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Innovative Approaches in Paddy Cultivation: An Analytical Study of Adoption Trends

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ABSTRACT

Adoption of farm innovations in food crops is necessary to modernize agricultural practices, improve efficiency and increase yields to meet the growing global food demand. This study analysed the adoption trends of innovations in paddy cultivation. Key innovations were identified including the adoption of advanced agricultural machinery starting from seed preparation to harvesting and storage, improved irrigation systems and utilization of hybrid rice varieties by interviewing the paddy farmers of Assam, India. Percentage analysis and paired t-test were used to assess the impact of innovations on rice crop productivity. The results of the study indicate a positive and progressive trend in the adoption of innovations in paddy cultivation. The widespread acceptance of improved machineries and a diverse array of hybrid rice varieties showcases a collective effort among farmers to enhance productivity, optimize resource utilization, and embrace sustainable agricultural practices. To maximize the benefits of these innovations, farmers must receive adequate training.

Keywords: *Adoption; Hybrid Rice varieties; Farmers; Technologies; Innovation; Productivity; Paddy Cultivation; Assam*

INTRODUCTION

Paddy cultivation, also known as rice cultivation, holds immense significance in India's agricultural landscape, contributing significantly to the country's food security and rural livelihoods (Source: Ministry of Agriculture and Farmers Welfare, 2022). Assam, a state in north-eastern India, is renowned for its paddy cultivation. Rice, being a staple food in India, holds immense cultural and economic importance in Assam. The state's favourable climate, abundant water resources, and fertile plains make it an ideal region for rice cultivation. With its fertile plains and abundant water resources, Assam stands as a prominent state in India, contributing substantially to rice production. The state's unique agroecological conditions have fostered the growth of aromatic and high-yielding rice varieties, contributing to its reputation as a region of rice diversity.

Innovation in paddy cultivation has played a pivotal role in revolutionizing India's agricultural landscape. As the world's second-largest producer of rice, India has recognized the importance of technological advancements and modern practices in ensuring food security and

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sustainable agricultural growth. The rice farming sector has witnessed significant changes recently, largely due to technological innovations (Gopal, 2019; Kumar et al., 2023). Over the years, various innovative approaches have been adopted to enhance productivity, conserve resources, and improve the livelihoods of millions of farmers who are dependent on rice farming. India's rapid population growth and the need to increase rice production to meet domestic food demands and export goals require innovation in rice farming (Mishra et al., 2022; Singh et al., 2022).

Adoption of innovation by farmers is important for quicker development in agriculture. Innovation in farming helps the farmers expand their production, which can directly or indirectly affect them. Agriculture therefore , needs technology infusion to increase production.

This study aims to investigate and analyze the adoption and impact of innovations on paddy cultivation in the region (Dhemaji District, Assam). Similar studies conducted in Assam had omitted investigating hybrid rice varieties and had concentrated primarily on the knowledge and constraints faced by rice farmers. The significance of this study lies in addressing the challenges posed by a growing population and evolving agricultural demands. By examining the adoption of innovations in paddy cultivation, the study seeks to provide insights into how modern agricultural practices can enhance productivity, sustainability and economic outcomes for farmers in the study area. Additionally, the findings may offer practical recommendations for policymakers, farmers, and stakeholders to promote innovation-driven approaches, ensuring the resilience and adaptability of local agriculture in the face of demographic and agricultural changes.

The objectives of the study are to

1. Study the socio-economic background of rice farmers.
2. Identify the innovations adopted by the farmers.
3. Assess the impact of adoption of innovations on paddy productivity.

METHODOLOGY

The study was conducted in Dhemaji district, Assam, India, where rice farming is the major occupation among a mix of small and medium farmers. Two hundred farmers from two villages, namely Dusutimukh Mishing(100) and Uriamguri (100) villages of Dhemaji Development Block and Bordoloni Development Block of Dhemaji District, were chosen randomly. The primary focus of the present study is to explore the implementation of farm innovations in agriculture, particularly in rice farming. Percentage analysis has been used to study the socio-economic profile and innovation adopted by the farmers, and a paired t-test was used to see the impact of innovation on rice crop productivity.

FINDINGS AND DISCUSSION

Socio-economic Background of the Rice Farmers

A majority of the farmers, were between the ages of 31 and 40 years. This concentration of farmers within a specific age group could have implications for factors such as the adoption of modern farming practices, succession planning in agriculture, and the overall resilience and adaptability of the farming community to emerging challenges. A majority of the selected farmers belonged to the Scheduled Caste category (100%), were married, had joint families with 4-6 persons, had studied up to higher secondary level and had an annual income between 200001 and 400000 INR. The substantial representation of joint families may

foster collective decision-making and resource-sharing, positively influencing the adoption of efficient and sustainable paddy cultivation methods. While their income level may allow for some investment in agricultural innovations, it also suggests a need for cost-effective solutions to ensure widespread adoption among farmers in this income bracket.

Profile of the Respondents Related to Agriculture

Analysing the agricultural details of the farmers, it is clear that the majority (94%) of the farmers' primary source of employment was agriculture . The fact that majority of the farmers identify agriculture as their primary source of employment indicates a strong dependence on farming activities. This suggests that these farmers are more likely to invest in innovative practices in paddy cultivation as it directly influences their livelihoods. With 78% of land-owners, there exists a considerable degree of autonomy and control over farming decisions. Land ownership is often associated with a higher willingness to invest in and experiment with new technologies, positively impacting the adoption of paddy cultivation innovations. A majority of the farmers were found to have land holdings ranging from 2 to 5 hectares (medium farmers). Medium-sized farmers may have the financial capacity and resources to adopt innovative technologies at a more substantial scale compared to smaller landholders, potentially influencing the widespread adoption of paddy cultivation innovations.

Innovations Adopted in Paddy Cultivation

Innovations adopted in Paddy Cultivation by the farmers were analyzed and presented in Table 1.

Table 1. Innovations Adopted in Paddy Cultivation

N=200

Sl. No.	Innovation	Yes		No	
		F	P	F	P
Machinery					
1	*Seed Preparation:* Rice wheat seeder	20	10	180	90
2	*Transplanting :* Mechanized direct dry DSR (Direct Seeding of Rice)	79	39.5	121	60.5
	'Walking' paddy rice transplanter	80	40	120	60
	Engine-operated rice transplanter	125	62.5	75	37.5
3	*Weed Management:* Power Operated Weeder	182	91	18	9
	Cono Weeder	98	49	102	51
	Rotary Weeder	192	96	8	4
4	*Water Management:* Alternative wetting and drying	65	32.5	135	67.5

Sl. No.	Innovation	Yes		No	
		F	P	F	P
5	*Pest Management:* Multi-Nozzle boom sprayer	172	86	28	14
	Battery-operated sprayer cum spreader	187	93.5	13	6.5
	Power tiller-operated sprayer	71	35.5	129	64.5
6	*Harvesting and Threshing:* Reaper	19	9.5	181	90.5
	Mini Combine Harvester	135	67.5	65	32.5
	Axial flow thresher	112	56	88	44
	Open Drum thresher	68	34	132	66.5
7	*Drying and Storage:* Solar bubble dryer	65	32.5	135	67.5
	Recirculating batch dryer	102	51	98	49
	Super bag	162	81	238	119
	Rice Ring bin	167	83.5	33	16.5
Hybrid Rice varieties					
8	Swarna-Sub1	196	98	4	2
9	Ranjit-Sub1	110	55	90	45
10	RNR 15048	78	39	122	61
11	Jayamati	182	91	18	9
12	Dinanath	132	66	68	34
13	Swarnabh	165	82.5	35	17.5
14	Kanaklata	68	34	132	66
15	Bahadur Sub-1	181	90.5	19	9.5

F= Frequency; P = Percentage (%)

Machinery

A majority (62.5%) of the farmers had used Engine-Operated Rice Transplanter, indicating a shift towards efficient planting methods. This technology likely contributes to increased productivity and labour efficiency compared to traditional manual transplanting. About 91 per cent had used power-operated weeder tool for weed management and 96 % had used rotary weeders, suggesting a widespread recognition among farmers of the importance of efficient weed management. A majority ninety-three point five per cent (93.5%) used Battery-Operated Sprayer cum Spreader. This method is

likely preferred for its precision and efficiency in applying pesticides to the crops. Additionally, the preference for super bag storage (81%) and rice ring bins (83.5%) highlights the significance of efficient and organized storage methods in preserving the quality of harvested rice. A study conducted by Saikia and Barman in 2013 had highlighted the poor adoption rate of paddy cultivation technologies among farmers. but from the current study, we have seen a positive shift towards adopting innovations in paddy cultivation. This evolution could be attributed to a combination of targeted educational initiatives, improved accessibility to resources and the tangible benefits demonstrated by the successful integration of modern technologies into paddy cultivation practices.

Hybrid Rice varieties

A majority of the respondents (98%) had adopted Swarna-Sub1 variety,followed by Bahadur Sub-1 (90.5%). The data underscores the varied choices of rice varieties among farmers, suggesting that different varieties cater to the distinct requirements and preferences of the local farming community. A study conducted by Singh and Barman in 2011 similarly reported that a significant proportion of farmers favoured hybrid rice varieties.

Impact of Innovations adopted by the Respondents

The impact of innovations adopted by the paddy farmers was ascertained and given in Table 2.

Table 2. Impact of Innovations

N=200

Sl. No.	Impact	Before		After	
		F	P	F	P
1	Faster cultivation	150	75	188	94.0
2	Increase in income	97	48.5	174	87.0
3	Minimization of human effort	110	55.0	181	90.5
4	Lesser production costs	79	39.5	163	81.5
5	Increased production	38	19.0	162	81.0
6	Enhanced Food Security	120	60.0	198	99.0
7	Capacity building through sharing of knowledge	111	55.5	179	89.5
8	Access to market	75	37.5	125	62.5
9	Improvement in Farm Efficiency	79	39.5	156	78.0
10	Increase in volume of Farm Produce	89	44.5	187	93.5
11	Value addition to the crop	81	40.5	119	59.5

**Multiple Responses ; F= Frequency; P = Percentage (%)*

About 93 % of the farmers had claimed that adopting innovations has improved their production while 87 per cent of farmers had reported that the innovations had enabled them to increase income. These comprehensive findings strongly support the notion that farming innovations have propelled a significant improvement in productivity, efficiency, and economic outcomes for farmers. These advancements not only benefit individual farmers but also contribute to the broader goals of sustainable and resilient agriculture. The results underscore the importance of ongoing investment in agricultural innovation to address the evolving challenges in the agricultural sector.

Association between Rice production Before and After Adopting Innovations

The data on association between the rice crop production before and after using innovations are given in Table 3.

Table 3. Association between Rice production Before and After Adopting Innovations

		Mean	SD	SE	t-value	Sig
Faster cultivation	Before	1.26	0.41	0.04	13.212	.000**
	After	2.18	0.67	0.05		
Increase in Income	Before	1.66	0.74	0.06	9.798	.000**
	After	2.16	0.69	0.06		
Minimization of human efforts	Before	1.99	0.58	0.05	8.121	.004**
	After	2.01	0.62	0.6		
Lesser production costs	Before	1.66	0.47	0.04	11.485	.000**
	After	2.12	0.78	.06		
Increased production	Before	1.18	0.39	0.03	12.356	.000**
	After	1.72	0.45	0.04		
Enhanced Food Security	Before	1.59	0.49	0.04	11.875	.000**
	After	2.03	.54	.07		
Capacity building through sharing of knowledge	Before	1.43	0.60	0.05	11.562	.000**
	After	2.38	0.68	0.06		
Access to market	Before	1.61	0.65	0.06	9.874	.000**
	After	2.37	0.69	0.06		
Improvement in Farm Efficiency	Before	1.72	0.66	0.06	9.121	.002**
	After	2.47	0.65	0.06		

		Mean	SD	SE	t-value	Sig
Increase in the volume of Farm products	Before	1.71	0.71	0.06	8.321	.004**
	After	2.33	0.71	0.06		
Value addition to the crop	Before	1.23	0.65	0.6	12.021	.000**
	After	2.45	0.78	0.6		

The results of the t test showed that there is a significant correlation between the introduction of innovation in agriculture and an increase in the yield of rice crops both before and after the innovation was implemented. Rice crop farmers are able to enhance their profits with the use of innovation, and they have been successful in accomplishing their goal of maximising their profits while minimising their costs. Notably, faster cultivation demonstrated a significant improvement, with a mean increase from 1.26 to 2.18 (t-value = 13.212, $p < 0.001$). The increase in income also exhibited a substantial rise, with a mean shift from 1.66 to 2.16 (t-value = 9.798, $p < 0.001$). Minimization of human effort, reduced production costs, improved production, enhanced food security, and capacity building through knowledge sharing all displayed statistically significant improvements after the implementation of specific measures. These findings suggest that the adopted agricultural interventions have led to multifaceted benefits, contributing to faster, more efficient, and economically viable agricultural practices, ultimately enhancing farmers' livelihoods and overall agricultural sustainability.

CONCLUSION

Understanding the adoption and impact of innovation on rice crop productivity is crucial for ensuring food security and reducing poverty in Assam. The research reveals that socio-economic factors and technological advancements strongly influence farmers of Assam to adopt innovative practices, leading to increased productivity. Statistical analysis shows a significant correlation between innovation introduction and enhanced rice yield, demonstrating its effectiveness before and after implementation. By embracing innovation, rice farmers have maximized profits while minimizing costs, highlighting the potential for economic advancement. Effective adoption of innovation requires training and knowledge among farmers, with government and non-governmental organizations playing a crucial role in implementing awareness programmes. This study underscores the importance of innovation in sustainable rice farming for food security and emphasizes its positive economic impact. The insights gained can inform policymakers and stakeholders, contributing to the community's overall economic development and well-being.

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