance the effectiveness of CSCs, it is essential to address these gaps in service provision and ensure that VLEs are equipped with the necessary expertise to meet farmers' needs effectively.



The results highlight that farmers derive significant benefits from CSC services, including increased access to financial resources and enhanced knowledge and skills. Additionally, many farmers report improvements in crop yield and market access, alongside better pest and disease management. This indicates a strong interest in expanding the range of services offered by CSCs in agriculture, horticulture, animal husbandry, and fisheries to meet diverse farmer needs.

Challenges in Agricultural Services offered by CSCs

Farmers face significant challenges primarily due to a lack of awareness regarding the agricultural services offered at Common Service Centres (CSCs), VLEs knowledge on agricultural services, inadequate infrastructure, especially in internet connectivity. Although issues like insufficient support and high service costs are less frequently cited, the absence of distance-related concerns indicates that accessibility is not a major barrier. To enhance the effectiveness of CSCs, it is essential to address these awareness, VLEs capacity building and infrastructure gaps. Additionally, financial constraints and market-related issues, such as ineffective price discovery mechanisms, hinder farmers' economic resilience. A successful transition to Village Knowledge Centres (VKCs) will require the timely provision of market information and price advisory services, enabling farmers to make informed decisions and improve their market access.

Role of Village Level Entrepreneurs

The data collected from Village Level Entrepreneurs (VLEs) provides additional insights into the current CSC setup and its potential for expansion into VKCs. Most VLEs are well-educated, primarily male, and between 26-45 years old, yet their incomes remain modest, reflecting limited financial incentives under the current model. This finding underscores the need to establish sustainable revenue streams or support mechanisms to sustain VLE engagement and dedication.

VLEs offer a variety of services, with high engagement in government programs such as PM-KISAN and PMFBY. However, there is notably less involvement in operational services like farm machinery rentals, indicating possible gaps in addressing farmers' specific needs. This variation in service delivery suggests that although VLEs are willing to provide assistance, they may lack the necessary resources or specialized knowledge to effectively deliver certain types of services. The preference expressed by VLEs for short, focused training sessions indicates a practical approach to improving their service delivery capabilities. Regular, accessible training sessions could help bridge existing knowledge gaps and equip VLEs to better serve their communities. VLEs often lack specific agricultural expertise, affecting service quality. Only 36.8% of VLEs reported receiving agricultural training, which indicates a considerable gap in the knowledge needed to effectively assist farmers. Regular, practical training for VLEs, focusing on agriculture-specific topics and digital tools, could significantly enhance their ability to meet farmer's needs.

Challenges also arise from infrastructure limitations and procedural barriers that reduce the effectiveness of CSC services. Poor internet connectivity and delays

in arranging expert consultations significantly hinder VLEs' ability to support farmers. Addressing these infrastructure challenges is crucial for enabling VLEs to meet the needs of farmers more effectively. Enhanced connectivity, simplified processes, and efficient access to expert advice would enable VLEs to provide timely, accurate information and services, thereby improving the overall efficacy of VKCs.

Sector-specific analysis reveals that VLEs recognize the importance of CSCs evolving into VKCs to address diverse agricultural needs. There is strong demand for expanded advisory services, high-quality inputs, accessible machinery, and support in areas such as insurance and credit access. Services for horticulture and animal husbandry also emerge as priorities, with particular emphasis on veterinary support, animal feed provision, and access to horticultural information. These insights demonstrate that VLEs are aware of the varied and complex needs of farmers and understand the potential impact of a more comprehensive suite of services.

Towards an Integrated Approach: Building Resilient Village Knowledge Centers

Overall, the findings suggest a compelling vision for CSCs to evolve into VKCs, thereby bridging critical knowledge and service gaps for rural farmers. To successfully transform CSCs into effective VKCs, service options expanded, VLEs equipped with practical continuous training, digital tools support for agricultural operations to be in-built into CSC frame work and infrastructure challenges must be addressed. Such steps would empower VLEs to support rural farmers more comprehensively, fostering a more resilient and responsive agricultural extension network.

This transformation promises to cultivate a knowledgeable, empowered farming community that is better equipped to navigate modern agricultural challenges. By leveraging VKCs as center of information, advisory support, and resource access, rural development initiatives can achieve sustainable, long-term impact, ultimately making VKCs indispensable resources for advancing rural resilience and prosperity.

In nutshell, the study underscores the importance of targeted improvements in CSC operations, with recommendations that span service diversification, enhanced VLE training, and infrastructure upgrades. By addressing these areas, CSCs have the potential to evolve into VKCs that better serve rural farming communities in the country, thereby strengthening agricultural productivity and rural livelihoods.

Policy Recommendations

1. Strengthen Partnerships with Agricultural Institutions: Collaborate with State Agricultural Universities (SAUs), Krishi Vigyan Kendras (KVKs), and departmental officials to offer expert advice and specialized knowledge through CSCs, enhancing their role as Village Knowledge Centers for rural communities. A continuous support from KVK and department is very essential to strengthen the VLEs for mainstreaming the agricultural extension services through CSCs.

2. Diversify Agricultural Services: Expand CSC services to cover a broader range of agricultural needs, including support for horticulture, livestock management, fisheries and establish fixed-day veterinary services and offer access to quality seeds, fertilizers, and farm machinery rentals for comprehensive support to address the diverse needs of rural farmers. Integrate market access services and price forecasting tools to help farmers make informed decisions about selling their produce. At present there are only 12 services are available at CSCs and out which particularly schemes related services are working effectively. Need to focus on all agricultural services to be made available and effectively implemented through CSCs. Annexure-I shows the list of services recommended by the both farmers and VLEs at CSCs.

3. Practical Training for VLEs: Organize hands-on, practical agriculture focused training sessions for Village Level Entrepreneurs (VLEs) that focus on real-world challenges they face and to improve their ability to deliver relevant agricultural advice and support farmers. Include mentorship programs with experienced district level KVK scientists and departmental officers that will guide VLEs on best practices in service delivery. Ensure VLEs receive periodic training on critical agricultural services, such as agricultural schemes, soil health management, pest control, crop advisory, inputs and efficient water usage. Such training could be scheduled quarterly to keep VLEs updated on best practices.

4. Expert Consultation Networks: Create a network of agricultural experts who can provide regular consultations via phone or online platforms. Facilitate access to these experts through the CSCs to ensure farmers receive timely and relevant advice. Equip CSCs with good internet connectivity, teleconsultation applications for expert consultation on farming practices.

5. Introduce Digital Tools for CSCs: Introducing digital tools such as mobile applications and IoT devices for weather, pest and crop management to enhance productivity and efficiency. Leverage Mobile Apps and IoT De-

vices can improve decision-making and enhance productivity by providing real-time information. Provide drone services at CSCs for precision agriculture, including pesticide spraying and crop monitoring, to improve productivity while reducing costs. This technology has been shown to increase efficiency and can be a valuable addition to CSC services. Implementation of VISTAAR application needs to be part of CSC agricultural services, to strengthen the CSCs with resource rich in agricultural information that will benefit farming community.

6. Align CSCs to FPOs: The CSCs should be made aligned with FPOs, so that the services needed by the farmers in that FPOs will be effectively met. It is a win-win situation for CSCs, FPOs, and Farmers as everyone gets the benefits from this.

7. DAESI Certified holder as VLE: The trained certified holder of DAESI dealer is a good choice for running CSCs as VLE. The training under DAESI programme not only equip certain knowledge on agricultural practices and also has business knowledge on selling inputs. The DAESI VLE can collaborate with IFFCO like institution to sell the quality inputs to farmer and provide the services needed by the farmers effectively.

8. Soil Testing Kits with CSCs: The CSCs are equipped with Soil Testing Kits to test the soil samples of farmers and update the information online through CSC-Agricultural portal for recommendations and generating soil health cards, on periodically. The CSCs working at block-level and major gram panchayats shall be equipped with these kits.

9. Market Access Workshops: Host regular workshops focused on market access and price discovery. Invite local market experts to educate farmers on pricing mechanisms, market trends, and negotiation skills, enabling them to sell their produce more effectively. Offer marketing platforms for real-time market prices and crop management information, helping farmers make informed decisions and improve profitability.

10. Streamline Access to Financial and Government Services: Simplify the application process for government schemes, financial products, and insurance at CSCs, providing farmers with clear guidance and support.

11. Establish Farmer Feedback Channels: Create simple, accessible channels for farmers to provide feedback on services received, such as suggestion boxes or regular community meetings. This feedback loop can help refine services and ensure CSCs are meeting local needs effectively.

12. Enhance Awareness and Outreach: Launch grassroots awareness campaigns that leverage local leaders and community networks to educate farmers, both male and female about available services at CSCs. Use simple language with focused community meetings and posters and relatable examples to ensure clear communication and engagement at CSCs will improve access to agricultural services.

Implementation Plan

1. **Village Knowledge Center (VKC) Model**

   The Village Knowledge Center (VKC) Model builds on the existing infrastructure and operational framework of Common Service Centers (CSCs), transforming them into agricultural-focused knowledge hubs, in addition to other services. The VKC model is designed to provide integrated, technology-driven, and farmer-centric services that address key agricultural challenges in the country.

2. **Core Components of the VKC Model**

2.1 Service Framework

VKCs will deliver a mix of agricultural, financial, technological, and capacity-building services tailored to the needs of rural farmers. Key services include:

- Agricultural Advisory: Real-time crop management guidance, pest control, and weather forecasts.
- Soil Testing and Analysis: On-site soil testing kits with expert recommendations integrated with National Soil Health Card.
- Market Information and Linkages: Digital platforms providing real-time price updates, e-marketplace integration, and buyer-seller connections.
- Financial Services: Simplified access to crop insurance, credit schemes, and government subsidies.
- Technology Access: IoT devices for monitoring, precision farming tools, and mobile-based advisory apps.
- Capacity Building: Training programs for digital literacy, sustainable practices, and advanced farming techniques.

2.2 Infrastructure and Technology Integration

The VKC model leverages existing CSC infrastructure while incorporating targeted upgrades to meet agricultural service needs. VKCs will utilize advanced digital tools and platforms to enhance service delivery:

- Connectivity: Reliable internet access and backup power systems for

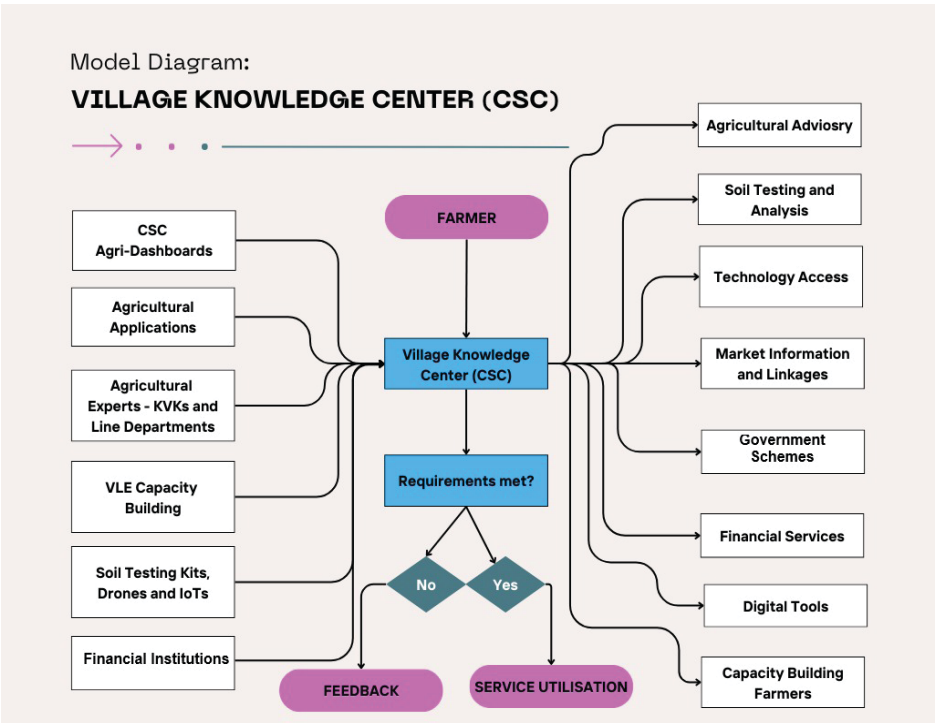
uninterrupted operations.

- Digital Tools: Soil testing kits, drones, and IoT-enabled crop monitoring devices.
- Physical Space: Dedicated kiosks for advisory services, training, and community interactions.
- Mobile Applications: Apps for advisory services, weather updates, and subsidy tracking.
- AI and IoT Systems: Precision farming tools for pest monitoring, irrigation scheduling, and yield optimization.
- Data Dashboards: Centralized platforms for real-time data on crop health, market prices, and farmer feedback.

2.3 Human Resources and Capacity Building

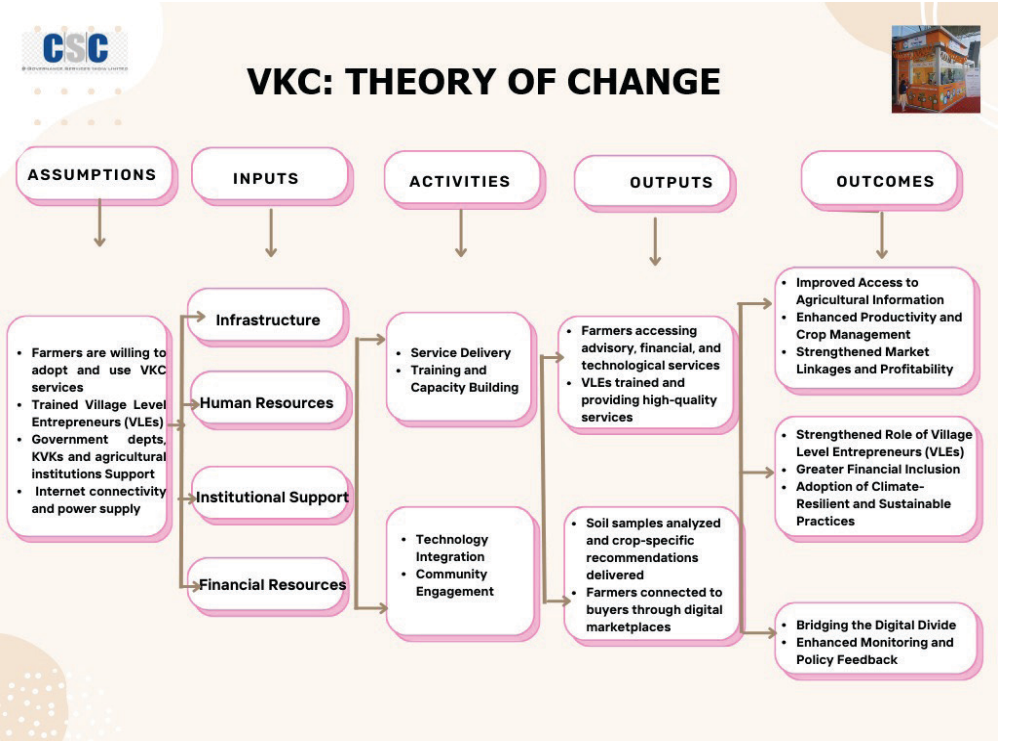
- Village Level Entrepreneurs (VLEs): Trained to deliver specialized agricultural services, including crop management and financial advisory.
- Agricultural Experts: Accessible through teleconsultations to provide advanced guidance.

MODEL VILLAGE KNOWLEDGE CENTER (CSC)



Operational Framework of VKC

The VKC model operates on a clear Theory of Change that links assumptions, inputs, activities, outputs, and outcomes. The Theory of Change diagram presented below:



The theory of change diagram illustrates the pathway through which the accessibility of Common Service Centres (CSCs) positively impacts farmers, highlighting key inputs, activities, outputs, outcomes, and the ultimate impact. Inputs include strategically located CSCs and extended operating hours, ensuring that these centres are conveniently accessible to farmers. These inputs support activities such as delivering agricultural services, providing technical support, and offering access to critical resources like market prices, weather forecasts, and crop insurance. The resulting outputs are increased farmer visits to CSCs and wider adoption of services, indicating their relevance and usability. As farmers leverage these services, outcomes such as improved access to agricultural information, higher utilization of farming technologies, and enhanced operational efficiency are observed. Ultimately, this leads to the impact of sustainable agricultural development, improved productivity, and better livelihoods for farmers. This structured progression underscores how targeted accessibility measures drive meaningful and measurable improvements in agricultural practices and outcomes.

The implementation plan for transforming Common Service Centers (CSCs) into Village Knowledge Centers (VKCs) is structured in three phases: Short-Term Goals (0–1 years), Medium-Term Goals (1–2 years), and Long-Term Goals (3+ years). Each phase focuses on specific actions to ensure gradual, measurable, and sustainable transformation.

Short-Term Goals (0–1 years)

Pilot the CSC-VKC model in select regions, enhance infrastructure, and train Village Level Entrepreneurs (VLEs).

1. Pilot Projects in Select Districts

» Identify 2–3 districts representing diverse agro-climatic zones for pilot implementation, covering major states like Punjab, Haryana, Rajasthan, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Odisha, West Bengal, Telangana, Andhra Pradesh, Tamilnadu, Kerala and Karnataka where 100% of rural CSCs are operationalised.

» Focus on regions with active CSCs and high demand for agricultural services.

» Test key VKC services, including soil testing, crop advisory, and teleconsultation.

2. Training Programs for VLEs

» Collaborate with Krishi Vigyan Kendras (KVKs) and State Agricultural Universities to design and deliver training modules.

» Focus on crop management, pest control, soil health, marketing information, weather-based advisory, financial benefits and use of digital tools.

3. Infrastructure Upgrades

» Improve internet connectivity and power reliability in pilot regions.

» Provide CSCs with basic agricultural tools such as Soil Testing Kits and digital advisory platforms.

4. Awareness Campaigns

» Launch campaigns to educate farmers about new VKC services using community meetings, local radio, and mobile messaging.

5. Monitoring and Feedback Mechanisms

» Establish a system for collecting farmer feedback on VKC services.

» Monitor pilot project outcomes to identify best practices and areas for improvement.

Medium-Term Goals (1–2 years)

Scale up VKC services nationally, integrate advanced technologies, and enhance service diversity.

1. National Expansion

» Roll out the VKC model to 25% of CSCs nationwide, prioritizing areas with high agricultural activity and digital infrastructure readiness.

» Incorporate findings from pilot projects to refine implementation strategies.

2. Service Diversification

» Expand VKC offerings to include

1. Horticulture, fisheries, and animal husbandry support.
2. Real-time market price forecasts and weather updates.
3. E-commerce platforms for direct farmer-to-market transactions.

3. Advanced Technology Integration

» Introduce IoT devices and mobile applications for precision agriculture.

» Deploy drones for crop monitoring, pest control, and spraying.

» Implement AI-based advisory tools to provide personalized crop management recommendations.

4. Strengthening Partnerships

» Establish collaborations with private companies, banks and Agri-Tech Startups to enhance VKC offerings.

» Partner with NGOs for grassroots outreach and capacity building.

5. Enhanced Training and Certification

» Develop certification programs for VLEs in collaboration with agricultural institutes – KVKs and SAUs.

» Include modules on advanced technologies like AI and data analytics for agriculture.

Long-Term Goals (3+ years)

Ensure sustainability and establish VKCs as self-sufficient, farmer-centric knowledge hubs.

1. Universal VKC Access:

» Transform all CSCs into VKCs, covering rural regions across the country.

» Ensure equitable access to services, including marginalized and remote communities.

2. Sustainability and Revenue Models

» Develop self-sustaining revenue models, such as subscription-based services for advanced tools and premium advisories.

» Encourage community ownership and engagement to reduce dependency on external funding.

3. Impact Measurement and Continuous Improvement:

» Conduct impact assessments to evaluate improvements in farmer productivity, income levels, and service utilization.

» Use data-driven insights to continuously refine VKC services and operations.

4. Integrated Knowledge Ecosystem:

» Link VKCs with state agricultural universities, KVKs and research organizations to provide cutting-edge agricultural knowledge and innovation.

» Create a unified digital platform connecting all VKCs for seamless information sharing.

Monitoring and Timeline

To ensure timely execution, the implementation plan will be monitored using the following timeline:

Phase	Key Activities	Timeline
Short-Term	Pilot implementation, Training, and upgrades	0–1 years
Medium-Term	National rollout, Tech integration, Partnerships	1–2 years
Long-Term	Universal access, sustainability, global benchmarking	3+ years

This phased approach ensures that the VKC transformation is practical, impactful, and sustainable, addressing immediate needs while preparing for long-term goals.

Anticipated Outcomes

The transformation of Common Service Centers (CSCs) into Village Knowledge Centers (VKCs) is envisioned to address critical challenges faced by rural farmers and catalyse sustainable agricultural development. By implementing the proposed policy measures, the following outcomes are anticipated:

Improved Access to Agricultural Information

VKCs will serve as centralized hubs offering real-time access to essential agricultural data, including Crop advisory, weather forecasts, pest control advisories, marketing and crop management strategies. Farmers will gain localized, actionable insights tailored to their needs, reducing their reliance on informal and often unreliable sources of information. Real-time advisory services will empower farmers to make informed decisions.

Enhanced Productivity and Crop Management

Through advanced tools like Soil Testing Kits, IoT devices and precision agriculture solutions, VKCs will empower farmers to make informed decisions about irrigation, fertilizer use, and pest control. These interventions are expected to enhance crop yields, improve resource efficiency, and minimize losses caused by poor farming practices. Better crop management and market access will boost agricultural output.

Strengthened Market Linkages and Profitability

Real-time market price updates and e-commerce platforms offered through VKCs will enable farmers to bypass intermediaries, ensuring better profit margins. The ability to connect directly with buyers and access reliable market intelligence will reduce price volatility and provide farmers with fairer and more predictable returns for their produce.

Greater Financial Inclusion

Simplified access to financial products, including government subsidies, crop insurance, and agricultural credit will reduce financial barriers for farmers. With the support of VKCs, farmers will be able to navigate application processes more efficiently, fostering a culture of financial literacy and security.

Strengthened Role of Village Level Entrepreneurs (VLEs)

The targeted training and capacity building, VLEs will evolve as agricultural service providers, capable of addressing local challenges. This will enhance the quality of services delivered and create entrepreneurial opportunities in rural areas.

Adoption of Climate-Resilient and Sustainable Practices

By disseminating knowledge about sustainable farming techniques, water conservation methods and crop diversification strategies, VKCs will promote climate-resilient agriculture. These efforts will enable farmers to adapt to changing climatic conditions, ensuring long-term environmental sustainability and productivity.

Bridging the Digital Divide

By leveraging technology and ensuring digital infrastructure in rural areas, VKCs will help bridge the urban-rural digital divide. Farmers will gain access to modern tools and platforms, integrating them into a digitally connected agricultural ecosystem.

Enhanced Monitoring and Policy Feedback

VKCs will provide a platform for collecting real-time data on farming practices, service adoption and farmer feedback. This data can be used to refine agricultural policies and ensure that interventions are responsive to the evolving needs of the farming community.

By realizing these outcomes, VKCs will not only address the immediate challenges faced by farmers but also create a foundation for a sustainable, inclusive, and resilient agricultural ecosystem in India.

Conclusion

The transformation of Common Service Centers (CSCs) into Village Knowledge Centers (VKCs) offers a unique opportunity to revolutionize rural agricultural service delivery in India. By addressing critical gaps in agricultural advisory support, weather, market linkages, and infrastructure, VKCs can empower farmers with timely, relevant, and actionable information. This transformation would significantly enhance farm productivity, improve income levels, and reduce the vulnerabilities faced by small and marginal farmers.

Key measures, such as targeted training for Village Level Entrepreneurs (VLEs), advanced digital tools, and diversified service offerings, can ensure that VKCs become one-stop hubs for agricultural extension services. And, integrating real-time crop information, market intelligence, and financial resources will enable farmers to make informed decisions, fostering long-term sustainability in agriculture. This policy shift requires collaboration between government organisation agricultural departments, KVKs, CSC-SPV and farming community. Overall, VKCs have the potential to bridge the digital divide in rural India, contributing to socio-economic development and aligning with national priorities of farmer's income and promoting inclusive growth. The appropriate actionable steps are necessary to unlock the full potential of CSCs to serve the farmers.

Annexure-I

Recommended Agricultural Services at CSCs

S.No.	Area	Type of Service	Service description
1	Advisory Services	a) Land preparation,	Land preparation for seasonal crops and selection of varieties
		b) Crop selection, varieties, sowing time	Selection of crops and varieties based on soil, its fertility, sowing time
		c) Soil testing and Soil Health Card	Soil testing services to provide customized fertilizer recommendations. Issue of Soil Health Card
		d) Weed management	Weed Management, herbicides availability
		e) Irrigation scheduling	Irrigation schedule for the crop. Efficient irrigation systems like drip or sprinkler irrigation to optimize water use.
		f) Pest and Disease management	Integrated pest management (IPM) practices. Knowledge and training on identifying and managing pests and diseases.
		g) Weather related information	IMD forecast weather for next 3 days and alerts, Agromet Bulletins for the blocks and advisory

2	Farm Inputs	a) Quality seeds	Access to high-quality, high-yielding, and disease-resistant seeds.
		b) Planting material	Availability of planting material for various crops and plants.
		c) Fertilizer availability	Adequate supply of fertilizers to ensure soil fertility
		d) Pesticides availability	Availability of effective pesticide, herbicides and it usage
3	Farm Machinery	a)Farm Machinery and hiring service	Access to modern and appropriate agricultural machinery and tools. List of custom hiring centers close to farmers area for hiring
4	Marketing	a) Marketing and price forecast	Real-time information on market prices, demand, and trends. MSP Platforms for direct sales to consumers or bulk buyers.
		b) Logistics	Providing logistics services to the farmers for transportation of inputs and farm produce
		c) Quality assurance	Providing quality assaying and assurance services on the farm produce and certification.
		d) Traceability	Providing traceability services for farm produce to the traders and end consumers

5	Processing and Post-harvesting technologies	a) Drying, Grading and storage	Storage facilities to reduce post-harvest losses. Details of cold storage facilities available nearby the farmers location, and charges etc.
		b) Post-harvesting technologies	Post harvesting technologies and value-addition including processing
6	Government Schemes and Subsidies	a) Government Schemes and subsidies of State and Central Government	Access to government scheme subsidies and grants provided by the Central sector schemes and State Level schemes.
7	Insurance	a) Insurance	Crop insurance notified for crops and insurance policy details, claims etc. Crop loss assessment during cyclones, droughts, pest & diseases etc. Providing insurance cover for farm machinery.
8	Banking and finances	Credit and finance	Affordable credit and loans for purchasing inputs, machinery, and infrastructure. Information on KCC.
9	Drone services	Drones Hiring Service	Drone hiring services for fertilizer, pesticide applications, crop survey and crop health monitoring etc.
10	Mobile Apps/ Technologies	Mobile Apps in Farming	Mobile apps providing weather forecasts, market prices, and farming tips.
11	IoT devices	IoT devices	Devices for Real-time crop health monitoring, Irrigation schedule etc

12	Training and Demonstrations	Trainings and demonstration	Training in modern farming techniques and best practices.
B. HORTICULTURE			
13	Schemes and subsidies information	Horticultural schemes and subsidies information	Horticultural schemes and subsidies information such as Horticulture Crops, Greenhouse Construction, Drip Irrigation, Polyhouse, Fruit Crop Plantation. Online application forms for subsidy claims etc.
14	Marketing linkages	Marketing linkages between horticultural producers and traders	Marketing linkages between horticultural producers and traders
C. ANIMAL HUSBANDRY			
15	Veterinary Clinics	Veterinary Doctors fixed day visits to farmers place. Animal Health Card issuance	Veterinary Doctors fixed day visits to farmers place. Animal Health Card issuance etc.
16	Schemes and subsidies in Animal husbandry	Subsidies and loans for purchase of cattle, sheep, Goat, poulty etc.	Subsidies and loans for purchase of cattle, sheep, Goat, poulty etc.
17	Animal Feed information	Availability of animal feed and price etc.	Availability of animal feed and price details etc.
D. FISHERIES			
18	Water Quality Management Service	Water Quality Management Service	Regular monitoring and management of water quality parameters such as pH, dissolved oxygen, ammonia, and temperature to ensure a healthy environment for fish growth and prevent diseases.

19	Fingerlings Supply	Fingerlings Supply	Provision of high-quality fingerlings of various fish species, ensuring optimal growth rates and survival rates in local conditions
20	Feed Supply and Nutrition Management service	Feed Supply and Nutrition Management service	Supply of nutritionally balanced fish feed and guidance on feeding schedules and quantities to optimize fish growth and minimize feed waste
21	Disease management and Advisory service	Disease management and Advisory service	On-site diagnostic services for identifying fish diseases, along with recommendations for treatment protocols and the supply of necessary medications or treatments.
22	Aquaculture Equipment Supply	Aquaculture Equipment Supply	Details about essential equipment such as aerators, nets, pumps, and tanks, along with installation and maintenance services

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Economics of Sorghum Production, Consumption and Trade in Sudan (1990 - 2020)

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ABSTRACT

This paper focuses on a set of high-potential of sorghum commodity in Sudan. Sorghum is considered as one of the most important calorie source in the Sudanese diet, future key source of sustainable farming systems and the national economy of Sudan. The paper analyzes sorghum by evaluating its production, consumption and trade trends for a 10-years period (term) for the last three decades (1990 to 2021), and indicates the projections for production, consumption and demand up to 2030. The paper depended mainly on secondary data collected from relevant sources such as the annual statistics of the central Ministries of Agriculture and Forests for various years. The findings have illustrated that the production of sorghum shows a high annual growth rate during the first (1990s) and the third terms (2010s) in the rain-fed sector. It is clear that, total sorghum consumption in the Sudan rose at an average annual rate lower than the production rate for the whole period of the study. Sorghum is mainly grown for local consumption by small scale holders (60% of quantity produced) in main producing areas, particularly in traditional rain-fed farming, in semi-mechanized and in irrigated agriculture. The overall trend of the most exports during 1990 -2020 is fluctuated. The period 2000s was the period of oil export from Sudan which was the major source of foreign currency to the government neglecting traditional agricultural exports and the impact was deterioration on agricultural export quantities.

Keywords: Sorghum, Economics, Production, Consumption, Trade, Sudan

Introduction

In Sudan, agriculture sector is the foundation of livelihoods for the majority of the rural population and considered as an essential pillar for rural development and for many Small and Medium Enterprises (SMEs), because of its importance for food security and household welfare and as a source of export earnings. The agriculture sector is expected to regain its role as a key source of foreign exchange. The loss of oil revenues in 2011 after the separation of South Sudan

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has been followed by resurgence in agriculture's share in the country's exports, reaching 55% in 2019 as reported by the United Nations International Trade Statistics Database, and helping cushion some of the impact of the loss of oil revenues. This improvement has been mainly led by the good performance of major agricultural export commodities like livestock, sesame, gum Arabic, and cotton. For at least three of Sudan's key exports sheep, goats, and gum Arabic— the ability to export in processed forms presents significant upside potential. Overall, the agricultural trade balance remains negative due to the high food import bill, which mainly goes for imports of wheat and wheat flour, sugar, and oils (World Bank 2015). Comparing the performance over the agricultural and the oil eras, as seen, the average value added share of industry has increased by 8.9 percentage points. Humid agro climatic zones are shifting southward, rendering vast arable lands increasingly unsuitable for agriculture production.

Agriculture is the mainstay of the economy of the Sudan. It contributes about 40 % of GDP and 80 % of the total exports, excluding oil. It provides employment and livelihood to about 65 % of the labor force and their families, as well as it plays a major role in the protection of the environment. The natural vegetative cover helps in inducement of rainfall, absorption of carbon dioxide and release of oxygen. While the rural sector is at a disadvantage compared with the rest of the country, food insecurity-related disparities exist among regions and farming systems. Historically, modern irrigated and the semi-mechanized sectors received more developmental assistance than the traditional rain-fed sector. Infrastructure, public finance, research and social services have been highly in favour of these two sectors. Growth rates of the rain-fed traditional sector and its livestock are by far outweighed by those of the irrigated and semi-mechanized sectors.

This is in spite of the reasonable GDP share of the rain-fed traditional sector and the magnificent share of the livestock sector. While irrigated crops invariably enjoyed rising yield trends, however small they are, trends for traditional rain-fed crops were all negative. Furthermore, variability was notably higher under rain-fed conditions than under irrigation one, subjecting producers in the former system to high risks of crop failure and higher livelihood vulnerability. Notable also is the steeper trend decline in mechanized rain-fed than traditional rain-fed production of both sorghum and sesame, which are produced under both systems. This is highly likely a sign of deterioration of soil productive capacity due to mono-cropping in the absence of conducive policies.

The farming systems of the agricultural sector in Sudan, could be categorized mainly in the three farming systems, namely the irrigated farming such as in Central and North regions, traditional rain-fed farming like in Kordofan

region and the semi-mechanized rain-fed farming similar to that in Gedarif district. The areas of the rain-fed farming systems have endowed huge sizes of land resources, but they different in their socio-economic and agricultural characteristics. Although the central region applies gravity irrigation farming systems but also the rain-fed one is existed in some areas. The irrigation sub-sector in this region is considered as the prevalent one and it enjoys gravity irrigation system from Sinnar Dam at south of the region. The Gezira state may represent to central region; it has vastly greater human population, somewhat greater per capita income and cultural diversity, and far less farmland than Gadarif. Average farm size is largest in Gadarif state, followed by Gezira, and smaller in Kurdufan of west region.

Sorghum (Sorghum bicolor L.) is intensively produced in rain-fed areas of the Sudan in large schemes and in small farms as well. The small-scale farmers whom their farms are scattered nearby villages usually practice sorghum production for subsistence. Farmers usually start to cultivate their fields when about 100 mm or more of rainfall occurs. They use the conventional machine, the wide level disk (WLD) plow with seeder box, for seedbed preparation and seeding operations. Delayed sowing date and the use of local varieties are common practices. The result of that is low average yield, misuse of resources and economic loss. There is, however, a potential and opportunities to improve the sorghum yield in rain-fed areas through adopt and use of the recommended technical packages and implementation of intelligent economic policies. Many efforts were made by the governmental institutions, NGOs and private sector to change the crop system in rain-fed areas. Sorghum is the world's fifth most important cereal after wheat, rice, maize, and barley in both production and area planted (FAO/ICRISAT, 1996).

Sorghum is one of the main staples for the world's poorest and most food-insecure people (Henry and Kettlewell, 1996).It is a staple food crop for many millions of people in the arid and semi-arid areas of East and Central Africa (ECA). The crop is generally suited to hot and dry areas where it is difficult to grow other food grains. These are also areas subject to frequent drought. In many of these areas, sorghum is truly a dual-purpose crop; both grain and Stover are highly valued outputs. In large parts of the developing world, Stover represents up to 50 percent of the total value of the crop, especially in drought years.

Developing countries account for roughly 90 percent of the world's sorghum area and 70 percent of total output (FAO/ICRISAT, 1996). Asia and Africa each account for about 25 to 30 percent of global production. Nigeria and Sudan are the major producers in Africa. Production in Africa remains characterized by

low productivity and extensive, low-input cultivation. Generally, sorghum is grown primarily for food in the developing countries and in the developed countries almost all sorghum production is used as animal feed.

Methodology

Data collection and analysis

This paper depends mainly on secondary data from different relevant sources. The secondary data relating to growth performance of sorghum crop is collected from annual reports of the General Directorate of Planning and Agricultural Economics, Department of Agricultural Statistics and Food Security Technical Secretariat (FSTS). To analyze the data collected descriptive statistical analysis was applied, while for examining the growth trends of sorghum commodity statistical tools like Compound Annual Growth Rate (CAGR) and Simple Annual Growth Rate (SAGR) are used. When plotting data in a graph to visualize the general trend in data is done by adding a trend-line to a chart. A trend-line, also referred to as a line of best fit, is a straight or curved line in a chart that shows the general pattern or overall direction of the data. This analytical tool is most often used to show data movements over a period of time or correlation between two variables. The study applied the Excel power trend-line equation, computing R2 (the nearer R2 is to 1, the better the trend line fits the data) and the formulas as mentioned follow.

Power trend-line equation and formulas:

A power trend-line in Excel is drawn based on this simple equation:

$$y = ax^b$$

Where:

a and *b* are constants, which can be calculated with these formulas:

a = EXP (INDEX (LINEST (LN (y), LN (x)), 1, 2))

b = INDEX (LINEST (LN (y), LN (x)), 1)

The time series data which is used in this paper analysis is sorghum crop analysis used the Central Ministry of Agriculture reports.

Results and discussion

Agriculture in sub-Saharan Africa suffers from low productivity growth as evidenced by the agricultural Total Factor Productivity (TFP) growth in the region which is lagging behind some countries in the regions. This is because of the performance of new technologies of production is not significantly different from that of old technologies; and the sorghum growers are less efficient in using

available technology of production due to weak dissemination and advisory systems coupled with low adoption rates. In Sudan, traditional subsistence agriculture dominates the Sudanese economy with over 70% of the population dependent on crop production and/or livestock husbandry to support their livelihoods.

Sorghum Production and development in Sudan

In Sudan, the productivity of this important crop still remains very low. In recent years, sorghum production has generally expanded mainly due to increase in crop area. However, yield per unit area has failed to increase or even declined because of biotic and abiotic factors. Over the last few years, sorghum crop attracted a lot of interest for its major role in food security, bio-fuels, feed and other manufactured products. Sudan is the largest producer of sorghum (Sorghum bicolor) in the Arab world, producing about 4.9 million tons in 2018, which is more than 70 percent of sorghum production in Arab world while long term average sorghum production in Sudan showed an average of 3.8 million metric tons over the period 2009-2010 to 2018-2019, the main States of sorghum production in the country are Gedaref, Gezira and North Kordofan, they contributed in season 2018-2019 by almost 993 thousand metric tons; 295 thousand and 109 thousand metric tons respectively. This is equivalent to almost 37 percent of the average stable production of sorghum in the country. The drastic fluctuations in sorghum production and yield threaten food security situation, increase wheat imports in the absence of strategic buffer stocks and increased sorghum losses. However, sorghum production is extremely erratic with variable fluctuations for many climatic, and managerial and financial factors. For instance, average sorghum production over the period 2009-2018 accounted for 3.82 million MT, about 6% of the world production while in season 2016-2017 production of sorghum accounted for 6.44 million metric tons, far above average by almost 70 percent (CBoS, 2017). Therefore, the potential for sorghum to be the main driver of economic development in Sudan is enormous and there is a clear reason to continue unleashing sorghum's potential capacity in the country to be the cornerstone of food security and other uses as well. Among cereals in Sudan, sorghum comprises almost 77% of cereals' production while pearl millet and wheat share 15% and 8% of total cereals respectively. Most of the sorghum is produced in the semi-mechanized farming system (49%) and traditional rain-fed agriculture (30%) while irrigated agriculture contributes only by 21% (Table 1).

Table 1: Summary of area, production and yield of Sorghum by farming system (1990 - 2021)

Crop	Farming system	Area Planted (000 ha)	Harvested (000 ha)	Production (000 MT)	Yield MT/ ha
Sorghum	Irrigated	1014	926	742	0.801
	Rain-fed (Traditional & Semi mechanized)	17201	13530	2922	0.216
Totals sorghum			**18215**	**14456**	**3664**

Source: Central Ministry of Agriculture, 2021

However, sorghum productivity is substantially lower than any neighboring countries mainly attributable to low use of technology inputs. Though growth rate for production is above the population growth rate still there are hard droughts times that reduce production substantially since yields are still at low pace. Sorghum is mainly grown for local consumption by small scale holders (60% of quantity produced) in the main producing areas, particularly in traditional rain-fed farming, semi-mechanized and irrigated agriculture. The total sum of sorghum industry in Sudan is close to one billion USD other than the related activities. For the majority, it is considered as a main source of livelihoods and generates income for producers, traders and processors as well as a source of nutritional diet and caloric value for consumers. In the Sorghum supply chain, it worth to note that, about 60% of the small holders' total produce was mastered by male farmers, while female farmers contribute by 40% of this total product. However, the crop produced represents a small amount (only 10%) to the male small holders' total income. This may be due to the argument that most of the product used to cover the cost of production, a considerable portion for family consumption and small proportion is marketed. However, small holder's female farmers usually consider the marketing process as the responsibility of the male household for they look to the farm as a whole family asset, even if the farm is her own.

Average cultivated area of sorghum: This paper revealed the area cultivated under sorghum crop, in Sudan as presented in Table (2). The required data regarding trends of the sorghum planted area in Sudan from 1990/91to 2020/21 were collected from relevant sources. The total average planted area of sorghum was found as 16,009 thousand feddan during 1990-91 to 1999-2000, only 6.6% of it under irrigation sector and the rest under rain-fed. The total average cultivated

area decreased to 15,469 during 2000-01 to 2009-10 but with increase in irrigated sector up to 1,088 thousand feddan, with significant jump during 2010-11 to 2020-21 up to 22,717 thousand feddans but with slight decrease in irrigated sector to 971thousand feddans and overall period of 18,215 thousand feddans, 5.6% under irrigated sector.

Annual growth rate of sorghum cultivated area: As shown in Table (2) the annual growth rate during the first term was found as 1.6%, with significant annual growth in rain-fed sector of about 4.9% during the same term, and a negative annual growth rate of -2.1% in the irrigated sector. The second term witnessed a decrease in the cultivated area, and a negative growth rate of -1.5% was observed and a negative growth rate for irrigated sector of -5.3, while in the third term the annual growth rate improved to 1% with overall period 1.7%. The total average planted area of sorghum has shown a mixed trend with an average annual growth rate of 1.6% during the first term, -1.5% during the second term and 1% during the third term.

Average harvested area: The paper also unveiled the size of area harvested under sorghum in Sudan as presented in Table (2). The total average harvested area of sorghum was about 12,482 thousand feddan during the period 1990-91 to 1999-2000, and only 7.7% of the total harvested area was under irrigation sector, while the rest of the harvested area was under rain-fed. The total average harvested area has increased to 13,661 during 2000/01 to 2009/10 but with decrease in irrigated sector to 934 thousand feddan, with significant jump during 2010-2011 to 2020-2021 up to 16,975 thousand feddans but with decrease in the irrigated sector to 885 thousand feddans with average total harvested area for the overall the period was about 14,456 thousand feddans.

Annual growth rate of sorghum harvested area: The study also evaluates the annual growth rate during the first term, it was found as 4% as shown in Table (2), with significant annual growth in rain-fed sector of about 4.9% during the same term and a negative annual growth rate of -4% in irrigated sector. The second term witnessed a growth rate of 2% for the average total harvested area and a negative growth rate for irrigated sector of -6.8, while in the third term the annual growth rate observed as 1.3 % with overall growth of about 1.7%. The total average harvested area of sorghum has shown a positive trend with a decreasing rate, with an average annual growth rate of 4% during the first term. The study emphasizes on the growth performance of sorghum production in Sudan.

Table 2 : Sorghum Production under Different Farming Systems of Sudan (1990 - 2021)

Items	First term (1990-2000)	Second term (2000 - 2010)	Third term (2010-021)	Whole period (1990 - 2021)
a. Average cultivated area				
- Irrigated (000 fedd*)	1055	1088	971	1014
- Rain-fed (000 fedd)	14954	1088	21746	17201
Total (000fedd)	**16009**	**15469**	**22717**	**18215**
b. Annual growth rate of sorghum cultiv. area				
- Irrigated Sorghum	-2.1	-5.3	-2.7	-0.7
- Rain-fed Sorghum	4.9	2.7	-2.7	1.9
Total Sorghum	**1.6**	**-1.5**	**1**	**1.7**
c. Average harvested area	963	934	885	926
- Irrigated (000 fedd)	11518	12727	16090	13530
- Rain-fed (000 fedd)				
Total (000 fedd)	**12482**	**13661**	**1697**	**14456**
d. Annual growth rate of sorghum harve. area				
- Irrigated Sorghum	-4	-6.8	-2.8	-0.8
- Rain-fed Sorghum	4.9	2.7	1.6	1.9
Total Sorghum	**4**	**2**	**1.3**	**1.7**
e. Average production	668	813	745	742
- Irrigated (000 ton)	2408	2776	3523	2922
- Rain-fed (000 ton)				
Total (000 ton)	**3076**	**3588**	**4268**	**3664**
f. Annual growth rate of sorghum production				0.1
- Irrigated Sorghum	-1.5	-7.6	-2.3	
- Rain-fed Sorghum	6.4	3.1	6.9	2.2
Total Sorghum	**4.2**	**1**	**4.8**	**1.8**
g. Average yield	694	870	842	801
- Irrigated (kg/fed)	209	218	219	216
- Rain-fed (kg/fed)				
Total (kg/fed)	**246**	**263**	**251**	**253**

h. Annual growth rate of sorghum yield				
- Irrigated Sorghum	2.6	-0.9	0.5	0.9
- Rain-fed Sorghum	1.5	-0.9	5.3	0.3
Total Sorghum	**0.1**	**-0.9**	**3.4**	**0.1**

*1 hectare (ha) = 2.38 feddans

Source: Central Ministry of Agriculture, 2021

Average production of sorghum: Table (2) presented the average production of sorghum by term and type of irrigation. The average total production of sorghum was 3,076 thousand metric tons during the first term which increased up to 3,588 thousand metric tons during the second term with significant increase up to 4,268 thousand metric tons during the third term, with overall average production during the whole period as 3,664 thousand metric tons. The total sorghum production and rain-fed production has shown a positive trend and a mixed trend in irrigated sector.

Annual growth rate of sorghum production: The paper aimed to illustrate the annual growth rate of sorghum production for the whole period as 1.8% with highest growth rate during the third term as 4.8%, followed by the first term of 4.2 % and 1% for the second term. The growth rate was observed to be negative during the three terms as shown in Table (2). The study also observed that the production of sorghum showed a higher annual growth rate of 1.8% than the cultivated and harvested areas respectively. This mostly means that the production of sorghum increased in the country due to utilization of improved technologies by sorghum growers rather than the increase in the cultivated areas of the crop. The paper revealed further results regarding sorghum yield as shown in Table (2).

Average yield of sorghum: The total average yield per feddan of sorghum was 246 kg in the first term which increased up to 263 kg in the second term but decreased to 251 kg in the third term with average of 253 kg for the whole period. The increase of yield in the rain-fed sector is positive during the three terms but with slight increase with exceptional to the increase between the first and second term.

Annual growth rate of sorghum yield: The study also found that the annual growth rate of sorghum yield was 0.1% for whole period of the study with the highest growth rate during the third period (3.4%) and a negative growth rate during the second term (-0.9%). The study shows a mix trend of growth rate in all sectors as shown in Table (2).

Sorghum consumption in Sudan: Home consumers, commercial poultry and dairy farms: sorghum is a staple crop in Sudan and especially in the eastern part of the country. However, consumption habits are changing with growing preference for wheat particularly around urban centers. This is clear through the increasing level of wheat and wheat flour imports in recent years (OEC, 2017). Commercial and large poultry and dairy farms purchase processed feed containing sorghum from feed mills either directly or through proxy distributors which supply these farms with other inputs.

Table (3) Sorghum production and consumption in Sudan in 000 tons (1990-91 to 2019-20)

Term*	Average Production (tons)	Average Consumption
First term 1990 - 1999	5560	4, 104
Second term 2000 - 2009	5936	3,355
Third term 2010 - 2019	6994	4,357

* Term= a 10-years period

Source: Ministry of Agriculture and Forestry and ICRISAT

Small poultry and dairy farms access sorghum through local market aggregators that also seem to advise them on appropriate feed mixes. Sorghum is mainly grown for local consumption by small scale holders (60% of quantity produced) in main producing areas, particularly in traditional rain-fed farming, semi-mechanized and irrigated agriculture. There has been a notable increase during the period (1990 - 2020) as shown in Table (5). The domestic consumption of sorghum is also grown and it is clear there is no import gab. as depicted in the table.

Sorghum Trade

In Sudan Sorghum is produced in different types of farming systems namely, irrigated and rain-fed. The large amount of the crop is produced at rain-fed semi-mechanized areas in Gedarif, Blue Nile and South Kordofan States while the irrigated farming system of Gezira scheme is ranked as a second largest area of production. The rain-fed traditional system comes after irrigated sector.

The exported quantities of sorghum depend mainly on favorable climatic factors that contribute to the success of the season. Sorghum is considered as an important crop for food security for both human consumption and animal feed, and because it is strategic crop its export quantities vary depending on

production quantities and consumption requirement, for example in 1997, 2009 and 2016 there was no export of sorghum due to food security policies which is prevent or restrict export of sorghum during seasons of low production.

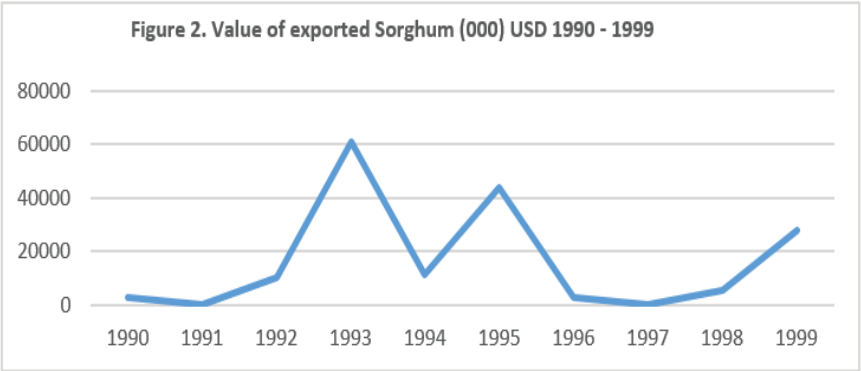

Figure 2. Value of exported Sorghum (000) USD during 1990 - 1999

The trend of annual exported quantities and the value from export of sorghum during the period of 1990 – 2020 was fluctuating as illustrated in figure (5). The average growth rate of the exported value of sorghum during the period 1990 – 1999 formed a positive rate of 28 %. Figure (2) depicts the trend of the export value of the crop during this period, while the average growth rate during the period 2000- 2009 showed a positive rate of 21 %.

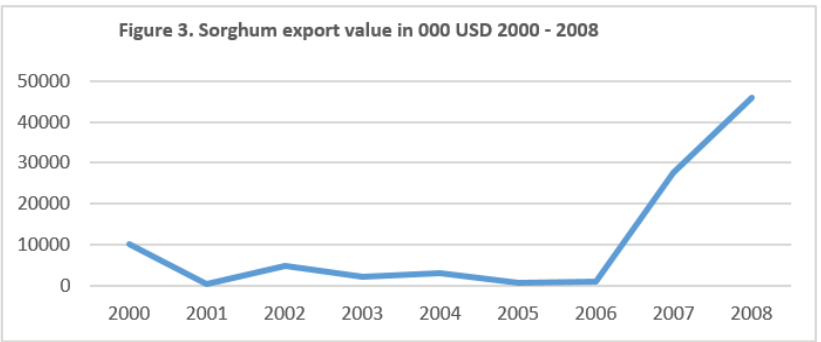

Figure 3. Value of exported Sorghum (000) USD during 2000-2008

Sorghum exports during the following 10 years, 2010 – 2020, showed a declining trend as in figure (4). The average growth rate of exported value declined from 28% during 1990 – 1999 to 21 % during the periods 2000 – 2008 and declined to 0.6 % only during the last 10 years 2010 – 2020. The overall average growth rate of the period 1990 – 2020 was positive (4.7 %). Figure (5) shows the change in values of exported quantities during the period 1990 – 2020 in thousand USD.

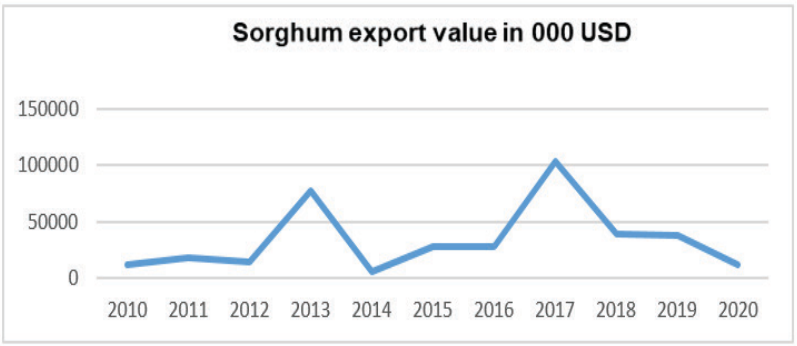

Figure 4. Value of Sorghum exported during 2010 – 2020

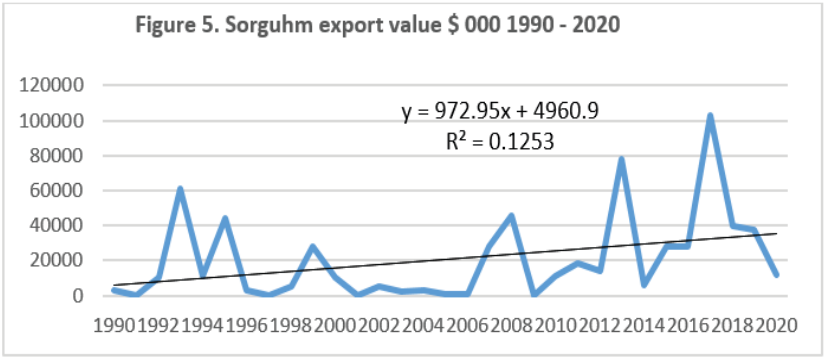

Figure 5. Value of Exported Sorghum during 1990 – 2020

The annual change in export value of the crop fluctuated between positive and negative rates. Figure (5) shows the linear trend of export values during the period 1990 – 2020, while figure (6) shows the change in the annual growth rate of the value.

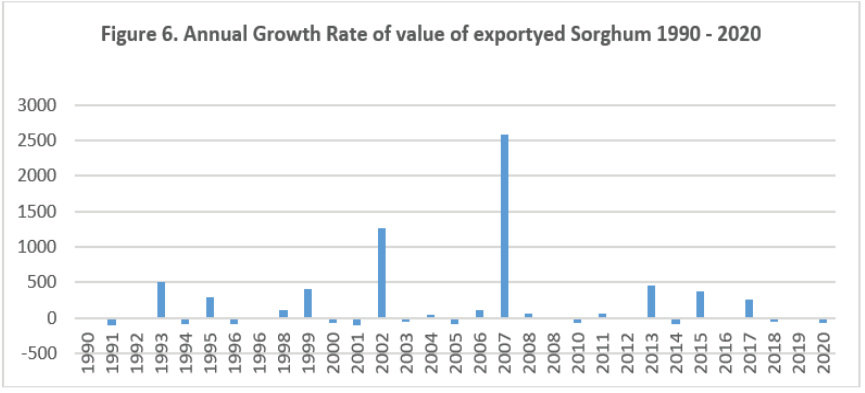

Figure 6. Annual Growth Rate of Value of exported Sorghum 1990 – 2020

Conclusion and Policy Implications

Agriculture is the backbone of Sudan's economy and is crucial for food security and poverty alleviation. Although between 1960 and 2020 agriculture ranked second to services in terms of contribution to the gross domestic product (GDP) each adding, respectively 35.2% and 48.7%. Recently, it generates 47.4% of employment with 69% of the own-account businesses operating in the sector (HBS, 2015). Agriculture in Sudan is enjoying three broad crop production systems namely, irrigated, mechanized rain-fed and traditional rain-fed farming systems, this beside the natural pastoral system. The rain-fed sector comprises both traditional rain-fed and mechanized rain-fed subsectors, and is considered as the most promising sector for the agricultural development in Sudan. The sorghum subsector is predominated by small and subsistence farmers (78%). Historically, the sorghum subsector faces numerous of challenges including: scarcity of improved seeds and dissemination of pest and diseases, leading to low crop yield. Furthermore, the sector is constrained by climate change volatility, population pressure; inadequate land tenure system and land fragmentation; lack of public investment, poor market infrastructure; and high poverty incidence. Therefore, the principal policy implications that needed to improve the sorghum subsector in Sudan are:

I. Adoption of advanced technologies including seed technologies to improve sorghum productivity and the existing seed systems in Sudan. This may contribute directly to poverty reduction, malnutrition and food safety, and farm sustainability.

II. Design of comprehensive sorghum research programs to manage climate change volatility.

III. Capacity building for labor in sorghum subsector. This will increase the availability and access to skilled manpower across the sorghum value chains.

IV. The pattern of sorghum consumption over the last three decades (1990 - 2020) has shown a clear trend: the increases demand of sorghum.

V. Management of sorghum farm transformation is needed to shift towards innovative and commercial farming systems to make the crop more attractive and to attain farm sustainability.

VI. Design a suitable strategy for sorghum bio-fortified development in Sudan

VII. Establish stakeholders network for sorghum bio-fortified products including social, nutrition, and public institutions.

VIII. Introduction of successful stories and experiences on of sorghum bio-fortified products and their nutrient bioavailability commercialization and trade.

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Landscaping the Status of Nutritional Literacy in Rural India

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ABSTRACT

Nutrition has a significant impact on the growth and development of an individual. India is suffering from the double burden of malnutrition i.e., a significant part of its population is affected by both over-nutrition and under-nutrition. One effective measure of fighting malnutrition is to consume balanced, nutritious food loaded with essential nutrients and micro-nutrients. However, to consume healthy diet, the nutrition literacy comprising of nutritional knowledge, attitude and dietary practices to meet nutritional requirement is a pre-requisite. The present study provides a comprehensive understanding of the nutritional literacy landscape of rural India. It also highlights the role of nutritional literacy in driving nutri-sensitive agriculture. The study also throws light on the constraints faced by the rural people in attaining nutritional literacy and policy framework suggestions to overcome them.

Keywords: Nutritional literacy, Nutri-sensitive Agriculture, Malnutrition.

Introduction

Nutritional literacy refers to the degree to which individuals have the capacity to obtain, process and understand nutrition information and skills needed in order to make appropriate nutrition related decisions. It comprises of components like nutritional knowledge, nutritional attitude and nutritional practices followed to meet the nutritional requirement. Nutritional knowledge refers to the understood information about the nutrition related aspects. Nutritional attitude is the degree of positive or negative feeling of the people towards nutrition. Nutritional practices are the set of activities and food consumption pattern performed regularly for intake of nutritious diet. Nutrition literacy plays a key role in transforming the food consumption pattern among the population and adopt healthy eating practices to combat the prevailing status of the malnutrition in India. India suffers from double burden of malnutrition. Child malnutrition is

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reported as 36.00 per cent of the children under 5 are stunted, 19.00 per cent are wasted, 32.00 per cent are underweight, 03.00 per cent are overweight and 67.00 per cent suffers from anaemia. Among adults, 16.00 per cent males and 19.00 per cent females suffer from under-nutrition, 23.00 per cent males and 24.00 per cent females suffer from over-nutrition and 25.00 per cent males and 67.00 per cent females suffer from anaemia (National Family Health Survey (NFHS) – 5, 2019). The statistics on the status of malnutrition in India highlights the dire need on improving nutritional literacy in the population to translate the learning into adoption of healthy dietary practices to combat malnutrition. With the active consideration of the above-mentioned concerns, the study was undertaken to explore the status of nutritional literacy in the rural India.

Objectives

- » To provide a comprehensive review of nutritional literacy in India
- » To document the constraints as perceived by the farmers to attain nutritional literacy
- » To provide suggestions to enhance nutritional literacy in rural India
- » To suggest policy framework to bridge the gaps in nutritional literacy in rural India

Research Methodology

The literatures based on research works conducted on nutritional literacy by the global scientific community were studied extensively and documented carefully. To document the constraints faced by the rural population in attaining nutritional literacy, the researchers adopted exploratory research design. The study was carried out in the Vadodara district of the Gujarat state in India. The sample size of the study was 150 and a total 150 farmers (75 males and 75 females) from 15 villages (5 male and 5 female farmers from each village), selected randomly for this study. The questionnaire was open ended and farmers were at the freedom of expressing the constraints faced in gaining nutritional literacy. The suggestions provided by the researchers are based on personal understanding of the issue and the comprehensive study of the suggestions provided by the respective scientific community across the globe. Based on the constraints perceived by the respondents, policy framework are suggested to address the issues and bridge the gap in nutritional literacy in rural areas.

Review of Literature

Nutritional knowledge

Suchitra and Ravindra (2018) revealed that slightly less than two-thirds (61.67%) of the respondents had medium knowledge, followed by 20.00 per cent and

18.33 per cent with low and high knowledge about nutrition, respectively. Soni and Verma (2019) stated that majority (45.00%) of the tribal women had medium level of knowledge about different types of anaemia, followed by 29.00 per cent and 26.00 per cent with low and high level of knowledge about different types of anaemia, respectively. Timothy et al. (2019) revealed that majority (76.80%) of the respondents had good knowledge of healthy nutrition, followed by 13.50 per cent and 9.70 per cent of the respondents had fair and poor knowledge of healthy nutrition, respectively. Bhimani et al. (2020) revealed that majority (73.00%) of the farm women had medium knowledge level about nutrition and food, followed by 18.00 per cent and 9.00 per cent with high and low knowledge level about nutrition and food, respectively. Geetha et al. (2022) stated that more than one-third (34.50%) of the rural farm women had high nutritional knowledge, followed by 33.50 per cent and 32.00 per cent with low and medium nutritional knowledge, respectively. Kumari et al. (2023) concluded that majority (71.00%) of the rural women had medium knowledge, followed by 15.00 per cent and 14.00 per cent with high and low level of knowledge about nutrition requirements of infants, respectively. Zala et al. (2025) reported that more than half (56.00%) of the male farmers had low level of nutritional knowledge, followed by 40.00 per cent and 04.00 per cent with medium and high level nutritional knowledge. Comparatively, more than half (56.00 per cent) of the female farmers had medium level nutritional knowledge, followed by 34.00 per cent and 10.00 per cent with low and high level of nutritional knowledge.

Nutritional attitude

Nivedita and Shanthini (2016) concluded in their study that the overall attitude towards antenatal check-up, healthy diet and the benefits of iron supplementation was favourable among the participants. Patimah et al. (2016) stated that more than half of the respondents (55.50%) of the respondents had negative attitude and 44.50 per cent had positive attitude towards the balanced diet. Geetha et al. (2022) stated that more than one-third (36.00%) of rural farm women had less favourable attitude towards nutrition, followed by 34.00 per cent had favourable and 30.00 per cent had more favourable attitude towards nutrition. Prasanthi and Sireesha (2022) concluded that less than two-thirds (65.00%) of the respondents had good attitude on millets and usage of millets, followed by 26.00 per cent and 9.00 per cent with average and poor attitude on millets. Priyadarshini and Biswal (2023) stated that the overall attitude of tribal adolescents towards the nutrition was found negative. Zala et al. (2025) reported that more than half (52.00 per cent) of the male farmers had more favourable attitude towards nutrition, followed by 48.00 per cent with favourable attitude and none had less favourable attitude. Comparatively, little less than two-

thirds (62.00 per cent) of the females had favourable attitude towards nutrition followed by 38.00 per cent with more favourable attitude and none had less favourable attitude.

Nutritional practices

Pareek (2015) concluded in their study that majority of the respondents adopted faulty nutritional practices. Patel et al. (2016) stated that more than two-thirds (68.00%) of the tribal women had medium level of knowledge, followed by 30.00 percent and 2.00 percent with high and low levels of knowledge about nutritional practices. Patimah et al. (2016) stated that more than two-fifths (46.50%) of the respondents followed poor nutritional practices followed by 53.50 per cent followed good nutritional practices to meet their nutritional requirements. Hoque et al. (2018) revealed that more than one-third (37.92%) of the respondents consume liquid milk several times per month, followed by more 29.64 per cent, 14.74 per cent, 14.18 per cent and 3.52 per cent consume liquid milk several times per week, daily, once in a month and several times in a day. Geetha et al. (2022) stated that two-fifths (40.00%) of rural farm women had poor nutritional practice, followed by 35.50 per cent and 24.50 per cent had fair practice and good practice of nutrition. Priyadarshini and Biswal (2023) stated that overall nutritional practice of the tribal adolescent girls was categorised as average, reflecting a lack of knowledge and negative attitude towards a balanced diet. Vahini et al. (2023) revealed that the average monthly consumption of millets is higher in urban households (2.29 kg) than in rural households (1.83 kg). Zala et al. (2025) reported that majority (84.00 per cent) of the male farmers followed fair practices, followed by 16.00 per cent with poor practices and none with good practices to meet their nutritional requirements. Comparatively, great majority (92.00 per cent) of the female farmers followed fair practices, followed by 06.00 per cent with good practice and 02.00 per cent with poor practices to meet their nutritional requirements.

Documented constraints as perceived by the rural people in attaining nutritional literacy

Rural population face significant challenges in gaining nutritional literacy. While understanding the constraints faced by the rural population, it became necessary to view it through gender lens. All the required care was taken to document the different problems faced by both the rural men and women. Table 1 shows the constraints faced by the respondents in gaining nutritional literacy.

In case of male farmers, 82.66 per cent of them felt that initiatives like POSHAN MAAH are not gender inclusive, followed by 73.33 per cent considered inadequate awareness about government schemes like PM-POSHAN Scheme

and passive participation in such programmes, 66.67 per cent considered lack of knowledge about nutrition related diseases, 64.00 per cent felt that inadequate knowledge about need-based diet, 53.33 per cent felt high cost of organic and nutritious foods, 46.66 per cent felt lack of health diagnosis camps in villages, 20.00 per cent considered lack of access to digital resources for information as major constraints in meeting their nutritional requirements. Interestingly, none of the male farmers considered gender-based stereotypes faced in the households as the constraint. This reflected the deep-rooted patriarchy and prevailing gender-blind situation in the rural areas. Whereas among the women farmers, majority (88.00%) of them considered lack of access to digital resources for information as major constraint, followed by 86.66 per cent considered gender based stereotypes faced in households, 80.00 per cent considered lack of health diagnosis camps in villages, 78.66 per cent felt initiatives like POSHAN MAAH are not gender inclusive, 77.33 per cent felt that inadequate knowledge about need-based diet, 70.66 per cent felt high cost of organic foods and highly nutritional foods, 66.67 per cent considered lack of knowledge about nutrition related diseases, 49.33 per cent felt that passive participation in programmes like PM-POSHAN Scheme, 40.00 per cent felt that inadequate awareness about government initiatives like PM-POSHAN Scheme and 33.33 per cent considered food prepared based on male members' preferences as major constraints in meeting their nutritional requirements. Overall, it can be stated that both male and female farmers faced different constraints and therefore need-based solutions should be devised for them to overcome the existing constraints and enhance their nutrition literacy.

Table 1: Perceived constraints by the respondents in attaining nutritional literacy **(n=150)**

Sr. No.	Perceived constraints	Male (n=75)			Female (n=75)		
		(f)	%	Rank	(f)	%	Rank
1	Inadequate awareness about government initiatives like PM-POSHAN Scheme	55	73.33	II	30	40.00	IX
2	Lack of knowledge about nutrition related diseases	50	66.67	IV	50	66.67	VII
3	Lack of health diagnosis camps in villages	35	46.66	VII	60	80.00	III
4	High cost of organic foods and highly nutritional foods	40	53.33	VI	53	70.66	VI

5	Initiatives like POSHAN MAAH are not gender inclusive	62	82.66	I	59	78.66	IV
6	Food prepared based on male members' preferences	10	13.33	IX	25	33.33	X
7	Lack of access to digital resources for information	15	20.00	VIII	66	88.00	I
8	Inadequate knowledge about need-based diet	48	64.00	V	58	77.33	V
9	Passive participation in programme like PM-POSHAN Scheme	55	73.33	III	37	49.33	VIII
10	Gender based stereotypes faced in households	00	00.00	X	65	86.66	II

Suggestions to enhance nutritional literacy in rural India

Based on the constraints documented, the effort was made to suggest ways and measures to enhance the nutritional literacy among the rural population. Training and capacity building programmes on nutrition education, health and disease diagnosis camps in the villages to identify the micro and macro-nutrient deficiencies in the rural population and prescribe them the necessary diet and foods to fulfill the deficiency. To combat malnutrition, household nutritional security is a key measure. This can be done by training them to grow and maintain a kitchen/nutrition garden with nutritional crops like spinach, bitter gourd, cucumber, bottle gourd, aonla tree, drumstick, etc. and consume them regularly. Inclusion of both male and females in nutri-sensitive programmes and schemes like ICAR's Nutri-Sensitive Agricultural Resources and Innovation (NARI) programmes, PM-POSHAN Scheme shall also consider anaemic males as target population. Bridging digital divide in rural areas, equipping them with the tools to gather information about the nutrition related aspects from social media platforms, TV programmes can play a catalytic role. Nutrition sensitive extension can also play a vital role for the same. Extension workers can encourage cultivation and marketing of nutritional crops like millets which will be gradually adopted by the consumers thus shifting the goal from increasing food production to the cultivation of nutrient rich foods, bio-fortified varieties to ensure nutritional security and combat malnutrition in India. Zala et al. (2025) suggested in their study the important policy framework to enhance nutrition literacy in India.

Policy framework to bridge the gaps in nutritional literacy in India

The constraints faced by the rural population in achieving nutrition literacy are to be addressed through targeted policy interventions. Therefore, the following points describe the applicable components to be included while formulating such a gender-inclusive policy to strengthen nutrition literacy in the rural population.

Components of the policy

Knowledge enhancement and capacity building

- Establish social institutions for training rural population about nutritional foods like millets and include both men and women in these programmes
- Organize regular health camps in villages for providing information about nutrition-related disorders and diseases like anaemia
- Collaboration of health department persons and extension officials to cover a larger target area
- Design programs like training on nutrition gardening for both men and women
- Set up Nutri-smart villages
- Build digitals tools like nutrition related information providing application, social media interventions like WhatsApp groups where healthcare staff and government officials upload information regarding nutrition.

Promote nutri-sensitive agriculture among the farmers

- Promote farmers to grow highly nutritional crops like millets, adopt organic farming practices
- Knowledge building about bio-fortified varieties and encourage their cultivation

Involve participation of civil society organizations

- Non-Governmental Organizations (NGOs) can help to reach the wider target area and influence the rural population to adopt nutritional practices.
- Self-Help Groups (SHGs) should be encouraged to take up millet-based entrepreneurship to supply more nutritional foods into the market
- Farmer Interest Groups (FIGs) should be trained by SHGs or private players like food processing companies to take up value-added enterprises to produce nutritional foods

Targeted programmes in village schools and community led programmes

- Create awareness among the children from school stage about nutritional food intake
- Prepare school kitchen gardens/nutrition garden with high nutritional

value vegetables like carrot, cabbage, spinach and coriander

- Organize millet fairs and exhibitions, organic food exhibitions to promote their marketing and encourage farmers to grow nutritional crops and vegetables.

The success of any policy and programme depends on its successful implementation. Therefore, effective implementation with regular monitoring is essential for the positive transformation on the grass root level.

Conclusions

Nutrition has significant impact on the development of the nation. Malnourished population is the army of the sick leading to the slowed down economic, social and technological growth of the nation. Therefore, it is of dire need to address the malnutrition by encouraging nutritional literacy among the population. Knowledge of healthy foods and diet will lead to their increased consumption among both the males and females, improving their nutritional practices gradually combating malnutrition. As India is progressively heading on the path of Viksit Bharat by 2047, let us strive to make India nutritionally secure and healthy.

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Assessment of The Demographic Profile and Current Status of Gender Mainstreaming in Agricultural Extension Services in Uttar Pradesh

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ABSTRACT

This study examines the implementation and effectiveness of gender mainstreaming strategies in agricultural extension services across four districts of Uttar Pradesh, India. Using a descriptive research design, the study surveyed 60 extension personnel across Hamirpur, Unnao, Amethi, and Agra districts. The research findings reveals significant gender disparities within extension services, with female comprising only 21.67 percent of the extension personnel and 78.33 percent of the organisations male field officers. Despite these imbalances, 70.00 percent of the extension personnel actively implement gender-inclusive strategies, including minimum participation quotas, collaboration with women's groups, and schedule adapted to accommodate women's needs. The study finds that 81.67 percent of the personnel consistently collected sex-disaggregated data, though implementation challenges persist, including insufficient fund, cultural constraints, and logistic barriers. Critical gender mainstreaming activities include gender sensitivity training, partnerships with Anganwadi workers, establishment of women's Self-Help Groups, mobile-based advisory services, and technical workshops. The research study highlights the need for increased recruitment of female extension officers, enhanced monitoring systems, and dedicated funding for gender-focused programs to address persistent gaps in agricultural extension services. These findings contribute to understanding the current state of gender mainstreaming in agricultural extension and provide actionable recommendations for improving gender equality in agricultural development.

Keywords: Gender Mainstreaming, Agricultural Extension Services, Women Farmers, Rural Development, Gender Equality.

Introduction

Gender mainstreaming in agricultural extension services has emerged as a

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critical strategy for promoting equitable and sustainable rural development worldwide. This approach seeks to integrate gender perspectives into the planning, implementation, and evaluation of agricultural support programs, ensuring that both men and women have equal access to resources, training, and opportunities in the agriculture sector. Despite women constituting a significant portion of the agricultural workforce globally, they often face disproportionate challenges in accessing essential services and resources (Hassan et al., 2014); Njenga et al., 2011).

Globally, women comprise an average of 43.0 percent of the agricultural labour force in developing countries, with participation rates rising to 50.0 percent or more in some parts of Africa and Asia (Diaz, 2017). However, access to agricultural resources and services shows stark disparities, with women often owning less than 20.0 percent of agricultural land and receiving only a fraction of available extension services (Ragasa et al., 2013). These disparities limit productivity and economic opportunities, affecting food security and rural development (Ofuoku, 2012); (Tsige et al., 2020). Gender mainstreaming was globally recognised during the United Nations Fourth World Conference on Women in Beijing in 1995 and has since been integrated into strategies across sectors (Ransom & Bain, 2011).

In India, agriculture accounts for approximately 17.0 percent of the GDP, employing almost half of the workforce, with rural women representing a critical share of this sector (Geethakutty, 2020). However, women's contributions are undervalued, with limited access to resources like land ownership, which remains at 12.8 percent, despite women comprising nearly 33.0 percent of the cultivators (Chete, 2019).

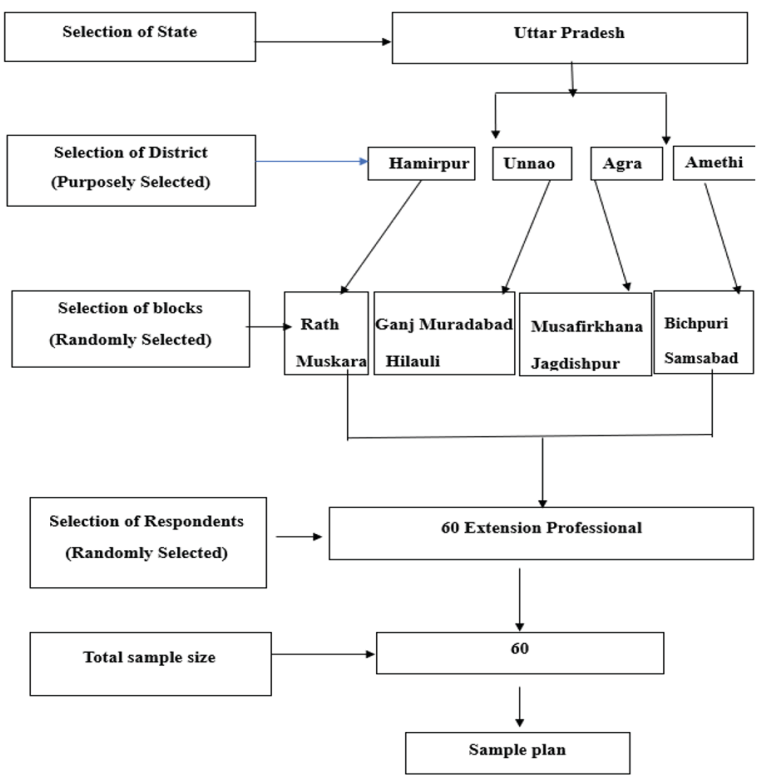
The gender gap in extension services is notable in India, where only 5.2 percent of the women farmers receive such support compared to 5.7 percent of men, underscoring broader inequalities in resource distribution (Bhuyan & Ponnusamy, 2017). Addressing this gap is crucial for enabling women farmers to reach their productivity potential and contribute meaningfully to agricultural growth (Nosheen et al., 2010). Uttar Pradesh mirrors these broader challenges. Programs like Mahila Kisan Sashaktikaran Pariyojana aim to empower women farmers by improving their access to resources and training; however, implementation at the grassroots level remains a challenge, especially in reaching the marginalised women (Buchy & Basaznew, 2005).

This study on gender mainstreaming in agricultural extension in Uttar Pradesh highlights the need for gender-sensitive policies that enable women to access resources equitably, unlocking their potential to improve food security, livelihoods, and rural resilience.

Methodology

The study employed a descriptive research design across four purposively selected districts of Uttar Pradesh, India—Hamirpur, Unnao, Amethi, and Agra—selected based on accessibility, ease of communication, and availability of transport infrastructure. The research was conducted through Krishi Vigyan Kendras (KVKs) and the Department of Agriculture at the block level in the selected districts. From each district, two blocks were randomly selected: Rath and Muskara (Hamirpur), Ganj Muradabad and Hilauli (Unnao), Musafirkhana and Jagdishpur (Amethi), and Bichpuri and Samsabad (Agra). Extension personnel associated with the KVKs of Hamirpur, Unnao, Amethi, and Agra, along with officials from the Agriculture Department operating at the block level, constituted the study population. The final sample comprised 60 extension personnel, selected using random sampling techniques. Data were collected using structured and pre-tested schedules, following standard measurement procedures. The collected data were analysed using appropriate statistical tools such as percentage, mean, and standard deviation.

Sample Plan



Gender

As presented in Table 1, the gender distribution among the extension personnel shows a considerable male majority, with 78.33 percent male and only 21.67 percent female participants. This disparity in gender representation reflects the gender imbalance often observed within agricultural extension services, where men predominantly occupy these roles. The low representation of female personnel suggests a need to prioritise gender balance in extension staffing, as female extension officers can play a critical role in connecting with and empowering female farmers, fostering inclusive information dissemination and adoption of agricultural practices.

Table 1. Gender of the Respondents

Sl. No.	Gender	Frequency (f)	Percentage (%)
1	Male	47	78.33
2	Female	13	21.67
3	Other	0	0

Age

Table 2. categorises the age distribution of the extension personnel into three age groups: young (upto 38), middle (39–52), and old (53 & above). The data revealed that the middle age group (39–52 years) comprised the majority (65.0%) of the extension personnel, followed by the young age group (18.33%) and the old age group (16.67%). This predominance of the personnel in the middle age group indicates that majority of them are in the middle of their career, with accumulated experience and expertise beneficial for practical extension work. However, relatively less percentage of the younger extension personnel may suggest challenges in attracting fresh, younger professionals into the field job. A small percentage of old extension personnel could imply either retirement transitions or limited career longevity in this sector.

Table 2: Age level of the Respondents:

Sl. No.	Age Group	Frequency (f)	Percentage (%)
1	Young (up to 38)	11	18.33
2	Middle (39-52)	39	65.00
3	Old (53 & above)	10	16.67

Education Level

Table 3 illustrates the educational qualifications of the extension personnel, revealing that the majority of them hold a Bachelor's degree (38.33%), followed

by a Master's (31.67%), and an almost equal percentage of a Doctoral degree (30.00%). The high educational attainment among the extension personnel highlights well-qualified field functionaries capable of providing informed and advanced agricultural support. The distribution of educational level of the respondents underscores the expertise accessible to farmers through them, fostering an environment where evidence-based practices and innovative agricultural techniques can be effectively communicated and implemented.

The presence of the extension personnel with postgraduate qualifications could also indicate enhanced research capabilities within the extension services, potentially contributing to localised problem-solving, accelerating technology adoption, and promotion of sustainable agricultural practices.

Table 3: Educational level of the respondents

Sl. No.	Education Level	Frequency (f)	Percentage (%)
1	Graduation	23	38.33
2	Post-Graduation	19	31.67
3	Doctoral	18	30.00

Job Roles in Agricultural Extension Services

As shown in Table 4, the job roles of the extension personnel vary significantly, with the largest group comprising of Assistant Technology Managers (ATMs) at 41.67 percent, followed by Subject Matter Specialists (SMS) at 36.67 percent. Directors or Deputy Directors accounted for a small percentage (5.0 %), reflecting a structure where the majority of the extension personnel are engaged in direct technical support or field operations rather than administrative roles. This distribution aligns with the need for a more field-oriented workforce to address farmers' immediate and technical needs.

Table 4: Job Roles in Agricultural Extension Services of respondents:

Sl. No.	Designation	Frequency (f)	Percentage (%)
1	Directors/Deputy Directors	3	5.0
2	Subject Matter Specialists	22	36.67
3	ATMs	25	41.67
4	BTMs	5	8.33
5	Others	5	8.33

Years of Experience in Agricultural Extension Services

Table 5 categorises the extension personnel based on their years of experience in job. The data revealed that 35.0 percent of the respondents had over 15 years

of experience, followed by 30.0 percent with 1-5 years, 21.67 percent with 10-15 years, and 13.33 percent with 5-10 years of experience. Notably, there was none with less than 1 year of experience. The distribution suggests a relatively experienced workforce, with a significant percentage of them well-versed in field challenges and able to provide seasoned insights to the farmers.

Table 5: Years of Experience in Agricultural Extension Services of Respondents

Sl. No.	Experience Range	Frequency (f)	Percentage (%)
2	1-5 years	18	30.0
3	5-10 years	8	13.33
4	10-15 years	13	21.67
5	More than 15 years	21	35.0

Participation of both male and female farmers in extension activities

Almost 70.0 percent of the respondents affirmed efforts to ensure participation of male and female farmers in extension activities, while 30.0 percent reported no such efforts (Table 6). This positive response rate suggests a growing recognition of the importance of inclusivity in agricultural extension services. Efforts to enhance female farmer participation is crucial, given the gender gap, often observed in rural agricultural settings.

Majority of the extension personnel are working hard to ensure that both male and female farmers participate in extension activities. They implement various strategies for gender inclusivity in agriculture such as, inclusion of at least 33.0 percent of the female participants; working with women's groups and local leaders to encourage female farmers to attend; organizing events at a time that aligns with their household responsibilities and organizing separate training sessions to make women farmers feel more comfortable. Additionally, they provide extra training to help women build their skills and confidence. By involving both male and female staff, they create a welcoming atmosphere for all the participants, and the training materials are designed that is relevant and valuable for both men and women farmers.

The study also explored the issues faced by 30.0 percent of the extension personnel towards adopting gender inclusive approach in extension activities. Some of the major problems include insufficient funding or staff to support programs aimed at women. Cultural beliefs also make it challenging to encourage women to participate in farming activities. Some people think that men and women already have equal access to programs, so they do not see the need for special efforts to include women. Additionally, gender-focused programs often get overlooked in areas with fewer women farmers. Resistance from staff and

community members can also prevent changes that would help include women. Lastly, practical issues like transportation, timing of events, and locations make it hard for women, especially those with household responsibilities, to attend. These challenges show that a more targeted efforts and resources are needed to better gender inclusion in agricultural extension services.

Table 6: Participation of both male and female farmers in extension activities

Sl. No.	Participation of both male and female farmers in extension activities	Frequency (f)	Percentage (%)
1	Extent of participation in extension activities	42	70.0
2	Extent of non-participation in extension activities	18	30.0

Collection of Sex disaggregated data.

Table 7, indicates a strong commitment among agricultural extension personnel to collect sex-disaggregated data, with 81.67 percent of the respondents stating that they always collect sex disaggregated data, while 18.33 percent reported doing it sometimes. Notably, none of the respondents indicated that they do not collect sex-disaggregated data. This demonstrates an understanding of the importance of gender-specific information in addressing male and female farmers' unique needs, which is essential for effective agricultural extension services.

Table 7: Collection of Sex disaggregated data

Sl. No.	Collection of Sex disaggregated data	Frequency (f)	Percentage (%)
1	Sex disaggregated data is always collected	49	81.67
2	Sex disaggregated data is sometimes collected	11	18.33

(a). If always:

No.	Statement
1	It is part of our routine work and is required in our regular reports.
2	Data is essential for studying how men and women use new farming technologies.
3	It helps us better advise both male and female farmers, meeting their specific needs.

4	Our forms have already been set up to collect information on men and women separately.
5	This data is needed to prepare reports and get funds for gender-specific programs.
6	It helps us see how many women farmers participate in government schemes and programs.
7	By having this data, we can create better policies that include both male and female farmers.

Respondents who consistently collected sex-disaggregated data mentioned the above listed points in Table a. The data in Table 7 is integral to their routine work and is required for regular reporting. It plays a crucial role in analysing how both men and women utilise new farming technologies, enabling extension personnel to offer tailored advice that meets the specific needs of male and female farmers. Furthermore, their data collection forms are designed to capture information separately for men and women, which is essential for preparing reports and securing fund for gender-specific programs. The data also allows for tracking women's participation in government schemes, ultimately facilitating in development of more inclusive policies that benefit all farmers.

(b) If sometimes:

No.	Statement
1	We collect it for specific projects focusing on gender, but it is unnecessary for all activities.
2	In quick surveys or initial studies, we do not always have time to split the data by gender.
3	Collecting gender-specific data from everyone at times is challenging.
4	Collecting detailed data during busy farming seasons is challenging because of heavy workloads.
5	Some old data collection methods do not ask for gender-specific information.
6	When we have extensive programs or fairs, time is limited for collecting detailed gender data.

Among those who sometimes collect sex-disaggregated data, several challenges were expressed by them that affects regular data collection practices. Many indicated that sex-disaggregated data is gathered only for specific gender-focused projects rather than across all activities. Time constraint often limits their ability to segregate data by gender, particularly during quick surveys or initial studies. Additionally, collecting gender-specific information during

important/major events can be challenging, e.g. during peak farming seasons when workload is heavy. Some respondents mentioned that conventional data collection methods do not include gender-specific inquiries, and there is often insufficient time to collect detailed gender data during extensive programs or fairs.

Extent of Female field officers in the organisations

Table 8. reveals that majority (93.33%) of the organizations had upto 20.0 percent female field level officers recruited in their organisations, while only 6.67 percent reported representation between 20.1-40.0 percent. Notably, none of the surveyed organizations reported more than 40.0 percent female field-level officers. This is a clear evidence that highlights a substantial gender disparity in the workforce at the field level, suggesting increased effort to recruit and retain more female extension officers, to promote gender equality in agricultural practices.

Total 8: Extent of Female field officers in the organisations

Sl. No.	Extent of Female field officers in the organisations	Frequency (f)	Percentage (%)
1	0-20.00	56	93.33
2	21.00-40.0	4	6.67

Activities being carried out for gender mainstreaming.

The activities aimed at gender mainstreaming reflect a comprehensive approach to empower women in agriculture. Key initiatives include sensitizing male staff on gender issues, promoting women's Self-Help Groups (SHGs), and offering specialised workshops to enhance women's skills in farm mechanization and managing finances. Other significant activities carried out included mobile advisory services for women farmers, visits to successful farms, and conducting training on various agricultural practices. The organisation aims to enhance women's participation and representation in farming by implementing these activities, thereby fostering gender equity within agricultural sector.

Table 9: Activities being carried out for gender mainstreaming.

Sl. No.	**Activities**
1	Training for staff on gender sensitization.
2	Establishing and promoting women's groups viz. SHGs, for joint farming activities.
3	Workshops to train Women.

4	Mobile advisory services, specifically for women farmers.
5	Working with Anganwadi workers to reach out to women in rural areas.
6	Exposure visit for women farmers to learn new techniques.
7	Specialized training for women.
8	Connecting women farmers with local markets to sell their produce.
9	Arranging child care facilities during training, to facilitate mothers to attend.
10	Establishment of demonstration plots, managed by women farmers, to encourage learning by doing.
11	Formation of women-led farmer-producer organizations (FPOs).
12	Facilitate access to farm loans and subsidies for women farmers.
13	Collaboration with local NGOs to provide technical support to women's farmers.
14	Encouraging women farmers to participate in government agriculture schemes.
15	Educating women about legal rights and entitlements in farming.

Top 5 Activities carried out are:

Sl. No.	Activities	Rank
1	Training for staff on gender sensitization	I
2	Working with Anganwadi workers to reach out to women in rural areas	II
3	Establishing and Promoting women's Self-Help Groups (SHGs) for joint farming activities	III
4	Mobile advisory services, specifically for women farmers	IV
5	Workshops to train women on farm mechanization	V

Measurement of the indicators of gender mainstreaming initiatives at farmer's level.

Table 10. describes the indicators of gender mainstreaming initiatives at the farmer's level. It highlights several initiatives undertaken by field level functionaries to understand the level of gender sensitization created among the farming community and indicators to measure them. Almost 50.0 percent of the respondents indicated that monitoring the participation rate is one of the key indicators, while 46.67 percent conducts regular survey of farmers to assess the outcomes. Tracking the adoption of recommended practices was reported

by 43.33 percent, and observing change in decision-making roles was also reported by 46.67 percent of the respondents. Additionally, 41.67 percent of the respondents assess change in income level as an indicator, to measure gender sensitization created among the farming community. However, 8.33 percent of them stated that they do not measure effectiveness to assess gender sensitization created.

Table 10: Measurement of the indicators of gender mainstreaming initiatives at farmer's level.

Sl. No.	Category	Frequency (f)	Percentage (%)
1	Regular Survey of Farmers	28	46.67
2	Monitoring Participation Rates	30	50.00
3	Tracking Adoption of Recommended Practices	26	43.33
4	Assessing Changes in Income Levels	25	41.67
5	Evaluating Changes in Decision Making Roles	28	46.67
6	Do not Currently Measure the Effectiveness	5	8.33

(* Multiple Response)

Conclusion

The study clearly establishes that while gender mainstreaming has gained recognition within agricultural extension services in Uttar Pradesh, its implementation remains uneven and constrained by structural and institutional gaps. Despite a reasonably experienced and well-qualified extension workforce, women remain significantly under-represented, particularly at the field level, which directly affects outreach to women farmers. Encouragingly, a majority of extension personnel have adopted gender-inclusive practices and regularly collect sex-disaggregated data, reflecting growing institutional awareness. However, persistent barriers—such as limited funding, sociocultural norms, logistical constraints, and weak monitoring mechanisms—continue to restrict the depth and sustainability of gender mainstreaming efforts. These findings underline that gender inclusion in agricultural extension is no longer a question of intent, but of systematic execution and policy prioritisation.

To strengthen gender mainstreaming in agricultural extension services, a multi-pronged policy approach is required. First, state-level recruitment

policies must prioritise increasing the proportion of female extension officers, particularly at the field level, supported by incentives, safe work conditions, and clear career progression pathways. Second, gender mainstreaming should be institutionalised through mandatory gender-sensitisation training and integration of gender indicators into performance appraisal systems of extension personnel. Third, robust monitoring and evaluation frameworks should be adopted, making sex-disaggregated data collection and outcome-based gender indicators compulsory across all extension programmes. Fourth, dedicated budgetary allocations for gender-focused extension activities must be ensured to address funding constraints and scale up proven interventions such as SHGs, mobile advisories, and women-led demonstrations. Finally, stronger convergence with allied institutions—Anganwadi networks, local NGOs, FPOs, and digital platforms—should be promoted to enhance outreach, market access, and decision-making power of women farmers. Collectively, these measures can transform gender mainstreaming from a supportive initiative into a core pillar of inclusive and sustainable agricultural development in Uttar Pradesh.

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