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# Understanding Livestock Technology Adoption and Farmer Decision-Making through Participatory Rural Appraisal: Evidence from an Adopted Village in Maharashtra, India

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***Abstract***— *The present exploratory and participatory study was purposively conducted in Shirol village of Udgir tehsil in Latur district of Maharashtra. The village was adopted by the College of Veterinary and Animal Sciences, Udgir under the Unnat Bharat Abhiyan Scheme. This study explores the dynamics of livestock technology adoption among farmers in Shirol village, utilizing Participatory Rural Appraisal (PRA) techniques. Recognizing the critical role of animal husbandry in rural Indian livelihoods, the research investigates how farmers make decisions regarding modern agricultural practices within a mixed-farming context. Using a whole-village participatory approach, primary data was gathered through PRA tools, specifically technology mapping, matrix ranking, and consequence diagram. The findings revealed that technologies are not simply adopted, but are discontinued, over-adopted, rejected, or reinvented as well based on practical field problems. Matrix ranking demonstrated that farmers prioritize simple, low-cost, and highly effective practices. Furthermore, farmers showed remarkable adaptability by reinventing tools such as creating homemade concentrate feeds and crafting low-cost poultry equipment to minimize daily expenses. While technologies like artificial insemination and vaccination ranked lower in overall farmer preference due to a heavy dependence on external veterinary services and specialized technicians. Ultimately, the integration of these livestock technologies has significantly enhanced animal health, milk yields, and overall socio-economic conditions in the region. However, realizing their full potential is hindered by high initial costs, limited awareness, and irregular technical support. The study concludes that strengthening field-level extension services and improving veterinary accessibility are vital steps toward promoting sustainable livestock development and maximizing technological benefits for rural communities.*

***Keywords— Participatory Rural Appraisal (PRA), Matrix ranking, Consequence diagram, Livestock technology, Technology adoption, Decision-making, Dairy farming, Goat rearing, Backyard poultry, Maharashtra.***

## I. INTRODUCTION

In India more than 20.5 million people depend on animal husbandry for their livelihood, thereby making livestock a vital source of additional income (Jain et al., 2023). Despite having a vast bovine population of 302.79 million (20th Livestock Census, 2024), the per capita milk production remains one of the lowest globally. However, recent studies have shown that adoption of improved technologies has worked for increase in the production as well as productivity of livestock, generating marketable surplus of milk and other livestock produce. In India, most of the farming is mixed type of farming in which farmers keep milch animals along with goat keeping and poultry to supplement income from livestock production, so this makes decision-making more complex than other types of farming. The term 'Participatory Rural Appraisal (PRA)' is being used to describe approaches and methods growing to enable local people to share, enhance and analyze their knowledge of life and conditions, thereby, to plan, to act and reach development (McCracken et al., 1988). To study impact of adoption of various livestock technologies and farmers' decision-making patterns, participatory rural appraisal techniques were used in the present study.

## II. MATERIALS AND METHODS

The present research was purposively conducted in Shirol village of Udgir tehsil in Latur district of Maharashtra, which was adopted by the College of Veterinary and Animal Sciences, Udgir under the Unnat Bharat Abhiyan. Shirol village has 2915 human population (Census, 2011) and 1466 livestock population (20th Livestock Census, 2024). Livestock ownership in this village mainly consists of cattle rearing followed by goat and poultry. The study was conducted by a team of multidisciplinary experts. An exploratory and participatory research design was adopted using a whole-village approach. Primary data was collected through various PRA tools viz. technology mapping, matrix ranking, and consequence/impact diagrams to gather information on farmers' decision-making behaviour regarding technology adoption, the criteria affecting adoption, and the outcomes connected with the use of improved livestock technologies.

Technology map was prepared separately to illustrate the presence of various livestock technologies in the village as well as the farmers' decision behaviour. These maps depicted technologies that were adopted, discontinued, over-adopted, rejected, or modified (reinvented) for different types of domestic animals. The identification of livestock technologies was carried out through transect walks across the village along with key informants, including direct observation, interaction, and focussed discussion. Following this, matrix ranking was conducted to analyze the factors influencing different patterns of technology-related decisions among farmers. Finally, based on the matrix ranking results, a consequence diagram was developed to understand the outcomes and impacts of livestock technology adoption.

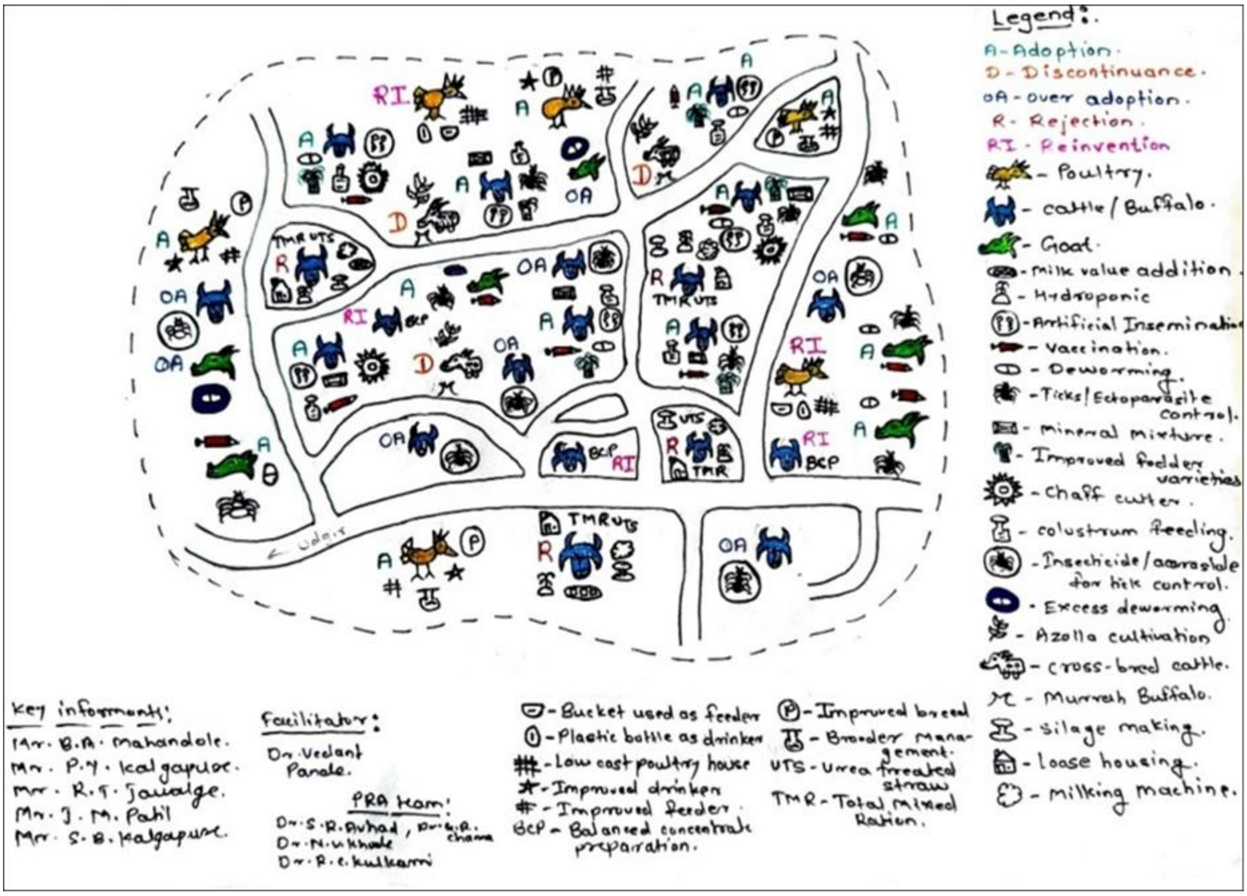


**FIGURE 1: Technology map of Shirol village**

# III. RESULTS AND DISCUSSION

## 3.1 Impact of Livestock Technology Adoption

The technology map (Fig. 1) reveals the different decision-making behaviour of farmers. Adoption is defined as the continued use of a technology as the best course of action. According to Chambers (1994), the aim of PRA is to help strengthen the capacity of villagers to plan, make decisions, and to take action towards improving their own situation. In this adopted village the impact of the livestock technology adoption was analysed. In village situations, technologies may be adopted, discontinued, over-adopted, rejected, or reinvented depending on farmers' experiences and constraints. Several livestock technologies were widely adopted by farmers in the adopted village Shirol, as they were perceived to be simple, beneficial, and supported by veterinary extension services. In dairy farming, practices such as artificial insemination, vaccination against major diseases (FMD, HS, BQ, and LSD) were practiced. These findings are in consonance with Reddy and Krishna (2002). In case of deworming, tick and ectoparasite control practices, the results corroborate with Ntume et al. (2015), who reported the widespread adoption of these practices by farmers. Regarding nutrition-related livestock practices viz. mineral mixture feeding, cultivation of improved fodder varieties like DHN-6 and Super Napier, the findings are similar to Vinod Prakash et al. (2013). Use of chaff cutters and timely colostrum feeding to newborn calves were also regularly practiced by the respondents. These results corroborate the findings of Swathi Lekshmi et al. (2009a). Similarly, in goat farming, vaccination against PPR and enterotoxaemia along with deworming and ectoparasite control were widely practiced due to their direct role in reducing mortality and maintaining herd health. In backyard poultry farming, the use of improved drinkers and feeders, proper brooder management for chicks, and rearing of improved breeds such as Improved Aseel were commonly adopted as they enhanced chick survival, reduced feed wastage, and increased egg and meat production.

Certain livestock technologies that were initially adopted by farmers were later discontinued due to practical difficulties, high management requirements, or lack of expected benefits under local conditions. For instance, Azolla cultivation, which had been promoted as a low-cost protein supplement, was discontinued by many farmers because maintaining Azolla pits required regular labour, water management, and protection from contamination, which farmers found inconvenient. Similarly, the rearing of crossbred cattle such as Holstein Friesian and Jersey, as well as Murrah buffalo, was discontinued by some farmers due to their high feed and water requirements, greater susceptibility to diseases, and poor adaptability to local climatic conditions compared to indigenous breeds. The higher cost of maintenance and management challenges led farmers to gradually abandon these technologies.

During the course of investigation it was observed that some technologies were over-adopted by farmers, meaning they were used beyond the recommended dose or frequency. In dairy farming, insecticides or acaricides used for ectoparasite control were often applied in excessive quantities or sprayed more frequently than the recommended dosage on animals and in animal sheds. This has led to excess cost on medicine and also drug resistance in animals. This practice was largely followed due to farmers' strong concern about tick infestation and their perception that higher doses would provide quicker and more effective control. Kumar et al. (2014) have reported resistance to the insecticides or acaricides drugs used for ectoparasite control in dairy animals. Similarly, in goat farming, deworming drugs were sometimes administered in higher doses or more frequently than the recommended schedule. Further investigation revealed that farmers often believe that repeated or higher-dose deworming would improve animal health and growth. Such overuse and overdose practices were mainly associated with limited technical knowledge regarding proper dosage and intervals, and could potentially lead to problems such as drug resistance, unnecessary expenditure, and potential health risks to animals.

Several technologies were recommended by experts from various agencies but were rejected by farmers because they were perceived as impractical, costly, or unsuitable for smallholder livestock systems. In dairy farming, practices such as silage making, preparation of balanced concentrate feed at home, total mixed ration (TMR) feeding, urea-treated straw feeding, and hydroponic fodder production were not accepted due to the requirement of technical knowledge, infrastructure, and additional labour. However, Walli (2010) reported widespread adoption of these feeding practices, which may be due to variation in geographical and agro-climatic conditions. While studying problems faced by farmers in Shirol village, the shortage of labour was reported as the second most important problem faced by farmers after the high cost of concentrate feed. Similarly, value addition of milk into products like paneer, use of milking machines, and adoption of loose housing systems were rejected because of small herd sizes, lack of processing facilities, limited market access, or financial constraints. Farmers preferred traditional practices that required less investment and were easier to manage under their existing farm conditions. The findings corroborate with Nahar et al. (2022), who reported the various constraints in adoption of value addition of dairy food products.

In many cases, livestock owners modified or adapted some technologies according to locally available resources and their economic capacity, resulting in reinvented technologies. In dairy farming the common reinvention was preparation of concentrate feed mixture. Farmers prepared homemade concentrate feed mixtures using locally available ingredients such as maize, wheat bran, soybean bran, tur bran, chick pea (chana dal), and cotton seed/ground nut oil cakes instead of purchasing commercial feed, thereby reducing feed costs while maintaining nutritional supplementation. Some backyard poultry farmers developed innovative low-cost alternatives by using plastic bottles as drinkers and converting buckets or tins into feeders. Backyard poultry houses were also constructed using locally available materials such as wooden planks, bamboo, and iron cages to provide basic shelter for birds. These local practices reflected farmers' creativity in modifying technologies to suit their socio-economic and environmental conditions.

### 3.2 Matrix Ranking of Livestock Technology

Matrix ranking involves placing items or activities in order based on single or joint criteria. Ranking was carried out to find out preference of farmer community members, their criteria of ranking, and priority order. It is very useful in understanding the decision-making procedure. Here, the technologies are listed vertically and their respective criteria horizontally. The technology which is considered most important is listed and ranked as I, II, III, and so on. The respective column total gives the details; the highest column total gives the technology considered most important by the farmers and the highest row total gives the criteria considered most important by the farmers.

In Shirol, among the technologies shown in Table 1, high yielding fodder cultivation secured the highest total score (45.76) and was ranked first, indicating that farmers consider it the most favourable technology. It received consistently high scores across all criteria, particularly for low cost (9.72), quick results (9.64), and milk yield impact (9.68). This suggests that farmers perceive improved fodder cultivation as an economically viable and highly effective strategy for enhancing dairy productivity. However, Swathi Lekshmi et al. (2009b) reported improved breed as the most important adopted technology and high yield as the most important criteria. Mineral mixture feeding ranked second with a total score of 44.48, reflecting its observed importance in improving animal nutrition and milk production. Deworming was ranked third (42.00), suggesting that farmers recognize the importance of parasite control for maintaining animal health and productivity. Its relatively balanced scores across all criteria indicate that it is considered a practical and beneficial management practice. Chaff cutter usage ranked fourth (39.12), primarily due to its moderate scores in ease of use (7.88) and availability (8.16), reflecting its role in improving fodder utilization efficiency. Tick and ecto-parasite control ranked fifth (35.96), showing that although farmers acknowledge its quick results (9.04) and milk yield impact (8.40), relatively lower scores in cost (5.00) and ease of use (5.68) may limit its wider adoption.

**TABLE 1**
**MATRIX RANKING OF LIVESTOCK TECHNOLOGIES IN SHIROL VILLAGE**

| Technology | Low cost | Ease of use | Availability | Quick results | Milk yield impact | Total score for technology | Final Rank |
|---|---|---|---|---|---|---|---|
| High yielding fodder cultivation | 9.72 | 9.24 | 9 | 9.64 | 9.68 | 45.76 | I |
| Mineral mixture | 9.64 | 9.56 | 8.96 | 9.2 | 8.96 | 44.48 | II |
| Deworming | 8.56 | 8.28 | 8.44 | 8.24 | 8.48 | 42 | III |
| Chaff cutter | 7.24 | 7.88 | 8.16 | 7.96 | 7.88 | 39.12 | IV |
| Ticks/ecto-parasites control | 5 | 5.68 | 7.84 | 9.04 | 8.4 | 35.96 | V |
| Artificial insemination | 7.96 | 5 | 8.44 | 4.96 | 8.2 | 34.56 | VI |
| Vaccination | 8.92 | 5 | 4.8 | 4.44 | 8.88 | 32.04 | VII |
| **Total score for criteria** | **57.04** | **50.64** | **55.64** | **53.48** | **60.48** | | |

***Note: Scores are based on farmer rankings (out of 10) for each criterion. Higher scores indicate greater perceived importance or performance.***

Technologies like artificial insemination and vaccination were placed in lower ranks, sixth (34.56) and seventh (32.04), respectively. Despite their recognized impact on milk yield and disease prevention, these technologies scored low on ease of use and availability. This reflects dependence on veterinary services, limited technical knowledge among farmers, or accessibility constraints in the village. In case of criteria totals, milk yield impact received the highest cumulative score (60.48), followed by low cost (57.04) and availability (55.64), indicating that farmers prioritize technologies that directly enhance productivity and which are affordable and accessible. In contrast, ease of use (50.64) received relatively lower emphasis.

The matrix ranking analysis indicates that farmers in the village prioritize livestock technologies that are low-cost, easily accessible, and capable of enhancing milk yield. Practices related to feed and nutrition management, such as high yielding fodder cultivation and mineral mixture supplementation, were perceived as the most effective and practical technologies. In contrast, technologies requiring external technical support or institutional services, such as artificial insemination and vaccination, received lower rankings despite their long-term benefits. This highlights the importance of strengthening extension services, improving accessibility of veterinary inputs, and enhancing farmers' awareness to promote the adoption of scientifically recommended livestock technologies.

### 3.3 Consequence/Impact of Technology Adoption

Consequences of technology adoption are the impacts caused by technology in terms of changes that occurred in a social system as a result of adoption or rejection of a technology. According to Chambers (1994), local people can express their ideas of how a technology may cause impact on their lives in terms of flows, linkages, connections, and causality. Consequence/impact of adoption of technologies in Shirol village is shown in Fig. 2. The adoption of improved livestock technologies by farmers in Shirol village has played an important role in upgrading livestock productivity, improving animal health, and strengthening rural livelihoods. These technologies have influenced the productivity of animals and also improved the socio-economic conditions of farmers. Thus, adoption of technologies plays an important role in overall development of the rural community. Technology adoption has generated several positive outcomes such as increased income, improved animal health, and employment opportunities, although certain adoption-associated limitations and challenges were also observed.

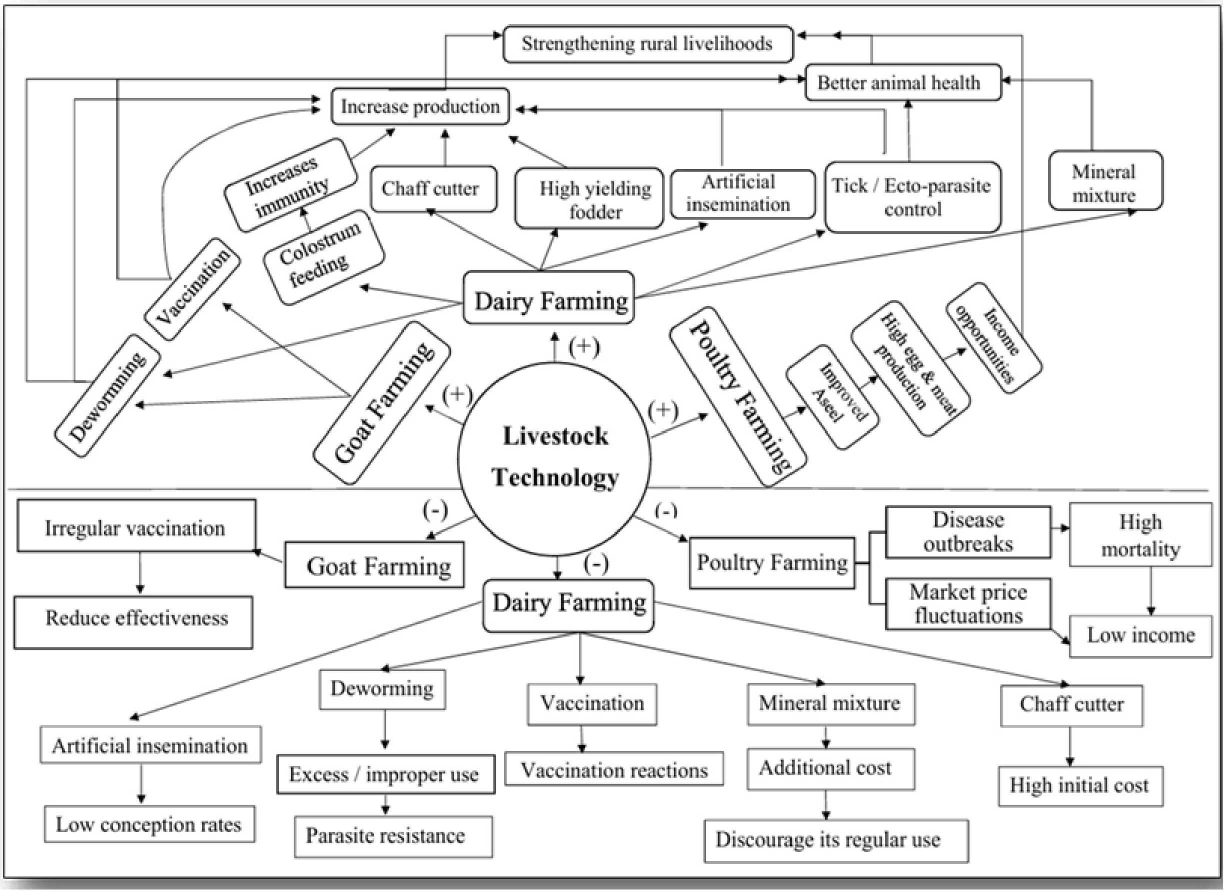


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**FIGURE 2: Consequence/impact diagram of Shirol village**

The adoption of artificial insemination (AI) has significantly contributed to genetic improvement in cattle and buffalo. Access to superior germplasm has improved breed quality, resulting in higher milk yield and better reproductive performance. However, the success of AI depends on proper heat detection and timely insemination, and poor management may result in low conception rates. Vaccination against major livestock diseases such as Foot and Mouth Disease (FMD), Haemorrhagic Septicaemia (HS), Black Quarter (BQ), and Lumpy Skin Disease (LSD) has played an important role in preventing disease outbreaks and reducing livestock mortality. However, irregular vaccination schedules, lack of awareness, and occasional vaccine reactions may limit its effectiveness.

Deworming and tick or ectoparasite control have improved livestock health by reducing parasite load. However, excessive or improper use of medicines may lead to parasite resistance, while the cost of treatment and lack of awareness about proper schedules may affect regular adoption of this technology. Mineral mixture feeding is an important nutritional practice to overcome mineral deficiencies in livestock. However, the additional cost and low awareness of long-term benefits sometimes discourage its regular use. Similarly, cultivation of improved fodder varieties such as DHN-6 and Super Napier has improved fodder availability due to their high agricultural yield and better nutritional value. This practice enhances milk production and reduces dependence on purchased feed, although it requires irrigation and proper management; however, lack of awareness and delayed feeding may reduce its benefits. The use of chaff cutters has improved feeding efficiency by reducing fodder wastage and making fodder easier to consume and digest. These results validate the findings of Chander (2010). However, the initial cost of the equipment and the risk of injury during operation may discourage some farmers. Colostrum feeding to newborn calves is another important managemental practice that strengthens calf immunity and improves survival rates.

In goat farming, vaccination against diseases such as Peste des Petits Ruminants (PPR) and Enterotoxaemia has reduced mortality and improved the health of goats. Deworming and ectoparasite control further improve growth rate, feed utilization, and overall production. However, irregular vaccination and limited veterinary services may reduce the effectiveness of these measures.

Backyard poultry rearing in Shirol village has benefited from improved managemental practices like use of improved drinkers and feeders, brooder management for chicks, and improved breeds like Aseel. Poultry farming also generates secondary employment and provides livelihood opportunities for women and small farmers. However, poultry production may face constraints such as disease outbreaks, market price fluctuations, and the need for better management practices.

## IV. CONCLUSION

The pattern of adoption, discontinuance, over-adoption, rejection, and reinvention of livestock technologies reflected farmers' practical experiences, resource availability, and socio-economic conditions. Technologies that were simple, economically beneficial, and supported by veterinary services were readily adopted, while those requiring higher investment, technical expertise, or intensive management were often discontinued or rejected. Farmers also demonstrated considerable adaptability by modifying and reinventing technologies using locally available resources to suit their needs. The matrix ranking indicates that farmers in the village prioritize livestock technologies that are low-cost, easily accessible, and capable of producing immediate improvements in milk yield. Practices directly related to feed and nutrition management, such as high yielding fodder cultivation and mineral mixture supplementation, were perceived as the most effective and practical technologies. The adoption of improved livestock technologies in Shirol village has enhanced animal productivity, livestock health, and farmers' socio-economic conditions. Dairy, goat, and poultry technologies have increased income opportunities, improved nutritional security, and generated rural employment.

**Recommendations:**

1. **Strengthening Extension Services:** Field-level extension services should be strengthened to provide farmers with regular technical guidance on the proper use of livestock technologies, including dosage, frequency, and safety practices.

2. **Improving Veterinary Accessibility:** Veterinary services should be made more accessible through mobile veterinary units, telemedicine, and increased frequency of veterinary visits to remote villages.

3. **Farmer Training and Awareness:** Regular training programmes should be conducted to enhance farmers' awareness of the long-term benefits of technologies like artificial insemination and vaccination, and to discourage over-adoption practices.

4. **Promoting Farmer-to-Farmer Learning:** Successful farmers should be encouraged to share their experiences with others through farmer field schools and demonstration plots.
5. **Support for Reinvented Technologies:** The government and extension agencies should recognize and support farmers' innovations, such as homemade concentrate feed and low-cost poultry equipment, through recognition and scaling-up mechanisms.
6. **Affordable Technology Access:** Subsidies or low-interest loans should be provided to farmers to reduce the financial burden of adopting high-cost technologies like chaff cutters and improved fodder cultivation.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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