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Smart Digital Tools for Livestock Farming: Ex-Ante Assessment of Willingness to Pay among Smallholder Dairy Farmers in India

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ABSTRACT

The study presents an ex-ante analysis of dairy farmers' demand and willingness to pay (WTP) for a smartphone application offering animal-specific alerts and service linkages. Using an open-ended contingent valuation method, WTP for the smart phone application was elicited among 611 dairy farmers in Uttar Pradesh and Haryana. The factors affecting WTP were estimated using Cragg's double hurdle model. Results showed that only 20.62% of respondents were willing to pay for the application despite widespread smartphone ownership. Factors such as age, education, herd size, and access to extension services influenced WTP. The findings suggest that alternative approaches, including public-private partnerships are needed to effectively scale digital innovations in India's dairy sector.

Keywords: Smart Digital Tools, Livestock Farming, Dairy Farmers, Willingness to Pay, Public-private Partnership

JEL Code: Q16, O33, Q12, O13, D12

I
INTRODUCTION

Use of digital tools and technologies is gaining popularity in livestock farming, particularly in case of precision livestock farming. With the rising demand for livestock products, these technologies have the potential to improve productivity and efficiency, while ensuring environmental sustainability and addressing animal welfare concerns (Birner et al., 2021; Klerkx et al., 2019; Pletsch et al., 2025; Yeates, 2017). From farmers' perspective, the immediate benefits of digital livestock technologies are highlighted in terms of its potential in assisting decision making and helping them to improve livestock management (Schillings et al., 2023).

Digital tools in livestock sector are broadly classified into different categories such as embodied digital tools including sensors and disembodied digital tools which include simple and smart mobile phone applications (Birner et al., 2021). While embodied tools often face adoption barriers due to high investment costs (Rathod and Dixit, 2020), smart disembodied tools offer affordable, data-driven solutions for animal health, breeding, and fertility management, particularly for smallholder farmers (Daum 2019; Daum et al., 2022). The increasing penetration of smartphones and mobile networks has further enhanced the scope for scaling of these digital technologies in developing countries (Aker, 2011; Aker et al., 2016). The digital transformation of agriculture and allied sectors are majorly driven by private companies, including agri-

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tech start-ups and software firms (Birner et al., 2021). In India, many agri-tech startups have emerged recently, focusing on the development and provision of digital tools and services. Providing customized advisories and services to farmers involve fixed development and dissemination costs, which are expected to be recouped through commercial business models involving subscription fee to individual farmers. Earlier studies indicated that the uptake of such paid digital services remains limited among smallholder farmers in developing countries (Fabregas et al., 2019). In this context, the current study tries to address the following research questions: Are dairy farmers in India, willing to pay for a subscription based commercial model of smart digital tool providing animal specific customized advisories and services? What are the major factors affecting their willingness to pay (WTP) for the smart digital tool? Based on the technology adoption and innovation diffusion literature, the study hypothesizes that farmers with higher education, having better access to information, and larger scale of dairy operations are more likely to exhibit a higher willingness to pay for smart digital tools.

Most of the existing studies on digitalization in the Indian livestock sector have primarily focused on demonstrating the scope and potential benefits of digital tools through pilot experiments or descriptive analyses. A few have documented case studies of digital service providers (Banerjee et al., 2025; Daum et al., 2022). Though a number of studies are available on digital advisory services, most of them are ex-post evaluations. There is a paucity of empirical evidence on the farmers' willingness to pay for non-embodied smart digital tools, that deliver animal-specific advisories, alerts, and service linkages to livestock farmers. This paper contributes to existing literature by conducting an ex-ante assessment of dairy farmers' readiness and willingness to pay for such digital tools. It further identifies the socio-economic and behavioral factors influencing farmers' demand for these innovations. By generating empirical insights into the drivers of adoption and willingness to pay, this study provides evidence-based guidance for scaling up digital innovations for the benefit of smallholder livestock farmers by enhancing affordable and inclusive access.

II

THEORETICAL AND CONCEPTUAL FRAMEWORK

Smart digital tools such as mobile applications and web platforms for agriculture and allied sectors are mainly considered as information/advisory (customized) service providers. Information is considered as a productive input, and like any other inputs, farmers will have a demand for information and they may be willing to pay for it (Dinar, 1996). However, the perfect market for information seldom exists in developing country context and there are some special characteristics of information such as rivalry, excludability and symmetry which are the necessary conditions for such perfect market situation (Anderson and Feder, 2007; Umali and Schwartz ,1994). In the current study context, rivalry implies that the use of the smart digital tools by one farmer reduces its availability to other farmers whereas

excludability indicates the farmers who are not willing to pay for the tool can be denied access.

In the context of smart digital tools offering farmer or animal specific advisories, the information becomes excludable but largely remains non-rivalrous, as one farmer's use does not diminish its utility for others. Such tools can therefore be classified as toll goods, and in this case, some farmers can be excluded from access if they are not willing to pay, but their value to users is not diminished by use by others. Furthermore, the prevalence of asymmetric information, where the buyers do not know the value of the information sold to them, and they may not trust sellers' claims may also result in their reluctance to pay.

Another theory applied in the study is the decision making theory. According to neoclassical economic theory, individuals are rational decision-makers who chooses actions that aim to maximize their utility. Decisions are assumed to be compensatory, implying that individuals weigh the perceived benefits of a good or service against its associated costs. As noted by Lades et al. (2025) and Frör (2008), individuals are presumed to have a clear understanding of the valuation scenario and to make rational choices that balance the benefits derived from a good with the expenditure required to obtain it.

In the current study, a hypothetical scenario of a smart digital tool (smart phone application) which provide animal specific advisories and alerts for heat detection, time of artificial insemination, disease diagnosis and preventive healthcare services was considered. In addition to customization of information, it is also assumed to bundle other inputs and services by connecting the farmers to qualified service providers. The services can be availed by dairy farmers through registration and payment of a monthly subscription fee.

As the digital innovations are currently led by private agencies, we are also assuming the smart digital tools as a private led innovation which involves fixed technology development and dissemination costs. They can use different business models for cost recovery and introduction of a subscription fee for customised advisory and service provision is one of the alternatives for the same.

The dairy farmers, the potential customers, may decide to pay the subscription fee for the smart digital tool, if the perceived benefits are more than the cost incurred on it and it is conditional on various factors like socio-economic and demographic characteristics of the farm, farmer, attributes of the digital tools *etc*. Dairy farmers' readiness to pay for it and its determinants will further help in designing its scale up strategies. The conceptual framework of the study is summarised in Figure 1.

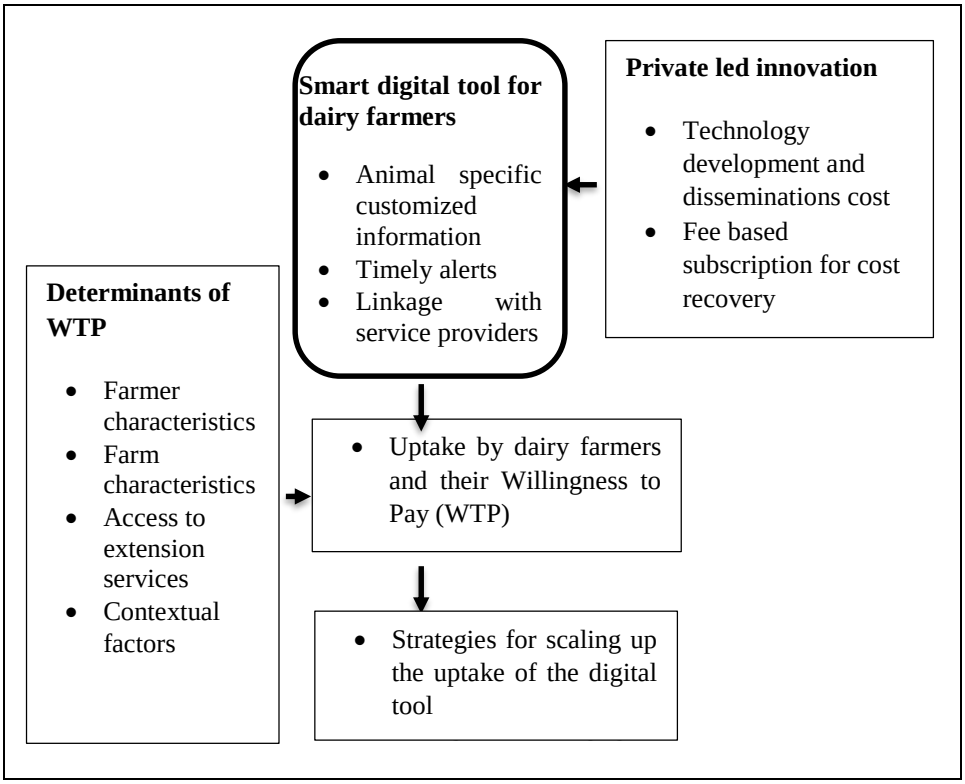

FIGURE 1. CONCEPTUAL FRAMEWORK OF THE STUDY

III

MATERIALS AND METHODS

The study was undertaken in two major milk producing states in India *viz;* Uttar Pradesh and Haryana (Figure 2). Two districts each were selected purposively considering the dairy profile in each state (Muzaffarnagar and Bulandshahr from Uttar Pradesh and Karnal and Sonipat from Haryana) and from each district two blocks were selected randomly. From the selected blocks five villages each were randomly selected and from each village, 15 households were selected for the study. Few additional large dairy farms in the selected districts were also added in the sample, thus the final sample size used for the estimation was 611 dairy farming households. Primary survey was conducted among the sampled households using structured interview schedule. Major decision maker of the household related to dairy farming was the respondent of the survey. In majority of the cases, the respondents were the respective household heads.

For assessing dairy farmers' willingness to pay (WTP), contingent valuation method, a stated preference method was used. The elicitation technique of open-ended

contingent valuation was applied in the current study. A brief description about the smart phone application and its potential benefits along with the hypothetical payment scenario were presented to the respondent dairy farmers during the survey. The description presented to the farmers was as follows:

"Many smart phone applications are now available which gives timely and animal specific advisories and alerts for heat detection, time of artificial insemination, disease outbreak, vaccination *etc.* for dairy animals after registering the farmer and animal details. They can also connect you to qualified service providers who provide artificial insemination service, vaccination services and other health services at a specific cost. Suppose there is some monthly subscription fee for using such applications, are you willing to pay for that? Yes/ No

If yes, what is the maximum amount of money you would be willing to pay for an animal on a monthly subscription basis?" Rs…….

The response was recorded as "yes" or "no" for their readiness to pay the subscription fee. Through the follow up question (open ended), the maximum amount they are willing to pay for an animal per month was also recorded from the farmers who were willing to pay for such services. As there are chances of overstating the WTP in the hypothetical scenario, participants were explicitly informed regarding it and asked them to answer as if the payment was real. It was also clarified to the respondents that whether the non-willingness to pay for the smart phone application was associated with lack of its need. But, majority of the farmers were ready to use it if provided free of cost.

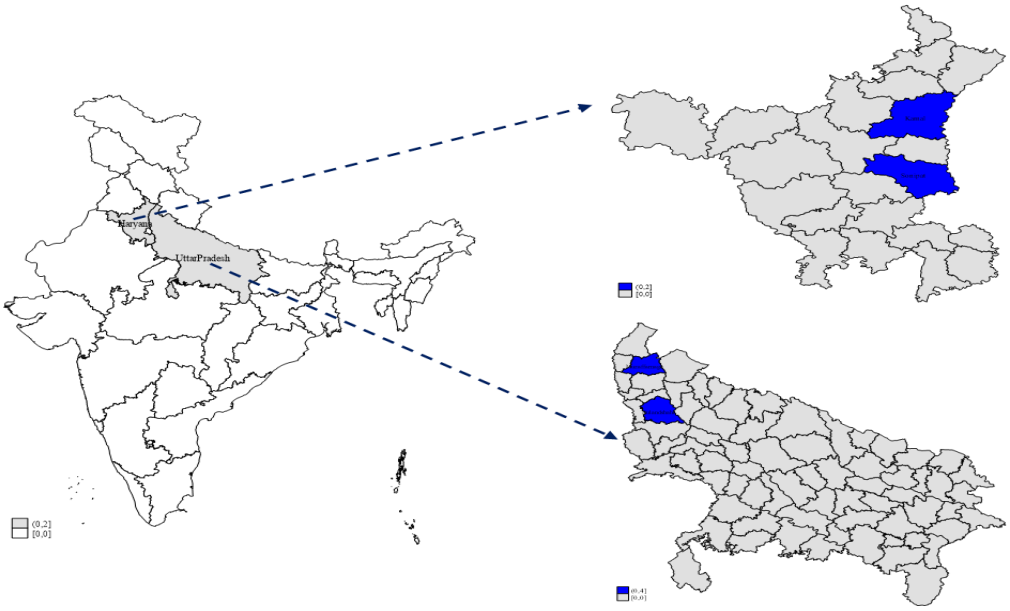

FIGURE 2. STATES AND DISTRICTS SELECTED FOR THE STUDY

Yet, the methodology has some limitations also. Though open-ended contingent valuation approach allows respondents to express their valuation without anchoring effects, it is often criticized for imposing a high cognitive burden, as respondents need to think too much to assess the utility of the service and determine an appropriate payment amount. There are also chances of getting large number of zero values along with very large values for the willingness to pay (Mitchell & Carson, 1989).

3.1 Empirical Estimation of Factors Affecting WTP

Building on the utility maximization theory, individual farmers are expected to choose the option that yields the highest level of utility, subject to their budget constraints and personal characteristics. The maximum amount of money an individual farmer is willing to forgo to obtain smart phone application, while keeping their overall utility constant is considered as their willingness to pay (WTP) for it.

$$U_i = V_i(X_i, Y_i) + \varepsilon_i$$

Where,

U_i= Total utility of individual farmer *i*,

$V_i(X_i, Y_i)$ = Observable component of utility determined by attributes of the application and socio-economic characteristics

ε_i= Unobservable/random component

"To identify the factors affecting dairy farmers' decision to pay towards a monthly subscription for a smart digital application and the amount they are willing to pay, we performed regression analysis." In the current study, as a large number of dairy farmers were not willing to pay for the smart digital tool, a limited dependent variable estimation methods would be more suitable for the empirical estimation (Humphreys, 2013). Though, the data regarding decision to pay is zero inflated, it does not necessarily indicate that there is no demand for the digital tool. Majority of the farmers who were not willing to pay also expressed their view that "they will use it, if provided free of cost". Hence, to accommodate the zero values also in the estimation, we have used a double hurdle model (Cragg, 1971) which assumes two step separate decision process expressed as hurdles. In our study, the first hurdle involves the decision of whether to pay or not pay for the application and the second hurdle involves the decision of how much to pay for such services. The first hurdle was estimated using probit regression and the second hurdle using truncated regression model. Model specifications of the first hurdle (Eqn 1- selection equation-Probit model) and the second hurdle (Eqn. 2 – intensity equation: truncated regression) are given below:

$$D_i^* = Z_i\delta + u_i, u_i \approx N(0,1) \quad \text{(Eqn 1-Selection equation)}$$

$$D_i = \begin{cases} 1 \; if \; Z_i\delta + u_i > 0 \\ 0 \; if \; Zi \; \delta + ui \leq 0 \end{cases}$$

Where, D_i^* refers to latent variable describing the readiness to pay for the smart phone application. Z_i refers to vector of explanatory variables explaining the willingness to pay for the application. δ refers to unknown parameter to be estimated in the model and u_i refers to the error term assumed to be independent and normally distributed.

The probability of payment is estimated using probit model with the following form:

$$P\ (D_i = 1|Z_i) = \Phi\ (Z_i\delta)$$

$$Y_i^* = exp\ (X_i\beta + \varepsilon_i),\ \varepsilon_i \approx Exponential(1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(Eqn 2-Intensity equation)}$$

$$Y_i = \begin{cases} y_i^* \; if \; D_i = 1 \; and \; exp(X_i\beta + \varepsilon_i) > 0 \\ 0 \; if \; D_i = 0 \; and \; exp(X_i\beta + \varepsilon_i) \leq 0 \end{cases}$$

Y_i^* refers to dependent variable that describing the amount the respondents were willingness to pay. β refers to unknown parameter to be estimated in the model. ε_i refers to the error term with an exponential distribution.

In the selection equation, farmers' willingness to pay the subscription fee expressed as 'yes' or 'no' answers were the dependent variable and the explanatory variables included the gender, age, education, experience in livestock farming and training in livestock management for the main decision maker related to livestock activities, caste category to which the household belong, number of breedable dairy animals (adult female animal in the reproductive age) the household possess, access to extension services and smart phone possession. State dummies were also included to address the state specific heterogeneity in preferences. All these variables, except the smart phone possession were included in the intensity equation with the amount the respondents were willingness to pay as the subscription fee per animal basis as dependent variable.

IV

RESULTS AND DISCUSSION

4.1 Characteristics of the Respondents and the Households

Results of the study highlighted that only 20.62 percent of the respondents were willing to pay for smart phone application subscription, though the smart phone possession status was high. Nearly 78.72 percent of the respondents were possessing smart phone in the study area (Figure 3). Further summary of the respondents' characteristics is given in Table 1. Summary of the characteristics of the respondent farmers across two groups viz; those who are willing to pay and not willing to pay and the difference between them tested statistically using two sample T test are summarized

TABLE 1. CHARACTERISTICS OF RESPONDENT FARMERS

Variables	Pooled sample (N=611) (1)	Respondents willing to pay (N=126) (2)	Respondents not willing to pay (N=485) (3)	Difference (2)-(3)
Gender of the respondent (=1 if male; 0 other wise)	0.95 (0.01)	0.99 (0.01)	0.95 (0.01)	0.04** (0.01)
Age of respondent (years)	48.84 (0.49)	45.32 (1.16)	49.76 (0.54)	-4.43*** (1.21)
Education of respondent (years)	9.14 (0.17)	11.27 (0.29)	8.59 (0.19)	2.68*** (0.41)
Experience in livestock farming (Years)	18.63 (0.39)	14.51 (0.66)	19.70 (0.46)	-5.18*** (0.96)
Training in livestock management (=1 if received; 0 other wise)	0.04 (0.01)	0.09 (0.03)	0.03 (0.01)	0.06*** (0.02)
Households belonging to general caste (=1 if general caste; 0 other wise)	0.53 (0.02)	0.56 (0.04)	0.52 (0.02)	0.03 (0.05)
Households belonging to Other Backward Castes (OBC) caste (=1 if OBC; 0 other wise)	0.33 (0.02)	0.38 (0.04)	0.32 (0.02)	0.06 (0.05)
Households belonging to Scheduled Caste/ Scheduled Tribe (SC/ST) (=1 if SC/ST; 0 other wise)	0.13 (0.01)	0.06 (0.02)	0.15 (0.02)	-0.08*** (0.03)
Number of breedable animals	3.95 (0.19)	6.67 (0.63)	3.25 (0.15)	3.43*** (0.44)
Access to extension services (=1 if having access; 0 other wise)	0.06 (0.01)	0.09 (0.03)	0.05 (0.01)	0.04* (0.02)
Smart phone possession (=1 if possess; 0 other wise)	0.79 (0.02)	0.98 (0.01)	0.74 (0.02)	0.24*** (0.04)

Note: *** Significant at the 1% level, ** Significant at the 5% level, *Significant at 10% level. Standard errors are given in the parenthesis

in Table 1. Majority of the respondents (decision makers of the dairy farming households) were men with an average age ranging between 45.32 to 49.76 across groups. Respondents who were willing to pay for the service were found to have significantly higher education compared to their counter parts, whereas their experience in dairy farming was bit lower. In case of participation in training, access to extension service, smart phone possession and number of breedable animals in the herd also the respondents who are willing to pay were relatively better off.

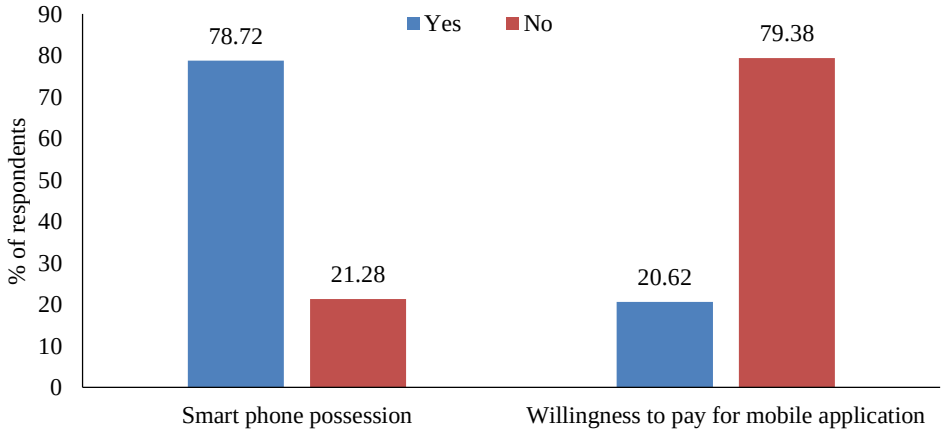

FIGURE 3. SMARTPHONE POSSESSION OF THE RESPONDENTS AND THEIR WILLINGNESS TO PAY FOR MOBILE APPLICATION

4.2 Dairy Farmers' Willingness to Pay for Smart Digital Tool and the Factors Affecting

Dairy farmers' WTP for the smart phone application was elicited through an open ended contingent valuation method. The WTP amount expressed by the respondents (20.62%) indicated a very high variation where the subscription fee per animal per month they were willing to pay ranged between Rs. 5 to Rs. 150. The mean WTP amount was Rs.31.15 per animal per month. Distribution of willingness to pay amount is highly skewed as indicated in Table 2.

TABLE 2. AVERAGE WTP AMOUNT AMONG THE RESPONDENTS

	Mean	Standard Deviation	Minimum	Maximum
Amount Willing to Pay (Rs./Animal/Month)	31.15	27.50	5	150

As the decision regarding WTP involves two hurdles; first one whether to pay for the service or not and second hurdle on decision regarding how much subscription fee to be paid the factors affecting the decisions were estimated through a double hurdle model and the results of the estimation are given in Table 3. Considering the skewed distribution of WTP amount, an exponential distribution is assumed in the second hurdle estimation.

Estimates in Table 3 indicated that as the age of the respondent increases, their readiness to pay for the smart digital tool for dairy farming significantly decreases. The education level and livestock farming experience of the farmers play a positive role in decision making towards the payment of the subscription fee. In Indian context, the caste dynamics also has a significant effect of the payment capacity of the farmers and the probability of payment was significantly lower among farmers who belong to backward and marginalized castes compared to general caste category. Relatively wealthy farmers, who owns more number of breedable dairy animals had significantly higher probability of subscription fee payment. Smart phone possession, one of the essential requirement of installation of the mobile application, undoubtedly affected farmers' decision to pay. In case of Uttar Pradesh, the state where the information and service gaps in livestock are higher, the probability of farmers deciding to pay for the digital tool was significantly higher compared to Haryana which is better off in those regards.

TABLE 3. FACTORS AFFECTING WTP: DOUBLE HURDLE MODEL ESTIMATES

Variables	1st Hurdle (Probit model)	2nd hurdle (Outcome model)
	Coefficient	Coefficient
Gender of the respondent (1=Male; 0 other wise)	0.80 (0.83)	-0.26 (0.72)
Age of the respondent	-0.04*** (0.01)	-0.01 (0.01)
Education of the respondent	0.06** (0.02)	0.02 (0.02)
Experience in livestock farming (Years)	0.07*** (0.02)	0.01 (0.02)
Training in livestock management (1=Yes; 0 otherwise)	0.38 (0.38)	-0.23 (0.27)
Caste category (Base=General)		
Other Backward Castes	-0.44** (0.17)	-0.47*** (0.14)
Scheduled Caste/ Scheduled Tribe	-0.87*** (0.26)	-0.32 (0.26)
Breedable animals	0.07*** (0.01)	-0.02* (0.01)
Access to extension services	0.53 (0.34)	0.58** (0.26)
Smart phone possession	1.56*** (0.36)	-
State dummy (1=Uttar Pradesh; 0=Haryana)	2.39*** (0.26)	-0.93*** (0.31)
Constant	-4.68*** (1.08)	90.12 (73.22)
Pseudo R2	0.40	0.20
N	611	611

Note: *** Significant at the 1% level, ** Significant at the 5% level, *Significant at 10% level.
Standard errors are given in the parenthesis

In Hurdle 2 estimation, the factors affecting the amount of money the farmers were willing to pay were identified. Compared to hurdle 1, major factors affecting the decision were quite different except the caste variable. Similar to the results in the hurdle 1, the farmers who belonged to marginal castes were willing to pay significantly lower amount compared to other castes. As the number of breedable animals increased, farmers' WTP amount decreased significantly indicating a negative own- price elasticity which is commonly observed in contingent valuation studies. Access to extension services positively influence the farmers WTP amount as it could help in overcoming the information asymmetry. Though the readiness to pay for digital tool among dairy farmers in Uttar Pradesh was significantly higher compared to Haryana, when it comes to WTP amount, it was significantly lower among the farmers in Uttar Pradesh compared to those of Haryana (Table 3).

Considering the two stages of estimation, the average marginal effects of different predictor variables on willingness to pay were calculated and the results are given in Table 4.

TABLE 4. AVERAGE MARGINAL EFFECT OF THE PREDICTORS ON WILLINGNESS TO PAY

Variables	Marginal effect
Gender of household head (1=Male; 0 other wise)	3.33 (7.20)
Age of household head	-0.28** (0.12)
Education of household head	0.53** (0.22)
Experience in livestock farming (Years)	0.48** (0.19)
Training in livestock management (1=Yes; 0 otherwise)	0.83 (3.04)
Caste category (Base=General)	
BC	-5.59*** (1.37)
SC/ST	-6.63*** (1.61)
Breedable animals	0.33*** (0.12)
Access to extension services	7.29** (3.09)
Smart phone possession	9.92*** (2.60)
State dummy (1=Uttar Pradesh; 0=Haryana)	8.92*** (1.82)

Note: *** Significant at the 1% level, ** Significant at the 5% level. Standard errors are given in the parenthesis

Better education of household head, more experience in livestock farming, bigger herd size of breedable animals (adult female animals in the reproductive age), access to extension services and smart phone possession positively and significantly affect the dairy farmers' WTP for the subscription fee of smart digital tool/ mobile application. State, where the information and service gaps are relatively high, the readiness to pay increases as seen in case of Uttar Pradesh, compared to Haryana state in India. As the age of farmers increase by one year, the WTP significantly decreases by 0.28 units. Similarly, the farmers belonging to marginalized caste groups were found to have less WTP compared to the other caste groups.

Over the past decade, smart phone ownership had increased significantly across developing countries. In India, the Comprehensive Modular Survey conducted by the National Statistical Office (2025) reported that 79.2% of rural males and 75.6% of rural females aged 15 years and above owned a smartphone and 83.3% of rural households had access to internet facilities within their premises. Consistent with these national figures, the present study also found that more than 75% of respondents owned a smart phone, suggesting considerable potential for the application of digital technologies in agriculture and allied sectors.

Smartphone-based tools can enhance access to private and extension-based agricultural information, improve management of input–output supply chains, facilitate delivery of services, strengthen accountability of extension systems, and foster communication linkages with research institutions (Aker, 2011). However, increased ownership does not necessarily reflect on its active use, especially on payment basis for agricultural purposes. In Kenya, smartphones have become more affordable and widely available, but the adoption of agricultural mobile applications remains low (Aparo et al., 2024). Fabregas et al. (2019) reported the low scale adoption of subscription based financial models of digital agricultural extension systems in the developing world. They also highlighted that even when the farmers were willing to pay, it may not be sufficient to cover the fixed development cost of the technology and customized information creation by the firm.

Earlier studies had also established that education of farmers, their experience in livestock farming characteristics, herd size and extension contact positively influence the adoption and willingness to pay towards digital technologies in agriculture allied sectors (Amoussohoui et al., 2024; Drewry et al., 2019; Groher et al., 2020; Silvi et al., 2021). An effective extension service can help the farmers to overcome information asymmetry, improve technological knowledge and improve learned decision making ability of farmers for better outcomes (Amoussohoui et al., 2024). Extension service can also help in confirming the measurable benefits of the digital technology to farmers so that it can create more demand among the farmers and may positively affect their willingness to pay (Rajkhowa and Qaim, 2021). Strengthening existing extension pathways and disseminating more information regarding use of smart digital tools among smallholders are crucial for improving technology penetration (Aparo et al., 2024).

A smart digital tool can achieve desirable outcomes in agriculture when there is imperfect information or when the information (general or specific) is a constraint (Aker et al., 2016). In our study, we had considered the demand/willingness to pay for a smart digital tool for dairy farmers across two Indian States; Haryana and Uttar Pradesh and it was found that the demand for the tool is high among farmers in Uttar Pradesh in comparison to Haryana. Access to livestock related information, infrastructure and services in Uttar Pradesh are lower in comparison with state like Haryana (Ashok and Chand, 2025). This implies the importance of demand-driven

digital service design, tailored to region-specific needs and information gaps. Moreover, early understanding of user contexts and readiness is critical for sustainable adoption (McCampbell et al., 2023).

V

CONCLUSION AND POLICY IMPLICATIONS

Smart digital technologies in livestock farming have the capability to enhance productivity, animal health, resource efficiency and environmental sustainability. Rapid growth of mobile connectivity and increasing smartphone penetration had added further momentum to the digital innovation generation and its use. In recent decades, many private agencies have evolved focusing on digital innovation generation for the benefit of the farming community in India. As many new innovations focus on customized information provision, it involves more fixed costs which they try to recover through commercial scaling. Finding adequate market size cover the innovation development cost is often a challenge for private firms in the initial stage and commercial scaling of non-transactional services like advisory provision among smallholder farmers is difficult due to many factors. Our current study indicates that only a small proportion of dairy farmers in India are willing to pay for such services and it is dependent on socio-economic and farm-level factors such as education and herd size. The findings also emphasize that technology adoption cannot rely solely on digital access but must be supported by effective extension systems that reduce information asymmetry and can demonstrate measurable benefits of the technology. Addressing region-specific information and service gaps can further enhance the effectiveness and equity of digital transformation in the livestock sector.

When cost recovery is a prime concern among the innovation developers, its affordable access is critical for smallholder farmers. In such context, public private partnership can help in effective scaling of the smart digital tools where the public sector role could be in terms of funding the innovators or providing effective extension services to overcome information asymmetry and to build trust on the technology among the potential beneficiaries. The modalities of the partnership may be established as per the objectives of both parties.

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