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Adoption and Determinants of Mobile-based Agro-advisory Services Among Farmers in Bharatpur Metropolitan City, Chitwan

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Keywords

Digital agriculture, Digital literacy, ICT adoption, Probit model, Smallholder farmers, STATA

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ABSTRACT

Mobile-Based Agro-Advisory Services (MBAAS) have emerged as an innovative tool for delivering timely agricultural information (Suriyapriya et al., 2018). However, limited studies have examined the specific services used by farmers and the factors influencing their adoption in the local context of Bharatpur. This study aims to assess the adoption and determinants of MBAAS. A total of 99 farmers were selected using multistage sampling technique. Primary data were collected through a pre-tested semi-structured questionnaire supported by focus group discussions (FGDs), and key informant interviews (KIIs). Descriptive statistics, probit regression, and index score method were applied using STATA version 14.2 and Ms Excel. The findings revealed that 85.86% of farmers had adopted MBAAS, with social media platforms being the most popular platform compared to others. Farmers primarily utilized these services for crop management tips, pest and disease identification and weather forecasts. Major constraints include lack of awareness, difficulty in understanding technical terms, and low digital literacy. Probit regression results indicated that digital literacy score (dy/dx=0.049), education (dy/dx= 0.024), primary occupation (dy/dx=0.199) and age (dy/dx=0.011) significantly affect the probability of adoption. The study highlights the need for inclusive, user-friendly digital advisory interventions to enhance accessibility, improve comprehension, and reduce the digital divide among farmers.

Introduction

As an agriculture-dependent country, Nepal must focus on effective and efficient agro-advisory service delivery to strengthen a sector that employs more than half of the population and contributes 24.09% to the Gross Domestic Product (GDP) (MOALD, 2025). Traditionally, agricultural extension services in Nepal have depended on face-to-face interactions. However, such approaches are often constrained by limited human resources, weak institutional reach, and geographic barriers, which reduce the efficiency of information delivery (Thapa, (2023).

In recent years, digital agro-advisory services have emerged as transformative innovations, offering cost-effective and accessible platforms for timely agricultural information (Vaidya et al.,

2023). Increasing digital connectivity with 39.0 million cellular mobile connections, 16.5 million individuals using internet and 55.8% online penetration, has created significant potential for mobile-based information delivery in agriculture (We Are Social & Meltwater, 2025). These services disseminate agricultural information through various channels, including voice calls, Short Message Service (SMS), mobile applications (apps), and websites. Collectively, these are referred to as Mobile-based agro-advisory services (MBAAS).

Among digital tools, MBAAS have become important in providing farmers with localized and real-time agricultural recommendations. These services help to address information gaps and improve farm-level decision-making (Mittal & Mehar, 2012).

Studies from Nepal and similar South Asian contexts indicate that younger and more educated farmers are more likely to adopt while older and less literate farmers encounter obstacles because of inadequate infrastructure and poor digital awareness (Mishra et al., 2023; Tiwari et al., 2024). Despite these insights, mobile-based agro-advisory systems are still not effectively utilized by a large proportion of Nepalese farmers.

From a theoretical perspective, this study is grounded in the Technology Acceptance Model (TAM), which explains that perceived usefulness and perceived ease of use are major drivers for adoption of technology (Mustonen-Ollila & Lyytinen, 2003). In addition, Rogers' Diffusion of Innovations Theory provides further insight into how innovations spread among farmers based on factors such as relative advantage, compatibility, complexity, and observability (Rogers, 2010). These frameworks help explain not only whether farmers adopt MBAAS, but also how and why they use them differently.

Despite the increasing integration of digital technologies in agriculture, Nepalese farmers still encounter significant barriers in accessing and utilizing essential agricultural information through Information and Communication Technology (ICT) tools (Thapa, 2018). Poor access to smartphones and the internet, coupled with limited digital literacy, app navigation difficulties, and language barriers, restrict farmers from effectively adopting technology, thereby widening the digital divide(Vaidya et al., 2023).

The paper aims to analyse the adoption and use of mobile-based agro-advisory services among farmers in Bharatpur. The specific objectives are:

- To identify the types of mobile-based agro-advisory services used by farmers and the features they prefer for accessing agricultural information.
- To analyse how socio-demographic, economic and technical factors affect the adoption of these services.
- To identify the opportunities and challenges faced by farmers while using these services.

Understanding the types of MBAAS farmers preferred and barriers affecting adoption can help in designing practical, more user-friendly solutions that improve access to timely agricultural information and enhance farmers' decision-making.

Literature Review

Role of ICT and Mobile-Based Agro-advisory Services in Agriculture

Information and Communication Technology (ICT) plays a crucial role in agricultural development by addressing constraints faced by farmers in both crop and livestock sectors (Salampasis & Theodoridis, 2013). ICT provides real-time information on weather, market prices, and crop management, enabling farmers to make informed decisions and enhance productivity (Samaddder & Rao, 2023). Mobile applications are used for cultivation practices, plant protection, post-harvest management, modern agriculture technologies, market information, weather forecasts, insurance, subsidies, and training (Tiwari et al., 2024). Furthermore, ICT strengthens agricultural extension services by connecting farmers with experts and facilitating information exchange (Thapa, 2023). These ICT services create significant opportunities by enabling farmers and agricultural experts to make well-informed decisions, increase production, adapt to technological advancements, foster innovation, solve agricultural challenges, and improve sustainability, while also expanding access to wider markets in a digitally connected world (Thapa, 2023).

With the rapid expansion of mobile-phone usage, there has been a shift from conventional ICT mediums such as TV and radio towards more contemporary tools like mobile-based agro-advisory services (MBAAS) (Vaidya et al., 2023). These MBAAS deliver information through voice calls, short message service (SMS), mobile-based applications (apps), and websites (Vaidya et al., 2023). The Agriculture Information and Training Centre (AITC) of the Nepal Government operates the Kisan Call Centre and provides SMS services to farmers (Paudel et al., 2018). Apart from that, the use of social media like YouTube, Facebook, TikTok, and WhatsApp for accessing agricultural information is also increasing (Vaidya et al., 2023). Mobile applications like Smart Krishi, Krishi Guru, National Agricultural Research Council (NARC) Krishi, Livestock Farming, Geo KRISHI, and Krishi TV provide farmers with agricultural practices, weather, news, e-books, expert advice, and livestock information (Magar, 2020).

However, while these studies highlight the availability and scope of services, they provide limited evidence on which specific types of services and features are used and preferred by farmers in practice.

Determinants impacting adoption of MBAAS

Several studies have identified that sociodemographic factors such as age, education, and gender that influence the adoption of agro-advisory services. Younger farmers are more likely to adopt agro-advisory services, while older farmers tend to have lower adoption rates (Mishra et al., 2023; Dhungana, 2024; Vosough et al., 2015; Tiwari et al., 2024). In contrast, Angelini (2023) suggests that the relationship between age and technology adoption is non-monotonic, where adoption initially increases with age but declines at higher age levels. Tiwari et al. (2024) state that an increase in the years of schooling increases the probability of the adoption of mobile based applications. On

the contrary, Mishra et al. (2023) and Dhungana (2024) found that with increase in the education of the respondent, the probability of use of ICT will decrease. Studies by Dhungana (2024) and Marie et al. (2020) state that male farmers are more likely to use modern technologies than female farmers. In contrast, Muzanenhamo et al. (2024) indicated that a larger number of female farmers have adopted mobile phone applications compared to their male counterparts.

Economic factors such as agriculture as a primary occupation and landholding have also been found to have an influence on the adoption of technology. Studies by Muzanenhamo et al. (2024), Akter and Tan (2023), and Vosough et al. (2015) revealed that farming as a primary livelihood increases the adoption of advisory services for agricultural purposes. Studies by Mishra et al. (2023) suggest that farmers with more land have a greater tendency to use technology.

Similarly, technical barriers like digital illiteracy are major constraints, limiting farmers' ability to use advisory tools (Tiwari et al., 2024; Thapa, 2023; Akter & Tan, 2023; Paudel et al., 2018). Dhungana (2024) and Mishra et al. (2023) also suggest increasing digital literacy of farmers through technical support from extension workers or policy reforms. However, while these studies highlight digital literacy as major barriers, the extent to which it affects adoption has not been sufficiently examined.

Overall research gap and link to present study

Existing literature highlights generalized findings of ICT tools and agro-advisory services or focuses on specific aspects such as mobile applications. Despite the several studies conducted in the past, important gaps still remain, particularly in the context of Nepal.

First, existing studies have primarily focused on the availability and general use of mobile-based agro-advisory services (MBAAS), with limited attention to the specific types of services used by farmers, the features they prefer, and the actual benefits they derive.

Second, although previous research has identified various socio-demographic, economic, and technical factors influencing adoption, these factors are often examined in isolation. There is limited integrated analysis of how these variables collectively shape farmers' adoption behavior in real-world contexts.

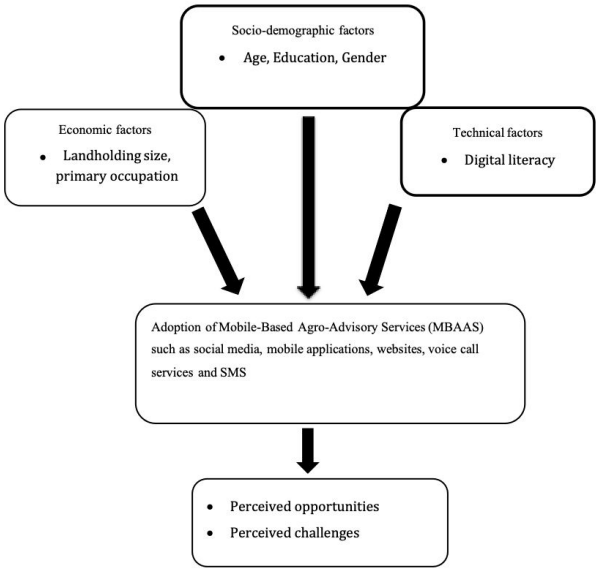
Third, while several determinants of adoption have been discussed, digital literacy has mostly been treated as a constraint to adoption rather than being examined in depth as a key factor influencing the effective use of MBAAS.

Therefore, this study seeks to address these gaps by providing an integrated analysis of mobile-based agro-advisory services in Bharatpur, with a particular focus on services used, determinants of adoption, and the opportunities and challenges faced by farmers.

Theoretical framework of the study

Figure 1

Theoretical framework of the study



The Figure 1 shows that adoption of mobile-based agro-advisory services (MBAAS) is influenced by multiple interrelated factors. Based on the literature, these factors are categorized into three major groups: socio-demographic, economic and technical factors.

Socio-demographic factors such as age, education, gender and Economic factors such as landholding size, agriculture as a primary occupation influence farmers' ability and willingness to adopt MBAAS. Technical factors such as digital literacy, determine farmers' capacity to use these services effectively. In addition, farmers' perceived opportunities (e.g., improved access to information, reduced pest and disease damage, better decision-making) and challenges (e.g., illiteracy, language barriers) further influence adoption behaviour. These factors collectively determine the likelihood of adoption of MBAAS among farmers.

Thus, adoption of MBAAS is considered a function of socio-demographic, economic and technical factors, along with perceived opportunities and challenges.

Hypotheses derived from literature findings

H1: Young farmers are more likely to adopt mobile-based agro-advisory services in agriculture than older farmers.

H2: Education level positively influences the adoption of mobile-based agro-advisory services.

H3: Men are more likely to adopt mobile-based agro-advisory services than women.

H4: Farmers with larger landholdings are more likely to adopt mobile-based agro-advisory services.

H5: Farming as a primary occupation influences farmer to adopt mobile-based agro-advisory services.

H6: Digital literacy positively influences the adoption of

mobile-based agro-advisory services.

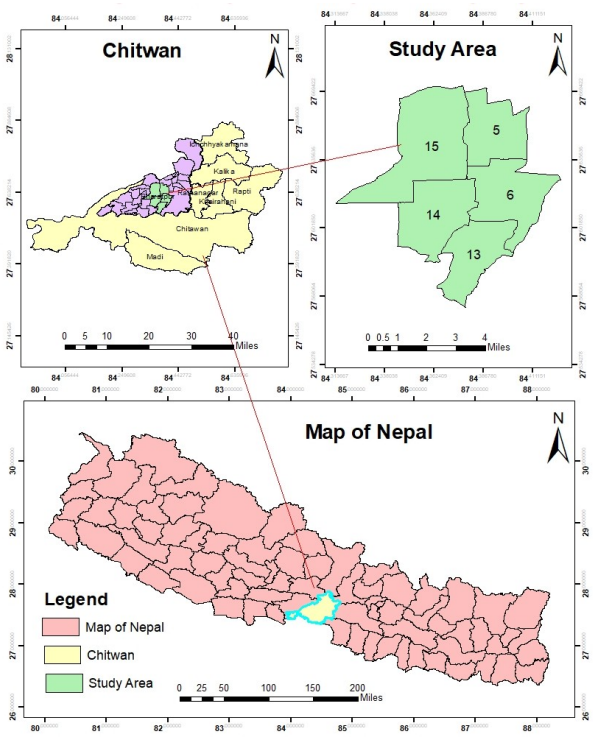
Materials and Methods

Study area

The research was conducted in the Bharatpur Metropolitan City of Chitwan District, Bagmati Province. It is in central-southern part of Nepal (Figure 2). The city extends from 27˚32'58" N to 27˚45'40" N latitude and from 84˚09'41" E to 84˚29'5" E longitude. The area of the city is 432.95 Sq. Km with a population of 369,377 and is divided into 29 wards.

Figure 2

Map of the study area in Bharatpur, Chitwan



Research design and sampling

The study employed a cross-sectional research design, in which data were collected from respondents at a single point in time. To better understand the influence of different factors on the adoption of mobile-based agro-advisory services, a mixed-methods approach was adopted. Quantitative data collected through a semi-structured questionnaire were complemented by qualitative insights from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs), thereby enhancing the validity and reliability of findings.

A multistage sampling technique was employed in this study. In the first stage, Bharatpur Metropolitan city was purposively selected, as previous studies (Mishra et al., 2023) report that various organizations, including government bodies, Prime Minister Agriculture Modernization Project (PMAMP), and I/NGOs like LI-BIRD, are actively promoting ICT-based agricultural initiatives in Chitwan district. In the second stage, five wards (Ward Nos.-5, 6, 13, 14 and 15) were purposively selected out of the 29 wards of metropolitan city based on accessibility and feasibility. In the final stage, farmers were selected using a combination of purposive and simple random sampling techniques. Cooperatives were first identified purposively based on recommendations from the Agriculture Knowledge Centre (AKC). A list of cooperative members was then obtained, which served as the sampling frame. From the list, respondents were selected using simple random sampling to ensure unbiased representation. The total number of households in the selected wards was 15,414. Due to the unavailability of disaggregated data on agricultural households at the metropolitan level, the proportion of population (i.e., 40.3% of Bharatpur's population engaged in agriculture) was used as a proxy to estimate the number of farming households within the selected wards. Accordingly, the number of agricultural households in the study area was estimated at 6,212 (N) (Central Bureau of Statistics, 2021), which was used as the population size for sample size determination.

The sample size was calculated using Yamane's (1967) formula:

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

Where n is the sample size, N is the population size (6,212), and e is the margin of error (10% kept in this study).

$$n = \frac{6212}{1 + 6212(0.10)^2} = 98.41 \approx 99 \tag{2}$$

Based on this calculation, the total sample size for the study was 99 households.

A 10% margin of error was adopted due to resource and time constraints. Similar studies such as Tiwari et al. (2024) also adopted a 10% precision level under comparable limitations. Despite being relatively high, the sample size remains adequate to capture variability in key variables and provide meaningful insights into MBAAS adoption.

Data collection and variable used

For primary data collection, a pre-tested semi-structured questionnaire was employed to capture detailed information on mobile-based agro-advisory services. Key Informant Interviews (KIIs), including those with AKC representatives, were conducted to gather preliminary information on selected wards. Following the individual surveys with farmers, Focus Group Discussions (FGDs) were carried out to enhance the accuracy of the collected data. Secondary data were obtained from government reports, census publications, and previous research studies.

The study also followed standard ethical guidelines, ensuring informed consent, voluntary participation, and the right of respondents to withdraw at any stage. Confidentiality and privacy were strictly maintained, with no personal identifiers recorded and data used solely for research purposes.

The following variables were analysed in this study (Table 1).

Table 1

Variables used and their description

S.N.	Variables	Description
A.	Dependent Variable	
1.	Adoption of MBAAS	Coded as Adopter = 1, Non-Adopter = 0
B.	Independent Variables	
1.	Socio-Demographic	Age of respondent in years; gender of respondent (coded as Female = 1, Male = 0); years of formal education of respondents; livestock standard unit (LSU)
2.	Economic	Agriculture as primary occupation (coded as Ag = 1, Non-Ag = 0); land holding in hectare
3.	Technical	Digital literacy score (score obtained based on digital skills)

Note. LSU = 1 (cow) + 1.5 (buffalo) + 0.4 (goat) + 0.02 (poultry) (Dhungana, 2024).

Data analysis and tools

The data collected were analysed using descriptive analysis, index score method and probit regression model using tools like STATA version 14.2 and Microsoft Excel. Descriptive statistics such as Frequency, Mean, Standard deviation, Percentage were applied to summarize characteristics of respondents. Index score method was employed to assess and rank the challenges faced by farmers in using mobile-based agro-advisory services. Probit regression model was used to identify and explain the determinants influencing the adoption of mobile-based agro-advisory services.

Index score method

Index score method is a simple but widely used technique in social science and agricultural research which helps to convert qualitative responses into quantitative score that allows comparison across different variables. Index score was calculated using the following formula:

$$I = \frac{\sum_i S_i F_i}{N \times MS}$$

where:

I index score;
$\sum$ summation;
S_i score obtained for the ith response category;
F_i frequency of the ith response category;
N total number of observations; and
MS maximum score.

Value of index score ranged from 0 to 1, where challenges with the highest index score was ranked first, followed by others in descending order.

Probit regression model

However, both probit and logit models are commonly used for binary outcome variables, a probit regression model was used to analyse the factors influencing the adoption of mobile-based agro-advisory services in this study. The dependent variable was binary, coded as 1 for adopters and 0 for non-adopters. The model estimates the probability of adoption conditional on explanatory variables.

$$P_i = P(Y_i = 1 \mid X_i) = \Phi(X_i'\beta) \quad (3)$$

(Asian Development Bank, 2016)

Where Φ denotes the cumulative distribution function of the standard normal distribution, X_i represents the vector of explanatory variables that influence the outcome of the model, and β is the vector of parameters that measures the effect of these variables on the probability of adoption. The relationship between each explanatory variable and the probability of adoption is interpreted using marginal effects, which indicate the change in the predicted probability resulting from a unit change in each variable, holding other factors constant.

Digital literacy score calculation

Digital literacy score was measured using nine binary indicators (1=skill possessed, 0=otherwise), based on respondents' reported ability to carry specific digital tasks. The digital literacy score was generated in Stata using a sum all nine indicators. The index ranges from 0 to 9, where higher values indicate a greater number of digital skills possessed by the respondents.

Nine indicators were as follows:

- Ability to make a phone call
- Ability to send SMS
- Ability to use social media (such as YouTube, Facebook or TikTok) for learning
- Ability to use agricultural apps
- Ability to search information on Google or browser
- Ability to check weather conditions
- Ability to make video calls
- Ability to check market price online
- Ability to send photos

Results

Socio-demographic profile of sampled household

Table 2 illustrates the categorical variable description of sampled household. The findings reveal that female respondents (61.62%) outnumbered the male (38.38%), indicating a higher participation of women in the study. All the respondents were involved in agriculture either as a main occupation (85.86%) or as a secondary occupation (14.14%), suggesting that the sample is highly relevant for assessing the adoption of agro-advisory services. This strengthens the validity of the findings, as the respondents are directly engaged in farming activities. The majority (65.66%) had not received training related to MBAAS, highlighting a gap in capacity-building efforts. Despite this, adoption of MBAAS was high (85.86%), suggesting that farmers are using these services due to accessibility and perceived usefulness rather than formal training. However, limited training may restrict effective utilization, particularly for advanced features.

Table 2

Categorical variable description

S.N.	Characteristics	Frequency	Percentage
1.	Gender		
	Male	38	38.38
	Female	61	61.62
2.	Primary Occupation		
	Agriculture	85	85.86
	Non-Agriculture	14	14.14
3.	Training related to MBAAS		
	Yes	34	34.34
	No	65	65.65
4.	Adoption of MBAAS		
	Yes	85	85.86
	No	14	14.14

Table 3

Continuous variable description

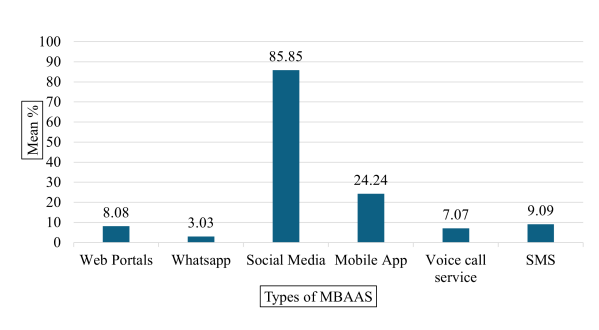
Variables	Mean	Standard Deviation
Age	50.49	7.75
Education	9.32	4.67
Land Holding (Hectare)	0.48	0.39
LSU	2.73	5.41
Digital Literacy Score	7.72	1.98

The results in Table 3 reveals a middle-aged farming population with an average age of 50.49 years and standard deviation of 7.75. The mean year of education is 9.32, with a standard deviation of 4.67. The mean landholding size is 0.48 hectares, with a standard deviation of 0.39. The average livestock holding, measured in Livestock Standard Units (LSU), is 2.73, with a standard deviation of 5.41, indicating variation among respondents. The mean digital literacy score is 7.72, with a standard deviation of 1.98, indicating a moderate level of digital literacy among the respondents.

Types of MBAAS and Mobile features used by farmers

Figure 3

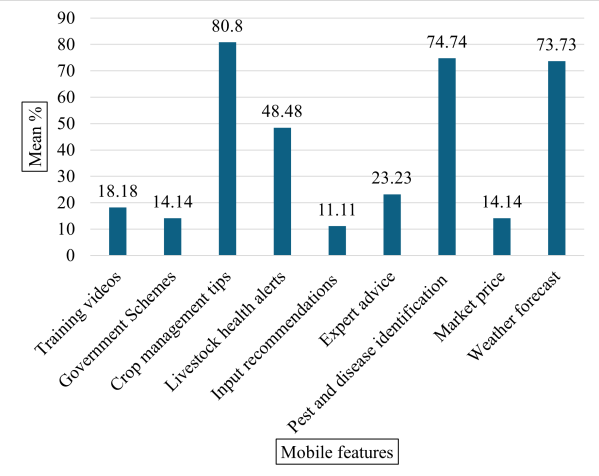
Types of MBAAS



The findings in Figure 3 illustrates the different types of mobile-based agro-advisory services utilized by farmers, expressed in mean percentage. Social media such as Facebook, YouTube and TikTok recorded the highest usage (85.85%). This was followed by mobile applications (24.24%). SMS alerts (9.09%), web portals (8.08%), and voice call services (7.07%) showed comparatively lower usage. WhatsApp had the lowest usage among the services, accounting for 3.03%.

Figure 4

Mobile features used by farmers



The findings in Figure 4 shows the different mobile features used by farmers, expressed in mean percentage. Crop management tips recorded the highest usage (80.8%), followed by pest and disease identification (74.74%) and weather forecasts (73.73%). Livestock health alerts accounted for (48.48%), while services related to expert advice (23.23%), training (18.18%), government schemes (14.14%), market price (14.14%), and input recommendations remain underutilized.

Factors affecting adoption of MBAAS

Table 4

Effect of the variables on adoption of MBAAS (1 = adoption, 0 = otherwise)

Variables	β	SE	t-value	p-value	dy/dx	SE	Sig
Digital Literacy Score	.35	.12	2.91	.004	0.049	0.014	***
Age	.08	.04	2.00	.046	0.011	0.005	**
Gender	1.11	.614	1.81	.07	0.156	0.082	*
Years of Education	0.17	.061	2.81	.005	0.024	0.008	***
Primary Occupation	1.42	.713	1.99	.046	0.199	0.095	**
Land Holding	.85	.865	0.99	.322	0.120	0.120	
LSU	.05	.109	0.48	.632	0.007	0.015	
Constant	−9.07	3.183	−2.85	.004			***
Mean Dependent Var	0.85		SD Dependent Var		0.35		
Pseudo r-squared	0.368		Number of Obs		99		
Chi-Square	29.71		Prob > chi2		0.000		

Note. *** $p < .01$, ** $p < .05$, * $p < .1$, SE: Standard Error, Sig: Significant, β: coefficient.

Table 4 presents the results of the probit regression model examining factors affecting adoption of mobile-based agro-advisory services. The model was statistically significant with chi-square (x^2) value 29.71 at p value < 0.000. The model explained 36.8% of the variance in the adoption of mobile application as per pseudo-R^2 value. The coefficients represent the change in the log-odds of adoption, whereas the marginal effects indicate the change in the probability of adoption associated with a one-unit change in the explanatory variable, holding other variables constant.

Digital literacy has a positive and statistically significant association with MBAAS adoption at the 1% level ($\beta = 0.35$, $p = 0.004$). The marginal effect ($dy/dx = 0.049$) indicates that a one-unit increase in digital literacy score is associated with a 4.9 percentage point increase in the probability of adoption, *ceteris paribus*. Thus, H_6 is supported. H_6: Digital literacy positively influences the adoption of mobile-based agro-advisory services (Liu et al., 2025).

Education is also positively and significantly associated with adoption at the 1% level ($\beta = 0.17$, $p = 0.005$). The marginal effect ($dy/dx = 0.024$) suggests that each additional year of schooling is associated with a 2.4 percentage point increase in the probability of adoption, holding other factors constant. Therefore, H_2 is supported. H_2: Education level positively influences the adoption of mobile-based agro-advisory services.

Primary occupation shows a positive and statistically significant relationship at the 5% level ($\beta = 1.42$, $p = 0.046$). The marginal effect ($dy/dx = 0.199$) indicates that farmers whose primary occupation is agriculture have a 19.9 percentage point higher probability of adopting MBAAS compared to those farmers primarily involved in non-agricultural occupations, *ceteris paribus*. Hence, H_5 is supported. H_5: Farming as a primary occupation influences farmers to adopt mobile-based agro-advisory services.

Age is positively associated with adoption and is statistically significant at the 5% level ($\beta = 0.08$, $p = 0.046$). The marginal effect ($dy/dx = 0.011$) indicates that each additional year of age is associated with a 1.1 percentage point increase in the probability of adoption. However, this finding is contrary to the expected direction stated in H_1; therefore, H_1 is rejected. H_1: Young farmers are more likely to adopt mobile-based agro-advisory services in agriculture than older farmers.

Gender is positively associated with adoption and is statistically significant at the 10% level ($\beta = 1.11$, $p = 0.07$). The marginal effect ($dy/dx = 0.156$) indicates that female farmers have a 15.6 percentage point higher probability of adopting MBAAS compared to male farmers, holding other variables constant. This result contradicts H_3; thus, H_3 is rejected. H_3: Men are more likely to adopt mobile-based agro-advisory services than women.

In contrast, landholding size was not found to have a statistically significant effect on adoption in this study. Therefore, H_4 was not supported.

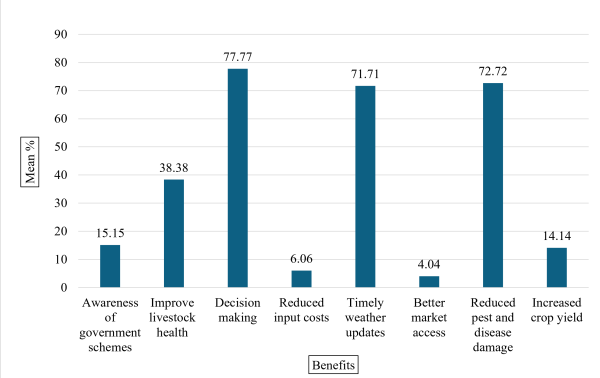
Variance Inflation Factor (VIF)

The Table 5 below shows the Variance Inflation Factor (VIF), which is used to check multicollinearity among independent variables. Multicollinearity refers to a situation where explanatory variables are highly correlated, which can distort regression estimates. The estimated VIF values are between 1.09 and 1.45, with mean VIF of 1.24. Since all values are very close to 1, the results indicate that there is no serious multicollinearity among the variables included in the model. This also suggests that the estimated coefficients from the probit regression are reliable.

Opportunities and challenges associated with MBAAS adoption

Figure 5

Opportunities provided by mobile-based agro-advisory services to farmers



The finding in Figure 5 mobile-based agro-advisory services for decision-making (77.77%), pest/disease management (72.72%) and weather-related planning (71.71%). Other benefits, such as improved livestock health (38.38%), awareness of government schemes (15.15%), increased crop yield (14.14%), reduced input costs (6.06%), and better market access (4.04%), are less utilized.

Table 5

Variance Inflation Factor (VIF) diagnostics

Variable	VIF	1/VIF
Age	1.45	0.69
Digital Literacy Score	1.39	0.71
Years of Education	1.25	0.79
Gender	1.24	0.80
Primary Occupation	1.15	0.86
Land Holding	1.10	0.90
LSU	1.09	0.91
Mean VIF	**1.24**	**1.24**

Table 6

Challenges faced by farmers

S.N.	Challenges	Index score	Rank
1.	Lack of awareness	0.71	I
2.	Difficulty with technical terms	0.68	II
3.	Lack of digital literacy	0.55	III
4.	Limited two-way communication	0.51	IV
5.	Lack of local language content	0.40	V

The problems associated with the adoption of mobile applications were analysed using the index score method, where reasons were ranked on a scale from 0 to 1 as shown as in the Table 6 . The findings indicate that lack of awareness was the most significant challenge faced by farmers, with the highest index score of 0.71. Difficulty in understanding technical terms ranked second with 0.68 index score, followed by lack of digital literacy (0.55), limited two-way communication (0.51), and lack of local language content (0.40).

Discussion

The findings reveal that farmers predominantly prefer social media platforms followed by mobile applications, over other advisory channels such as web portals, SMS alerts and voice call services. This preference may be attributed to the user-friendly nature of social media, ease of access, and the availability of audiovisual content, which enhances understanding. These findings are consistent with previous studies, which highlight the increasing role of platforms such as YouTube, Facebook, TikTok, and WhatsApp in agricultural information dissemination (Magar, 2020; Vaidya et al., 2023).

Regarding the types of services used, farmers mainly utilize MBAAS for crop management, pest and disease identification, weather forecasting, and livestock health alerts, while services related to training, subsidies, and expert consultation remain underutilized. This suggests possible gaps in awareness, accessibility, or trust in mobile-based advisories. Similar patterns were observed by Tiwari et al. (2024), who reported that advisory services were primarily used for cultivation practices, plant protection, post-harvest, modern agriculture technology, market, weather forecast, insurance, subsidy, and training.

The regression results indicate that digital literacy has positive and significant influence on adoption of MBAAS, thereby supporting H6. Farmers with higher digital skills are more capable of using mobile platforms for agricultural information and utilize advisory services effectively. The findings align with previous studies (Tiwari et al., 2024; Thapa, 2023; Paudel et al., 2018), which identifies technical barriers like digital illiteracy as major constraints to technology adoption.

Education was also found to have a positive and significant effect on adoption of MBAAS, supporting H2. Educated farmers are most likely to understand and trust mobile-based agro-advisory platforms. Tiwari et al. (2024) also states that keeping other things constant, one year increase in the year of schooling increases the probability of the adoption of mobile based application by 9%. On the contrary, Mishra et al. (2023) and Dhungana (2024) suggest that higher education may lead to off-farm employment, reducing engagement in agricultural innovations.

Contrary to H_1, which hypothesized that younger farmers are more likely to adopt mobile-based agro-advisory services, age was found to have a positive and significant relationship with adoption. This is possibly because mean age of respondents was 50.48 years ($SD = 7.75$) and in the present situation, farmers in their fifties are not only experienced in farming but also increasingly familiar with mobile phones and social media platforms (e.g., Facebook, YouTube), which are already being used as advisory services. These findings align with Angelini

(2023) who reported that the relationship between age and technology adoption is non-monotonic, where adoption initially increases with age but declines at higher age levels. On the contrary, Mishra et al. (2023), Dhungana (2024) Vosough et al. (2015) Akter & Tan, (2023) and Tiwari et al., (2024) found a negative association between age and technology adoption. The findings highlight the importance of considering age differences among farmers when designing and implementing agricultural interventions, as adoption levels vary across age groups.

Farming as a primary occupation had a positive and significant effect on adoption, supporting H_5. Farmers primarily engaged in agriculture are more likely to seek and utilize advisory services to improve productivity. This finding is consistent with previous studies (Muzanenhamo et al., 2024; Akter & Tan, 2023; Vosough et al., 2015).

Contrary to H_3, female farmers were more likely to adopt mobile-based agro-advisory services than male farmers. Several contextual factors may explain this. First, cooperative membership, which served as the sampling frame in this study, tends to have high female participation, this may have introduced a sample-specific effect. Second, Nepal has experienced significant male out-migration, leaving women as de facto farm managers who bear greater responsibility for day-to-day agricultural decision-makings, and thus have stronger motivation to seek advisory information through accessible digital channels. Similar findings were reported by Muzanenhamo et al. (2024). On the contrary, studies by Dhungana (2024) and Marie et al. (2020) states that male farmers are more likely to use modern technologies than female farmers. Therefore, gender differences should be carefully considered, as they influence the adoption of mobile phone applications in agriculture. Understanding these differences can help in designing inclusive interventions that address the specific needs and constraints of both male and female farmers.

Mobile-based agro-advisory services were primarily used by farmers for decision-making, pest and disease management and weather-related planning, and improve livestock health. However, services related to awareness of government schemes, market access, increasing crop yield are less utilized. Similar findings were reported by Thapa, (2023), who reported that ICT enable farmers and agricultural experts to make well-informed decisions, increase production, adapt to technological advancements, foster innovation, solve agricultural challenges, and improve sustainability, while also expanding access to wider markets in a digitally connected world. Despite the benefits, adoption of mobile-based agro-advisory services remains constrained by several factors, including lack of awareness, difficulty in understanding technical terms, low digital literacy, limited two-way communication, and lack of localized content. Similar constraints have been identified in earlier studies (Paudel et al., 2018; Navinkumar et al., 2018). These findings suggest that many farmers are still not adequately informed about the availability and benefits of such services and tend to rely primarily on information obtained through social media platforms. The technical complexity of the content limits comprehension, particularly among farmers with lower educational levels. Additionally, Low digital literacy restricts effective use of digital tools thereby hindering the optimal utilization of MBAAS. Limited interaction and feedback mechanisms between farmers and service providers further exacerbate communication gaps, while the absence of local language content continues to restrict accessibility for many users. Therefore, to enhance adoption, mobile-based agro-advisory services should focus on improving accessibility, simplifying technical language, incorporating local languages, and providing audio-based interfaces. Additionally, strengthening training programmes and awareness campaigns through extension services and public institutions is essential to improve digital literacy and promote wider adoption.

Conclusion

This study shows that social media has become the dominant platform for mobile-based agro-advisory services among farmers in Bharatpur. Farmers mainly use these services for crop management, pest and disease identification, weather forecasting, and livestock-related information, indicating their role in improving decision-making. Opportunities such as market access, awareness of government schemes, and productivity improvement remain underutilized. Adoption is significantly influenced by digital literacy, education, age, gender, and primary occupation. However, challenges such as low awareness, technical complexity, and lack of local language content limit effective use.

This study makes several contributions to the digital agriculture and agro-advisory services in Nepal. First, by applying a probit regression model with a comprehensive set of socio-demographic, economic, and technical covariates, the study offers direct insights applicable to policy design. Second, the study documents the emergence of social media (Facebook, YouTube, TikTok) as the dominant channel for agro-advisory information from the SMS and voice-call centric models previously described in the Nepalese literature. Third, the finding that female farmers and middle-aged farmers exhibit higher adoption rates challenges prevailing assumptions in the Nepalese agricultural digital literature and highlights the need to revisit extension service designs that continue to target primarily younger, male farmers. From a policy perspective, effective and inclusive use of agro-advisory services can be promoted by integrating social media into formal extension systems, strengthening digital literacy programmes and developing simple and localised content.

Implications

The findings of this study carry important implications for extension agencies, policymakers and app developers aiming to promote mobile-based agro-advisory services. Effective and inclusive use of agro-advisory services can be promoted by integrating social media into formal extension systems, strengthening digital literacy programmes, and developing simple, user-friendly and localised content. Expanding advisory services to include market information, government schemes, and productivity-related guidance can enhance their relevance. Strengthening two-way communication through both digital platforms and face-to-face interaction is essential, while using

authorised or verified social media account can enhance farmers' trust.

Future research should assess the impact of these services on farm productivity, income, and resilience, while using larger and more geographically diverse samples to improve generalizability.

Limitations

This study has certain limitations, such as a cross-sectional research design, purposive sampling, a small sample size with a 10% margin of error, and the focus on a single metropolitan area. Despite these limitations, the study provides valuable insights into the adoption dynamics of mobile-based agro-advisory services in a rapidly evolving digital agricultural landscape.

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References

Akter, A. T. (2023). Agro-based mobile applications adoption among Bangladesh framers at the 'hamlet' of Bangladesh: A case study of Chapindura Village of Barisal. Jurnal Komunikasi: Malaysian Journal of Communication, 39(4), 324-329. https://doi.org/10.17576/jkmjc-2023-3904-17

Angelini, D. (2023). Aging population and technology adoption (Working Paper Series No. 2023–01). University of Konstanz. https://ideas.repec.org/p/knz/dpteco/2301.html

Asian Development Bank. (2016). Analysing the determinants of project success: A probit regression approach. SSRN. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1682130

Central Bureau of Statistics. (2021). National population and housing census 2021. https://censusnepal.cbs.gov.np/Home/Index/EN

Dhungana, S. M. (2024). Information and communication technologies (ICTs) in farming and its determinants: A reference of Dhankuta, Nepal. OCEM Journal of Management, Technology & Social Sciences, 3(2), 37–46. https://doi.org/10.3126/ocemjmtss.v3i2.67858

Liu, H., Chen, Z., Wen, S., Zhang, J., & Xia, X. (2025). Impact of digital literacy on farmers' adoption behaviors of green production technologies. Agriculture, 15(3), Article 303. https://doi.org/10.3390/agriculture1503030m3

Magar, K. (2020). E-extension in Nepal: Brief overview in Nepalese agriculture. WikiJournal of Science, 3(1). https://doi.org/10.15347/wjs/2020.06

Marie, M., Yirga, F., Haile, M., & Tquabo, F. (2020). Farmers' choices and factors affecting adoption of climate change adaptation strategies: Evidence from northwestern Ethiopia. Heliyon, 6(4), Article e03867. https://doi.org/10.1016/j.heliyon.2020.e03867

Mishra, B. P., Sigdel, U. P., Devkota, D., & Devkota, K. (2023). Factors affecting the use of information and communication technology (ICT) for agricultural information among smallholder farmers in Chitwan and Lamjung districts of Nepal. Journal of the Institute of Agriculture and Animal Science, 37(1), 132–140. https://doi.org/10.3126/jiaas.v37i1.56995

Mittal, S., & Mehar, M. (2012). How mobile phones contribute to growth of small farmers? Evidence from India. Quarterly Journal of International Agriculture, 51(3), 227–244. https://doi.org/10.22004/ag.econ.155478

Ministry of Agriculture and Livestock Development. (2025). Ministry of Agriculture and Livestock Development. Government of Nepal.

Mustonen-Ollila, E., & Lyytinen, K. (2003). Why organizations adopt information system process innovations: A longitudinal study using diffusion of innovation theory. Information Systems Journal, 13(3), 275–297. https://doi.org/10.1046/j.1365-2575.2003.00141.x

Muzanenhamo, T. J., Tsvere, M., & Mubaya, C. P. (2024). Socio-demographic characteristics and adoption of mobile phone applications for improved small-scale commercial agriculture in Makonde District, Zimbabwe. East African Journal of Interdisciplinary Studies, 7(1), 397–408. https://doi.org/10.37284/eajis.7.1.2356

Navinkumar, Dhananjaya, B., Hanumanthappa, M., & Ranjeeth, T. H. (2018). Constraints faced by the farmers in using mobile agro-advisory services. International Journal of Current

Microbiology and Applied Sciences, Special issue-6, 2885-2890. http://www.ijcmas.com

Paudel, R., Baral, P., Lamichhane, S., & Marahatta, B. P. (2018). ICT-based agro-advisory services in Nepal. Journal of the Institute of Agriculture and Animal Science, 35(1), 21–28. https://doi.org/10.3126/jiaas.v35i1.22510

Rogers, E. M. (2010). Diffusion of innovations (4th ed.). Free Press.

Salampasis, M., & Theodoridis, A. (2013). Information and communication technology in agricultural development. Procedia Technology, 8, 1–3. https://doi.org/10.1016/j.protcy.2013.11.001

Samadder, S., & Rao, D. (2023). Role and importance of ICT in agricultural extension. In S. Thakur et al. (Eds.), Recent trends in agriculture (Vol. 13). Integrated Publications. https://doi.org/10.22271/int.book.221

Suriyapriya, E., Kavaskar, M., & Santha, G. (2018). Effectiveness of mobile agro-advisory service as perceived by the members of farmer producer organisation. Bulletin of Environment, Pharmacology and Life Sciences, 7(7), 32–36.

Thapa, K. (2018, May 18). ICT in agriculture: Need of the hour. The Himalayan Times. https://thehimalayantimes.com/opinion/ict-in-agriculture-need-of-the-hour

Thapa, M. (2023). Empowering agricultural extension agents of Nepal: Assessing ICT needs and constraints. Translingual: The Journal of International Voices, 2(1), 31–37. https://ielp.ehe.osu.edu/files/2023/12/Translingual-V2.-I1.-Final.pdf

Tiwari, B., Dumre, A., & Jaishi, M. (2024). Are farmers using mobile application for agro-advisory services: Evidence from Devchuli Municipality. Big Data in Agriculture, 6(2), 133–137. https://doi.org/10.26480/bda.02.2024.133.137

Vaidya, B., Rana, H., & Sharma, S. R. (2023). Adoption of digital agro-advisory services among smallholder farmers: Patterns of the innovation-decision process. Bodhi: An Interdisciplinary Journal, 9(1), 313–345. https://doi.org/10.3126/bodhi.v9i1.61847

Vosough, A., Eghtedari, N., & Binaian, A. (2015). Factors affecting ICT adoption in rural area: A case study of rural users in Iran. Research Journal of Fisheries and Hydrobiology, 10(10), 611–616.

We Are Social & Meltwater. (2025). Digital 2025: Nepal. DataReportal. https://datareportal.com/reports/digital-2025-nepal

Yamane, T. (1967). Statistics: An introductory analysis. Harper & Row.