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Evaluation Of Mobile Applications For Rice Crop Management: An Empirical Study On Farmers' Adoption And Satisfaction

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ABSTRACT
In countries with extensive agricultural landscapes, extension workers traditionally deliver agricultural services. This study examines the adoption and satisfaction levels of smartphone applications for rice crop management among farmers in Imphal West district, Manipur. Focusing on three villages within the Wangoi block Wangoi, Leiphrakpam, and Phoubakchao a random sampling method was employed to select 150 farmers who actively use mobile phones for agricultural purposes. The study investigates independent variables such as mobile application usage, farm size, and farming experience, while dependent variables include rice crop productivity, resource optimization, farm management efficiency, and farmers' adoption and satisfaction with mobile applications. Data were collected from both primary and secondary sources and analyzed using Microsoft Excel and SPSS. Statistical tools such as ANOVA, regression analysis, mean, and standard deviation were applied for comprehensive data evaluation. The findings provide critical insights into the factors affecting the adoption and effective use of mobile applications for rice farming. This study offers practical recommendations for policymakers, agricultural extension services, and technology developers to enhance agricultural practices and improve farmer livelihoods through digital innovations in rice crop management.
Keywords: *Rice Crop Management, Mobile Applications, Farmer Adoption, User Satisfaction, Agricultural Technology, Imphal West, Manipur, Resource Optimization, Farm Management Efficiency, Agricultural Extension Services, Digital Agriculture, ANOVA, Regression Analysis.*

INTRODUCTION

Agriculture remains a cornerstone of economic development and food security globally, particularly in countries with extensive agricultural landscapes. Traditional agricultural extension services have historically played a vital role in disseminating information and best practices to farmers. However, these services often face limitations such as inadequate reach, resource constraints, and delayed communication, which hinder their effectiveness (Swanson & Rajalahti, 2010). The rapid advancement of mobile technology offers a transformative alternative by providing farmers with real-time information, resource optimization tools, and decision-support systems (Mittal & Mehar, 2016; Aker, 2011). Mobile applications, in particular, have emerged as innovative tools in agricultural management, offering significant potential to enhance productivity and sustainability.

Rice, a staple food for over half of the global population, is especially significant in Asian countries like India, where it is integral to both economic and food security (Fageria, 2014). Rice farming is resource-intensive and susceptible to environmental factors, pest infestations, and inefficient management practices. Timely access to agricultural information is crucial for managing these challenges effectively. Mobile applications provide farmers with essential services, including weather updates, pest and disease management, market price information, and best agricultural practices (Patil et al., 2021; Tripathi et al., 2020). These digital tools can significantly improve farm productivity, reduce input costs, and enhance overall farm management efficiency (Ferris et al., 2014; Baumüller, 2018).

In India, the adoption of mobile agricultural applications has been promoted through government initiatives and private sector innovations. Applications such as Kisan Suvidha, mKisan, and IFFCO Kisan have been designed to deliver timely agricultural information to farmers (Kumar et al., 2020; Saravanan et al., 2015). Despite these efforts, adoption rates among farmers remain inconsistent due to challenges such as limited digital literacy, inadequate infrastructure, socio-economic disparities, and language barriers (Kshetri, 2019; Ali & Kumar, 2011). Furthermore, agricultural practices vary widely across regions, necessitating localized solutions tailored to specific crops and farming contexts (Deichmann et al., 2016).

The northeastern state of Manipur in India, with its predominantly agrarian economy, provides a relevant context for examining mobile application adoption in agriculture. Smallholder farmers in the Imphal West district primarily cultivate rice and face numerous challenges related to pest management, resource optimization, and market access (Singh & Devi, 2017; Devi & Singh, 2018). Traditional extension services in the region are constrained by geographical and infrastructural limitations, making it difficult for farmers to access timely and relevant agricultural information (Duguma et al., 2019). Mobile applications could bridge this gap by offering tailored information and decision-support tools directly to farmers.

This study focuses on the adoption and satisfaction of mobile applications among rice farmers in the villages of Wangoi, Leiphrakpam, and Phoubakchao within the Wangoi block of Imphal West district. Using a random sampling method, 150 farmers who use mobile phones for agricultural purposes were selected for this research. The study examines independent variables such as mobile application usage, farm size, and farming experience, while dependent variables include productivity, resource optimization, and farm management efficiency. Data analysis was conducted using Microsoft Excel and SPSS, with statistical tools such as ANOVA, regression analysis, mean, and standard deviation applied to evaluate the data comprehensively (Field, 2013; Hair et al., 2010).

The primary objective of this study is to identify factors influencing the adoption and satisfaction of mobile applications for rice crop management. Understanding these factors is essential for developing user-centric digital tools that cater to the specific needs of rice farmers in Manipur. The findings of this study offer valuable insights for policymakers, agricultural extension services, and technology developers. By addressing barriers to adoption and enhancing the functionality of mobile applications, stakeholders can contribute to improving agricultural productivity, resource efficiency, and farmer livelihoods in the region (Goyal & Kumar, 2020; Jain et al., 2021).

This research aligns with broader initiatives to leverage digital technologies for sustainable agricultural development. The United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 9 (Industry, Innovation, and Infrastructure), highlight the importance of technological innovation in transforming agriculture and ensuring food security (United Nations, 2015; FAO, 2018). By exploring how mobile applications can support rice farmers in Manipur, this study contributes to ongoing efforts to integrate digital solutions into agricultural practices, promoting economic growth and rural development (Qiang et al., 2012; Nakasone et al., 2014).

In conclusion, the integration of mobile technology into agriculture presents significant opportunities for enhancing rice crop management. However, the success of these digital tools depends on various socio-economic and contextual factors that influence their adoption and use. This study aims to bridge the existing knowledge gap by providing empirical evidence on the adoption and satisfaction of mobile applications among rice farmers in Imphal West, Manipur. The insights derived from this research will inform the development of more effective, user-friendly agricultural applications and guide policy interventions aimed at fostering sustainable agricultural practices (Ferris et al., 2014; Baumüller, 2018). This study aims to improve rice crop management methods by successfully utilizing mobile technologies, with the ultimate goal of encouraging sustainable agricultural growth in the region. Hence, the present study was undertaken to

(a) Investigate the impact of mobile application usage on rice crop management (productivity, resource optimization, and farm management efficiency).

(b) Analyse the role of demographic variables (farm size and experience) in influencing farmers' adoption and satisfaction with mobile applications for rice crop management.

(c) Explore the challenges and barriers faced by farmers in adopting and effectively utilizing mobile applications for rice crop management.

METHODOLOGY

The impact of mobile phone usage on farming activities in the western district of Imphal West, Manipur, is the subject of this study, which employs a quantitative methodology and a random sample technique. Specifically, the study concentrates on three communities inside the Wangoi block. Wangoi, Leiphrakpam, and Phoubakchao are the names of these villages. This research study focusses on a particular subset of the population: farmers who use mobile phones for various farming operations. There were 150 farmers in all who took part in the study, and they were split up fairly and equally across the three communities. Numerous independent variables are considered in the study, such as the use of

mobile applications and demographic information about the size and expertise level of the farm. The dependent variables, which include a variety of aspects of managing rice crops, such as productivity, resource optimisation, and farm management effectiveness, as well as farmers' adoption of mobile applications and their degree of satisfaction with these applications, are examined in relation to the components. The data is gathered through the utilization of both primary and secondary sources, and software applications such as Microsoft Excel and SPSS are utilized for the purpose of organizing and analysing the data. For the purpose of conducting a comprehensive analysis and interpretation of the data that has been acquired, a variety of statistical methods, such as the mean, standard deviation, regressions, and analysis of variance, are applied. The purpose of this all-encompassing method is to provide substantial insights on the influence that mobile technology has had on agricultural practices and the improvement of the lives of farmers in the region.

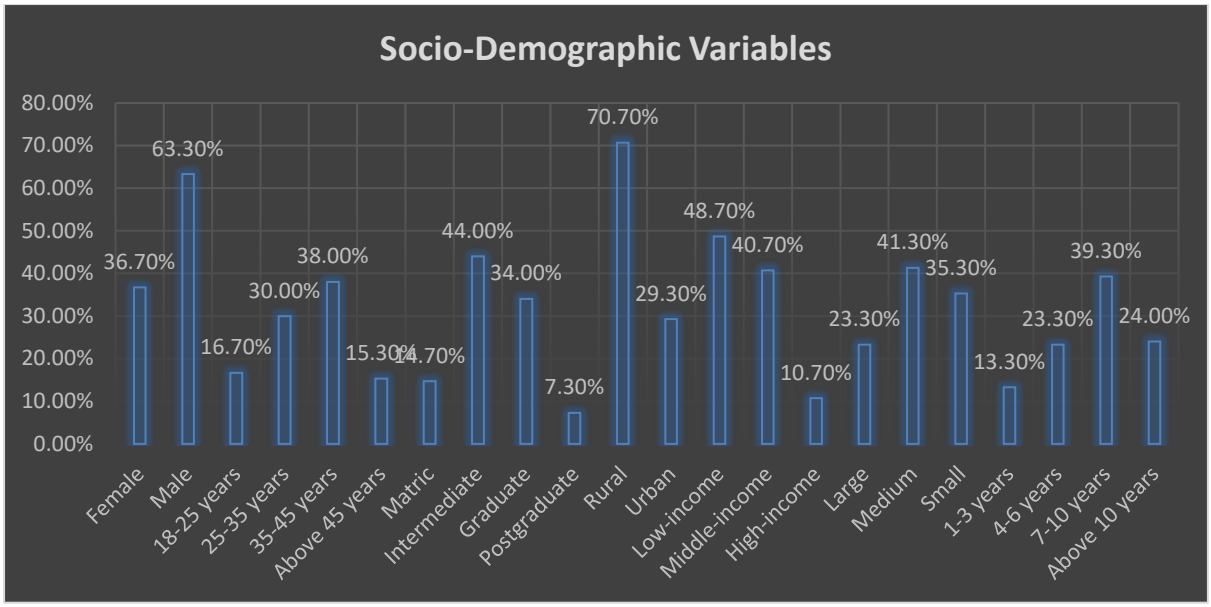
RESULTS

Table 1 outlines the respondents' demographic attributes based on the following factors: gender, age group, income, location, education, size of farm, and experience. Based on Table 1, it is clear that of the 150 respondents, 63.3 percent are men and 37 percent are women. According to Samarpitha et al. (2016), the majority of farmers in the study region were middle-aged, active, and involved in paddy cultivation, as evidenced by the sampled farmers' average age of 46.04 years. The age group of 35–45 years old accounted for the largest percentage of respondents the majority, or 38.00 percent. The majority of respondents, or 66%, had intermediate-level education as their highest level of schooling. Of the 73 respondents, 48.70 percent reported having a poor overall income. When respondents are grouped by farm size in Table 1, it becomes clear that 41.30 percent of them owned medium-sized farms in the chosen area. When it came to the years of experience that respondents had in paddy cultivation, it was found that the majority of them—59 percent—had seven to ten years of experience.

Table 1: Demographic characteristics of the respondents (n=150)

Demographic characteristics	Category	Frequency	Percentage
Gender	Female	55	36.70%
	Male	95	63.30%
Age	18-25 years	25	16.70%
	25-35 years	45	30.00%
	35-45 years	57	38.00%
	Above 45 years	23	15.30%
Education	Matric	22	14.70%
	Intermediate	66	44.00%
	Graduate	51	34.00%
	Postgraduate	11	7.30%
Geographic Location	Rural	106	70.70%
	Urban	44	29.30%
Income	Low-income	73	48.70%
	Middle-income	61	40.70%
	High-income	16	10.70%
Farm size	Large	35	23.30%
	Medium	62	41.30%
	Small	53	35.30%
Experience	1-3 years	20	13.30%
	4-6 years	35	23.30%
	7-10 years	59	39.30%
	Above 10 years	36	24.00%

Fig – 1 – Socio-Demographic Variable



H1: To investigate the impact of mobile application usage on rice crop management (productivity, resource optimization, and farm management efficiency).

Table 2: Regression Analysis

Hypothesis	Regression Weights	Beta Coefficient	R	R2	F	t-value	p-value	Hypotheses Result
H3	Mobile application usage -> Rice Crop Management	0.270	0.270	0.73	11.609	3.407	0.001	Supported

The statistical study carried out to compare the variations in farmers' adoption and satisfaction between three groups is detailed in the ANOVA (study of Variance) table 4 above. According to ANOVA Table 4, there is a noteworthy distinction in farmers' adoption and contentment among the three Farm Size groups (small, medium, and large). With a p-value of 0.049, it is statistically significant (sig value is smaller than 0.05) and suggests that the observed variations between groups are probably the result of random chance.

H2: To analyse the role of demographic variables (farm size and experience) in influencing farmers' adoption and satisfaction with mobile applications for rice crop management.

Table 3: Descriptive analysis of the farm size

Farmers' adoption and satisfaction

Farm size	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
Small	53	18.3962	3.34169	.45902	17.4751	19.3173	8.00	24.00
Medium	62	16.8387	3.89701	.49492	15.8491	17.8284	8.00	25.00
Large	35	16.6857	4.33706	.73310	15.1959	18.1755	8.00	25.00
Total	150	17.3533	3.87409	.31632	16.7283	17.9784	8.00	25.00

The table 3 provides descriptive statistics for farmers' adoption and satisfaction. The mean rating for Farm Size small is 18.3962. The standard deviation is 3.34169. The mean rating for Farm Size Medium is 16.8384. The standard deviation is 3.89701. The mean rating for Farm Size Large is 16.6857. The standard deviation is 4.33706.

Table 4: Farmers adoption and satisfaction by using ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	89.664	2	44.832		
Within Groups	2146.609	147	14.603	3.070	.049
Total	2236.273	149			

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Table 5: Statistical analysis of farmers experience years in farming

Farmers' adoption and satisfaction

					95% Confidence Interval for Mean			
Experience year	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
1-3 years	20	18.6000	2.62378	.58669	17.3720	19.8280	14.00	24.00
4-6 years	35	16.0857	4.08276	.69011	14.6832	17.4882	8.00	23.00
7-10 years	59	17.9661	4.06400	.52909	16.9070	19.0252	8.00	25.00
Above 10 years	36	16.8889	3.63929	.60655	15.6575	18.1202	8.00	23.00
Total	150	17.3533	3.87409	.31632	16.7283	17.9784	8.00	25.00

The table 5 provides descriptive statistics for farmers' adoption and satisfaction. Table 5 shown as a graphical representation in fig. 1. In figure data level are visualised clearly and helps to understand the statistical analysis data. The mean rating for experience 1-3 years is 18.60. The standard deviation is 2.62378. The mean rating for experience 4-6 years is 16.0857. The standard deviation is 4.08276. The mean rating for experience 7-10 years is 17.9661. The standard deviation is 4.064. The mean rating for experience above 10 years is 16.8889. The standard deviation is 3.63929.

Table 6: Farmers adoption and satisfaction by using ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	117.243	3	39.081		
Within Groups	2119.031	146	14.514	2.693	.048
Total	2236.273	149			

The above ANOVA (Analysis of Variance) table 6 provides information about the statistical analysis conducted to compare the differences in farmers' adoption and satisfaction between groups. The ANOVA table 6 suggests that there is a significant difference in farmers' adoption and satisfaction between the four groups of experience (1-3 years, 4-6 years, 7-10 years, above 10 years). The p-value of 0.048 indicates that the observed differences between groups are likely due to random chance and statistically significant (sig value is smaller than 0.05).

H3: To explore the challenges and barriers faced by farmers in adopting and effectively utilizing mobile applications for rice crop management.

There has been a lot of buzz about mobile phones' potential to help alleviate poverty and advance development in the last decade. Businesses, government organizations, and NGOs are increasingly focusing on health, education, and agricultural service delivery using mobile phones in developing nations to capitalize on the fast growth of mobile phone usage in these sectors. Farmers in underdeveloped nations are already making use of, and potentially benefiting from, mobile services to access, use, and monetize new technology in agriculture. Whether or not a new technology is suitable for a given farming setting is more important than whether or not the technology is acceptable in general. The majority of the literature on adoption, however, has neglected the context in which technology adoption and diffusion occur in favour of analysing the traits of the technologies themselves and the farmers themselves (e.g., the farmers' attitudes or personalities, their socio-economic status, landholding, or level of education). Similarly, the physical, economic, and social complexity and variety of the farmer's surroundings received less attention throughout the Green Revolution (Baumüller, 2012).

DISCUSSION

As the evolving nature of technology impacting every sector associated with needs of individuals. Agriculture and farmers are also being impacted by the development of technology which includes the mobile application evolvement and usage. The present study found that Willingness to adopt mobile applications had a positive correlation with parameters such as perceived utility, convenience of use, innovativeness, affordability, socio-demographic factors, social impact, and information awareness. Focusing on rice farming and crop management in particular makes this study stand out and may provide more applicable insights for farmers in comparable agricultural contexts. In light of this Michels, M., et. al., (2020) explored various aspects influenced the uptake of smartphones among German farmers, with the role of educational attainment, farm size, and age being substantiated. The study also takes a different approach than others by focusing on the adoption and satisfaction levels of mobile applications designed specifically for the requirements of rice farmers. While other studies have examined the elements that influence smartphone use and how agricultural apps portray values, this study takes a more direct approach. On the other hand, Shams, R. A., et. al., (2021) investigated that the ideals were portrayed in agricultural applications by women farmers from Bangladesh, with a particular emphasis on the most vulnerable and oppressed members of the community in question. Fifteen values were discovered to have already been reflected and seven were left out in a mixed-methods investigation. Techniques such as human-centered methods and devoted teams helped instil these principles. To support the adoption of technology by farmers, this study can better help rice farmers and their farming techniques by focusing on this specific region and then offering suggestions and insights that farmers may put into practice while Diaz, A. C., et. al., (2021) assessed that in Maasin, Iloilo province, Philippines, farmers were open to using bamboo product marketing applications like Bamboost as a marketing tool.

Several important insights on farmers' acceptance and satisfaction with mobile applications for rice crop management may be seen from the study's results. To begin, there are a somewhat larger number of men than women among the respondents, and their demographics show a diverse distribution across all categories. It appears that this demographic sector is very mature, since the bulk of responses are between the ages of 35 and 45. The majority of respondents live in rural regions and have a low to moderate income; a considerable number of them hold graduate degrees. Not only that, but medium-sized farms predominate when looking at farm size distribution, which is otherwise quite even among small, medium, and big farms. In addition, there is a wide range in the amount of time people have been farmers; for example, many respondents have 7-10 years of experience.

In terms of testing hypotheses, the findings show that the use of mobile applications significantly affects the management of rice crops, specifically production, resource optimisation, and farm management efficiency. The regression analysis shows that there is a statistically significant link ($p < 0.001$) between using mobile applications for rice crop management. The study also examined the effects of demographic variables on farmers' adoption and satisfaction with mobile apps, such as farm size and experience. The results of the ANOVA revealed that the adoption and satisfaction levels among the different experience groups and farm sizes varied statistically significantly. Collectively, our findings demonstrate the critical role that mobile applications play in improving rice crop management as well as the significance of customising interventions to farmers' unique backgrounds, passions, and degrees of experience.

CONCLUSION

The study titled "Evaluation of Mobile Applications for Rice Crop Management: An Empirical Study on Farmers' Adoption and Satisfaction" concludes that socio-demographic factors, mobile application usage, farm size, and effective rice crop management significantly influence the adoption and satisfaction levels of mobile applications among farmers. The findings reveal that farmers with greater farming experience, larger farm sizes, and higher digital literacy are more likely to adopt and benefit from mobile applications for managing rice crops. These applications have proven effective in improving productivity, optimizing resource use, and streamlining farm management practices. However, challenges such as limited digital literacy and infrastructural gaps hinder widespread adoption. Therefore, targeted interventions, including farmer training programs, infrastructure development, and the creation of user-friendly, localized applications, are essential to enhance adoption rates and maximize the benefits of digital tools in agriculture. This study underscores the critical role of tailored digital solutions in advancing sustainable farming practices and improving farmer livelihoods.

Implications, Limitation and Recommendation for further studies

A number of parties involved in agriculture stand to benefit from this study's conclusions. First, this research can help policymakers and agricultural extension agencies understand how to best encourage farmers to utilize mobile applications for managing their rice crops. With this information, they can create more effective interventions. Policymakers may devise plans to remove obstacles and ease the incorporation of digital technology into farming operations by gaining knowledge of the elements impacting adoption and satisfaction. In addition, developers of agricultural technology may take farmers' comments into account when making changes to current mobile apps, making them more practical and useful in actual farming situations.

This study, while offering valuable insights, possesses certain limitations that warrant acknowledgement. The study exclusively involved people from a specific region, rendering its findings potentially inapplicable to other locations. Researchers faced the potential for response bias and social desirability bias owing to the study's dependence on self-reported data from farmers. Furthermore, the study cannot establish definitive conclusions regarding causality due to its cross-sectional design. To enhance comprehension of the dynamics of mobile app adoption and satisfaction over time, subsequent research may employ longitudinal methodologies.

Several prospective avenues for future research may enhance and address the study's limitations and deficiencies. Initially, a longitudinal strategy might be employed to examine the impact of mobile app usage on agricultural outcomes and crop management practices over an extended period. To enhance the applicability of the results to a broader spectrum of farms and regions, the research may be expanded to incorporate a more representative sample. Furthermore, the adoption decisions and experiences of farmers about mobile applications may be elucidated by qualitative research approaches such as focus groups and interviews. Ultimately, it would be feasible to identify optimal methods for developing and utilising mobile applications in agricultural settings by a comparative analysis of their effectiveness.

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