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Protecting Livelihoods Through Technology

AI-Assisted Goat Health Monitoring in the Rajsamand District of Rajasthan, India

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Field: Natural Sciences

Abstract

Goats are a key source of food and income for small farmers in Rajasthan, India, but disease, weak veterinary access, and tight finances put those benefits at risk. This paper looks at goat-keeping households in Rajsamand district, where a 2025 survey of 200 goat keepers ranked grazing shortages, poor veterinary services, and lack of credit as their biggest problems. It reviews India's current tools, including PPR vaccination and Mobile Veterinary Units, along with research on wearable movement sensors in cattle and goats. It then proposes a low-cost, AI-assisted collar that learns each goat's normal movement and rumination patterns and alerts farmers to unusual changes. The collar would support existing veterinary services rather than replace them. The paper closes with a staged pilot plan, possible funding sources, and the system's main limits.

Keywords: goat health monitoring, food security, wearable sensors, livestock, Rajasthan

1. Introduction

Food security is often associated with the amount of food a country produces. However, producing enough food does not necessarily mean that every household can afford or access it. For many rural families in India, food security is closely connected to their ability and skills to earn an income and maintain the resources they depend on. One important resource is livestock, particularly goats. Goats provide food, income, and financial security for these rural households, especially those

with limited agricultural land. However, animal diseases, limited veterinary access, the financial difficulties amongst families, and issues associated with livestock losses can threaten these benefits.

India has one of the world's largest goat populations, with approximately 148.88 million goats recorded in the 2019 Livestock Census. Rajasthan alone accounted for approximately 20.84 million of these animals, making it a crucial state for goat production (Press Information Bureau, 2019). Despite the importance of goat farming, small-scale farmers may struggle to recognize health problems early and obtain the timely veterinary assistance required for their livestock.

This paper focuses on goat-keeping households in Rajsamand district, Rajasthan. It examines the challenges affecting these farmers and delves into whether an affordable, artificial intelligence-assisted goat health monitoring system could help identify potential health concerns earlier. The proposed system would use wearable sensors to monitor changes in animal behavior and alert farmers when an animal may need attention. Rather than replacing veterinarians or present programs that aim to eliminate these diseases, the technology would support the services already available. Ultimately, the goal is to investigate whether accessible technology could help support people who make a living from livestock and help families get reliable food.

2. Country and Family Background

India is a federal parliamentary democratic republic with a population exceeding 1.48 billion people. Agriculture and activities closely tied with it remain one of the most important sources of employment and income, particularly in rural communities. However, access to nutritious food and stable income is not equally proportionate across the whole population. The World Food Programme emphasizes poverty, malnutrition, and unequal access to food as the biggest growing concerns in India (World Food Programme, 2025).

Rajasthan is located in northwestern India and contains a combination of desert, semi-arid, and agricultural regions. Its climate includes high summer temperatures and areas with limited rainfall. These conditions can make access to water and grazing difficult for livestock owners. As a result, livestock is an important part of the state's rural economy. According to the Government of Rajasthan's *Economic Review 2024–25*, the state had approximately 56.8 million livestock animals in the 2019 census alone (Government of Rajasthan, 2025).

Goats are particularly important because they can be raised by households that may not have enough land or resources to maintain larger livestock such as cattle or buffaloes. They provide meat, milk, manure, and a source of income through animal sales. They can also serve as financial assets that families may sell when they need money for not just household expenses but also for paying taxes and marriages.

The 2019 Livestock Census recorded 148.88 million goats across India, compared with

135.17 million in 2012. This depicts an increase of approximately 10.1% in seven years. Rajasthan accounted for approximately 20.84 million goats, or about 14% of the nation's total population (Press Information Bureau, 2019). These values emphasize the importance of goat farming to the state's agricultural economy.

However, the financial benefits of goat farming do not mean that every livestock-keeping household is secure financially and economically. Smaller farmers may have limited savings, and losing even one productive animal can create a significant setback for the farmer. A sick goat may require treatment, transportation, and additional care. If the animal dies or becomes less productive, the household may also lose a potential extra source of income.

Women are also important participants in livestock care. In many rural communities, women contribute to feeding, watering, cleaning, and observing animals. However, their access to financial resources, agricultural training, and veterinary services can vary (Food and Agriculture Organization of the United Nations, 2026). Solutions intended to support livestock farmers should also consider the people who actually care for the animals, rather than focusing heavily on animal owners.

3. The Challenge and Its Impact on Food Security

One of the main challenges affecting goat farmers in the Rajsamand district is the difficulty of maintaining livestock health while dealing with limited resources and veterinary access. A particularly useful source for understanding this issue is a 2025 study by Salvi and colleagues, which examined the challenges experienced by goat keepers in Rajsamand district.

The researchers surveyed 200 goat keepers across four subdistricts: Rajsamand, Nathdwara, Deogarh, and Kumbhalgarh. Each selected respondent owned at least ten goats. The study found that 69.5% of respondents experienced severe overall constraints in goat farming. The most concerning problems included grazing land shortages, lack of veterinary services, and insufficient credit facilities (Salvi et al., 2025).

The study assigned mean percentage scores of 94.16 to grazing land shortages, 91.5 to inadequate veterinary services, and 87 to insufficient credit facilities. These scores represent the researchers' ranking measure, not the percentage of farmers who experienced each problem. Nonetheless, this study shows that access to veterinary services was among the most important challenges identified within the study.

The findings also identified feed and fodder shortages, limited availability of green fodder, and a lack of knowledge of scientific goat management as additional challenges. These issues matter because animal health depends on more than recognizing illness. Goats also need appropriate nutrition, water, shelter, and preventive healthcare.

Infectious diseases create another challenge. Peste des petits ruminants, commonly known as

PPR, is a contagious viral disease affecting goats. Because it spreads from animal to animal and is highly contagious in tight spaces, it can cause serious losses in affected herds. India's Department of Animal Husbandry and Dairying includes PPR vaccination and disease control among its livestock health priorities. According to a March 2026 government update, reported PPR outbreaks across India decreased from 98 in 2019 to 29 in 2025 (Press Information Bureau, 2026). This is a reduction of approximately 70.4%, demonstrating progress in disease-control efforts. However, the continued reporting of outbreaks shows that livestock diseases still remain a concern for not just small farms but also for well-developed ones as well.

Veterinary access is also an important part of the problem. India's government reported 92,459 registered veterinarians as of March 31, 2025. Using the country's livestock population from the 2019 census, the government calculated a ratio of approximately 5,808 livestock animals per veterinarian (Press Information Bureau, 2026). This national ratio does not describe the exact availability of veterinarians in Rajsamand, but it depicts the demands placed on the veterinary workforce.

These challenges connect directly to the four pillars of food security. First, availability may be affected when livestock losses reduce the amount of animal-derived food produced by a household. Second, access may be affected when losing a goat reduces household income and the ability to purchase food to sustain the household. Third, utilization is connected to nutrition because milk and meat can contribute important nutrients to a family's diet. Finally, stability may be affected when repeated livestock health problems make household income and food access more disproportionate and unstable.

The effects are particularly important for households that depend heavily on livestock and have limited financial resources. However, the impact varies according to the number of animals owned, other sources of income, and access to veterinary services.

Environmental conditions create additional difficulties. Rajasthan's dry climate and limited rainfall in some areas can contribute to shortages of grazing land, water, and animal feed. A 2025 study of Rajsamand goat keepers identified grazing land shortages as their highest ranked issue (Salvi et al., 2025). This demonstrates that animal health cannot be separated from the environmental conditions in which livestock are raised.

4. Existing Solutions and Their Limitations

India already has several programs intended to improve livestock health. These provide an important foundation for developing additional approaches towards the issue.

The first is vaccination and disease prevention. Under the Livestock Health and Disease Control Programme, India supports vaccination, disease surveillance, and efforts to control econom-

ically important animal diseases. PPR vaccination is particularly relevant to goat and sheep farmers. These efforts are important because preventing disease can protect livestock and reduce financial losses. However, vaccination targets particular diseases and does not identify every possible health concern.

The second approach is improving access to veterinary services. India's Mobile Veterinary Units are intended to bring veterinary assistance closer to farmers. As of August 2025, the government has reported 4,019 operational Mobile Veterinary Units across the country. These services had altogether benefited approximately 9.69 million livestock farmers and treated around 20.15 million animals (Press Information Bureau, 2025).

Rajasthan had 536 operational Mobile Veterinary Units in the same government report. These units had cumulatively benefited approximately 905,948 livestock farmers and treated more than 3.60 million animals. This goes to show that the state already has an established system that could potentially adapt a new monitoring approach.

The third approach is wearable livestock-monitoring technology. Research has demonstrated that accelerometer-based sensors can record animal movement and behavioral patterns. In a 2021 study, Iqbal and colleagues evaluated a sensor-based collar using 48 dairy cows and 144 observations. The researchers found strong correlations between sensor measurements and direct observations of grazing and rumination behavior, with correlation values of 0.91 and 0.89, respectively (Iqbal et al., 2021). However, the study also identified differences between automated measurements and human observations, proving that sensor accuracy requires careful evaluation.

More recent research has examined wearable monitoring specifically in goats. Faillot and colleagues published a 2025 dataset containing more than 144 hours of accelerometer measurements from 59 Creole goats (a type of small, hardy landrace goat native to the Caribbean and parts of Latin America) (Faillot et al., 2025). The data included behaviors such as grazing, movement, resting, and rumination. This provides a useful foundation for understanding how movement sensors could be applied to goat behavior.

However, these studies do not prove that a monitoring collar can diagnose goat diseases. They demonstrate that behavioral measurements can be collected and classified, not that every unusual behavior indicates illness. This distinction is important when developing a reliable system to help minimize as many false positives as possible.

5. Proposed Solution: An Affordable AI-Assisted Goat Health Monitoring System

I recommend investigating an affordable, AI-assisted wearable collar designed specifically for smallholder goat farmers in Rajsamand. Its purpose would be to identify unusual changes in animal

behavior and notify farmers when an animal may need further attention.

The first component would be a lightweight collar containing sensors. The initial design would prioritize movement and rumination monitoring. Temperature sensing could also be further looked into if it can be implemented accurately and safely. These measurements would provide baseline information about changes in an animal's normal behavior.

The second component would be an AI-assisted monitoring system. Instead of relying on one measurement, the system would analyze patterns across the collected data. For example, a combination of reduced movement and unusual rumination patterns could trigger an alert based on the change in patterns. The AI would compare an animal's current measurements with its normal behavioral patterns (which requires the farmer to calibrate the device during the goat's healthy cycle, for each goat) rather than assuming that every goat behaves identically.

The system would not identify a specific disease. Its main purpose would be to recognize unusual patterns that may justify closer observation or a casual veterinary checkup.

The third component would be a comprehensive alert system. Farmers shouldn't need to interpret complicated graphs or operate advanced software. Clear visual indicators could communicate whether an unusual pattern has been detected. Audio alerts using locally spoken languages could also be implemented for farmers who would benefit from them. The system should be designed around the people who care for the goats, including women who perform much of the daily livestock work.

The fourth component would connect alerts with existing animal healthcare services. When a concerning pattern is detected, the farmer would be encouraged to contact a veterinarian or trained livestock health worker. This is crucial given that a farmer needs to have a viable solution to their already identified problem in the livestock.

Affordability and durability also guide this design. The electronics could be placed inside a protective, dust- and water-resistant enclosure to minimize damage to the main circuit and wires. A rechargeable battery and removable electronic module could make maintenance easier. A separate solar charging station would be included for locations where electricity access is unreliable. The system will also be capable of offline data storage, collecting and storing basic information without requiring a continuous internet connection, which is not available in such locations.

6. Implementation and Recommendation

The project would begin with a small pilot in Rajsamand district rather than immediate distribution across Rajasthan. This would allow the system to be evaluated under local farming conditions before considering expansion to include other factors.

The first stage would involve consulting with goat farmers, veterinarians, and local livestock

health workers and experts. Their feedback would help identify which behavioral measurements are most useful and what type of alert system would be easiest to operate. Women involved in daily animal care should be included in these discussions.

The second stage would involve developing and testing a basic prototype. Testing would be designed to examine sensor accuracy, battery life, durability, communication reliability, and collar comfort. The AI system would need to be trained and evaluated using reliable data from goats in relevant farming environments.

A particularly important part of testing would be evaluating the system's ability to distinguish normal behavioral variation from unusual changes. Factors such as heat, grazing schedules, feed availability, age, and individual animal differences could affect such measurements. The system will be tested against direct observations and veterinary assessments. Both false alerts and missed health concerns should be measured. In order for the device to distinguish between normal and unusual behavior, the device would need to be calibrated. As the farmer attaches the device to the goat, the device will automatically start testing and analyzing patterns to set the baseline normal standards for the goat, with each individual goat having different patterns resulting in different problems affecting different goats on a wide spectrum of effects.

After the prototype meets appropriate safety and reliability standards, a supervised field trial could follow. A small group of consenting farmers could use the collars while researchers compare the alerts with animal observations and veterinary assessments. Farmers would also provide feedback about affordability, maintenance, and ease of use.

The project could involve several organizations. Rajasthan's Department of Animal Husbandry could help connect the trial with existing veterinary services. Veterinary colleges and agricultural universities could provide scientific guidance and help evaluate the system. Technology developers could support sensor and AI development, while local farmer organizations could help with community participation.

Funding would be needed for sensors, electronic components, software development, veterinary consultation, field testing, farmer training, and maintenance. Possible funding sources could include government agricultural innovation programs, university research grants, nonprofit organizations, and agricultural technology partnerships both locally in Rajasthan and nationally in India.

There are important limitations to consider. Sensors may not recognize every health problem, and different illnesses can produce similar behavioral changes. False alerts could create unnecessary expenses, while missed alerts could give farmers an inaccurate sense of security. The collar also cannot solve grazing shortages, feed shortages, or limited veterinary staffing. These problems would continue to require government programs and community-level support to consistently keep up with the problems.

Cost is another important challenge. Even if the prototype works well, it may still be too expensive for the families who need it most. One possible solution would be to distribute the devices through local farming cooperatives or community organizations, which could also help farmers access technical support and repairs. However, the long-term costs of maintaining this system would need to be carefully considered.

The system should also complement existing veterinary infrastructure. Rajasthan's *Economic Review 2024–25* reported 2,240 veterinary hospitals, 7,565 veterinary subcenters, and 102 district mobile veterinary units as of December 2024 (Government of Rajasthan, 2025). These resources provide a potential foundation for connecting farmers with professional animal healthcare. The proposed collar would add another source of information instead of replacing these preestablished services.

7. Conclusion

Goat farming is an important part of rural livelihoods in Rajasthan, but animal health challenges, limited veterinary access, and financial constraints can threaten the households that depend on livestock. Research conducted in Rajsamand district demonstrates that these concerns are not simply theoretical. In a 2025 study of 200 goat keepers, veterinary service limitations and grazing shortages ranked among the most significant challenges.

India has already invested in vaccination programs, veterinary infrastructure, and mobile animal healthcare services. However, additional tools could help farmers recognize potential health concerns and seek assistance earlier.

An affordable, AI-assisted goat health monitoring collar would complement these existing services by identifying unusual changes in movement and rumination and communicating simple alerts to farmers. Its success would depend on more than the accuracy of its sensors. It would also need to be affordable, durable, comfortable for animals, easy to understand, and connected to accessible local veterinary support.

In essence, the purpose of this proposal is not to replace traditional livestock care with technology. It is to analyze how technology could strengthen the resources that farmers already depend on. A carefully tested and community-informed monitoring system could provide one additional way to protect livestock-dependent livelihoods and support more stable food security in rural Rajasthan.

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