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An Ai-driven Livestock Communication Model for Enhancing Farmer Engagement: A Field Study from Sirsa, Haryana

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ABSTRACT

The adoption of digital technologies in livestock farming is often limited by gaps in farmer engagement and ineffective communication systems. This study evaluates an AI-driven communication model designed to enhance livestock management practices through improved interaction and behavioral motivation among farmers in Sirsa district of Haryana. A field survey was conducted among 59 livestock farmers using structured questionnaires and personal interaction. The study assessed digital access, livestock practices, and farmer responsiveness to AI-based tools. Results revealed that while 95% of farmers used mobile communication platforms, only 18% had experience with livestock applications. A majority (88%) preferred voice-based communication, and 76% showed increased motivation through performance-based engagement features. Farmers also showed willingness to adopt simple data recording practices such as milk yield and animal weight tracking. The findings indicate that effective communication design, simplicity, and engagement mechanisms play a critical role in technology adoption. The study concludes that integrating artificial intelligence with participatory communication strategies can significantly improve farmer engagement and decision-making. The proposed model offers a scalable solution for strengthening digital livestock extension services in rural areas.

Introduction

Livestock farming plays a significant role in global agriculture, contributing to food security, income generation, and rural livelihoods. The sector supports more than one billion people worldwide and contributes substantially to agricultural output, especially in developing countries (FAO, 2011; Thornton, 2010). In India, livestock contributes about 4–5% to the national GDP and nearly one-fourth of agricultural GDP, making it a critical component of the rural economy (Government of India, 2022). States like Haryana have a well-established livestock sector, particularly in dairy production, where districts such as Sirsa depend heavily on cattle and small ruminants for income and sustainability (Department of Animal Husbandry & Dairying, 2023). With the expansion of mobile connectivity in rural areas, digital technologies have emerged as potential tools for improving

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livestock management through better information delivery and advisory services. However, despite high mobile penetration, the actual use of livestock-related applications remains low among farmers. Studies have shown that factors such as lack of awareness, poor usability, and mismatch between technology design and farmer needs limit adoption (Mittal and Mehar, 2016; Klerkx et al., 2019). Artificial Intelligence (AI) offers opportunities to enhance advisory systems through data-driven insights and personalized recommendations (Wolfert et al., 2017). However, the effectiveness of such technologies depends not only on their technical capabilities but also on how well they are communicated and adopted by farmers. Most existing approaches focus on technology development rather than farmer engagement and communication design. The importance of communication in development has been emphasized in various Indian studies, where traditional and modern media are considered essential tools for rural transformation. The concept of communication as a universal medium has been discussed in Smart Media: Ek Sarvabhaum Madhyam (Kadian, 2023), which highlights the expanding role of media in connecting institutions with society. Similarly, regional perspectives presented in Haryana Janvichar ke Vividh Ayam (2020) underline the significance of participatory communication and public engagement in strengthening rural governance and awareness. These perspectives support the idea that effective communication, rather than technology alone, plays a crucial role in improving adoption, interaction, and behavioral change among farmers. The Telegaon model implemented in Sagar district of Madhya Pradesh (Singh, 2005) serves as an early example of effective development communication based on direct interaction between administration and rural communities. The model involved scheduled telephonic communication where villagers could register their problems, and officials ensured timely review and resolution through regular monitoring. It demonstrated that simple, structured, and participatory communication systems can significantly improve governance and rural problem-solving. This approach highlights that the success of any extension system depends not only on technology but also on communication design, accountability, and farmer engagement, which strongly supports the AI-driven communication framework proposed in the present study. Despite these insights, there is limited field-based evidence on how AI-enabled communication tools, combined with simple engagement mechanisms such as voice interaction and performance comparison, influence farmer participation and behavioral change in livestock systems, particularly at the district level. Therefore, the present study was conducted with the following objectives: (i) to assess the digital access and communication behavior of livestock farmers in Sirsa district, with particular focus on their use of mobile platforms and awareness of livestock-related applications; (ii) to evaluate farmer response to selected AI-enabled communication features, including voice-based interaction and simple data recording practices such as milk yield and animal weight tracking; and (iii) to examine how basic engagement mechanisms, such as performance comparison and interactive elements, influence farmer participation and to develop a practical communication model for strengthening digital livestock extension services.

Materials and Methods

The study was conducted in Sirsa district of Haryana, where livestock farming is a major source of livelihood. A total of 59 livestock farmers were selected based on their availability and willingness to participate. Data were collected using a structured questionnaire through Google Forms and personal interaction. Information related to farmer profile, livestock practices, mobile usage, and communication preferences was collected. Selected features such as milk yield recording, goat weight tracking, and voice-based communication were explained to farmers, and their responses were recorded. Data were analyzed using descriptive statistics such as frequency and percentage with the help of Microsoft Excel.

Results

The results of the present study reveal a clear gap between digital access and the effective use of livestock-related technologies among farmers in Sirsa district. A large majority of respondents (95%) reported regular use of mobile phones and communication platforms such as WhatsApp, indicating a high level of digital connectivity in the study area. However, only 18% of farmers had prior experience with livestock-related mobile applications. Despite this low level of application use, around 68% of farmers expressed willingness to adopt digital tools if they were simple, locally relevant, and easy to operate. The details of digital access and adoption are presented in **Table 1**, while the contrast between high access and low application use is clearly illustrated in Fig. 1.

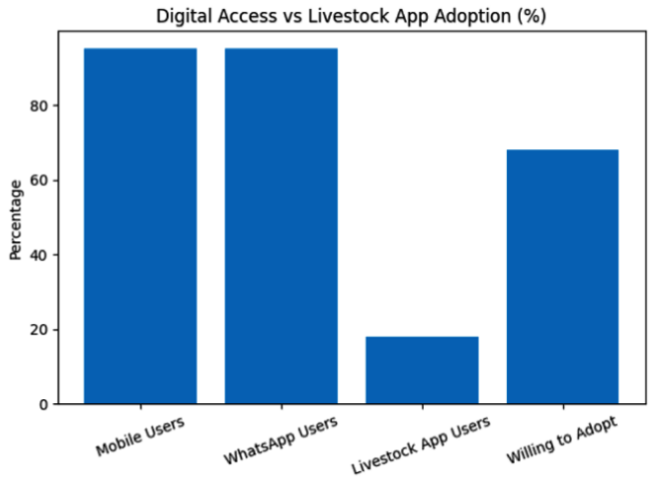


Fig. 1: Digital access and adoption of livestock-related technologies among farmers

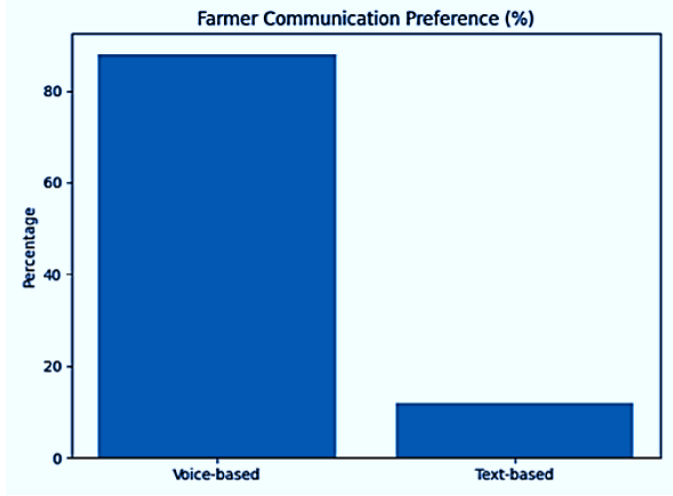


Fig. 2: Preference of livestock farmers for communication methods (voice vs text)

Table 1: Digital access and use of livestock-related technologies among farmers (n = 59)

Parameter	Percentage (%)
Farmers using mobile phones	95
Farmers using WhatsApp	95
Farmers using livestock applications	18
Farmers willing to adopt digital tools	68

Further analysis of communication preferences showed that farmers strongly favored voice-based interaction over text-based communication. About 88% of respondents preferred audio communication, as it is easier to understand, requires less effort, and is more compatible with their daily routine. In contrast, only 12% of farmers preferred text-based communication. This clear preference highlights the importance of designing advisory systems that align with the communication behaviour of farmers. The distribution of communication preferences is presented in Fig. 2.

When farmers were introduced to simple data recording practices such as daily milk yield entry and animal weight tracking, their response was encouraging. Although most farmers did not maintain records earlier, nearly 68% showed willingness to adopt these practices when explained in a simple manner. Farmers also indicated that maintaining such records could improve monitoring and decision-making at the farm level. An important finding of the study relates to the response towards engagement-based features. When the concept of a leaderboard or performance comparison was introduced, about 76% of farmers responded positively. They believed that such features could motivate them to improve performance and remain actively involved in livestock management activities. This suggests that farmer participation can be enhanced not only through information delivery but also through simple motivational and interactive approaches. Overall, the results indicate that while digital infrastructure is already available, the adoption of livestock-related technologies depends largely on simplicity, communication design, and user engagement. Tools that are easy to use, locally understandable, and interactive are more likely to be accepted and adopted under field conditions.

Discussion

The findings of the present study clearly highlight a substantial gap between digital access and the actual adoption of livestock-related technologies among farmers. Although a large proportion of farmers reported regular use of mobile phones and communication platforms, as indicated in **Table 1** and further illustrated in **Fig. 1**, the use of livestock-specific applications remains considerably low. This gap suggests that the issue is not the availability of digital infrastructure but the lack of

user-friendly, relevant, and need-based technological solutions. Similar observations have been reported in earlier studies (Mittal and Mehar, 2016; Klerkx et al., 2019), which emphasize that adoption is strongly influenced by usability, awareness, and contextual relevance rather than mere access.

One of the most significant findings of this study is the strong preference for voice-based communication, with a majority of farmers favour audio interaction over text-based systems, as shown in Figure 2. This preference reflects the practical realities of rural settings, where literacy constraints, time limitations, and ease of use play an important role in technology acceptance. Voice-based systems reduce cognitive effort and make advisory services more accessible, suggesting that future digital extension models should prioritize audio-enabled interfaces for better outreach and effectiveness.

The study also demonstrates that farmers are willing to adopt simple data management practices when they are presented in an easy and understandable format. The positive response towards recording daily milk yield and animal weight indicates that farmers recognize the value of data in improving farm-level decision-making. However, the adoption of such practices depends on simplicity and perceived usefulness, reinforcing the need for designing technologies that align with farmer capabilities and daily routines. Another important insight is the positive response towards engagement-based features such as performance comparison and leaderboard systems. A significant proportion of farmers reported increased motivation when such features were introduced, indicating that behavioral and motivational components can play a crucial role in enhancing participation. This aligns with the concept of gamification in extension systems, where simple competitive elements can improve user engagement and sustained usage. Overall, the findings suggest that the effectiveness of AI-driven livestock communication systems depends less on technological sophistication and more on communication design, user engagement, and contextual adaptability. The integration of voice-based interaction, simple data recording, and motivational features can significantly improve farmer participation and technology adoption. These results support the need for a communication-oriented approach in designing digital extension systems, where technology serves as a facilitator rather than a standalone solution.

Conclusion

The present study demonstrates that the primary challenge in adopting digital livestock technologies lies not in access but in communication design, usability, and user engagement. Although farmers are well connected through mobile platforms, livestock-specific applications remain underutilized due to limited awareness, relevance, and ease of use. The findings indicate a preference for simple, practical, and voice-based communication systems aligned with farmers' daily routines and capabilities. Positive responses toward basic data recording and engagement-based features, such as performance comparison, suggest a willingness to adopt digital tools when they offer tangible benefits and are locally relevant. Integrating artificial intelligence with participatory, user-friendly communication strategies could improve farmer interaction, motivation, and decision-making. However, the study is limited by its relatively small sample size and reliance on self-reported responses. Future research should focus on large-scale implementation and validation across diverse field conditions. Overall, a communication-oriented and behavior-driven approach can strengthen digital livestock extension systems, with potential integration into existing institutional frameworks, particularly Krishi Vigyan Kendras (KVKs), to enhance outreach, scalability, and impact.

Conflicts of interest and financial disclosures

The authors state that there are no conflicts of interest to disclose.

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