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Empowering Smallholder Goat Farmers through Participatory Extension: Enhancing Knowledge and Management of Ruminal Tympany in Rural Indonesia

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Abstract
Ruminal tympany is a major digestive disorder that limits productivity and increases mortality in smallholder goat production systems, particularly in rural areas with limited veterinary support. This community service study aimed to improve farmers' knowledge and awareness of ruminal tympany through a participatory extension approach. The program applied a one-group pretest–posttest quasi-experimental design involving 30 smallholder goat farmers in Panerokan Village, Jambi Province, Indonesia. The intervention combined lectures, interactive group discussions, and hands-on demonstrations focusing on disease identification, risk factors, preventive feeding management, and basic on-farm response strategies. Farmers' knowledge was measured using structured questionnaires administered before and after the intervention. The results showed a substantial increase in knowledge, with mean scores improving from 45% in the pretest to 77% in the posttest across all assessed indicators. The novelty of this program lies in its practice-based and context-specific extension model that integrates scientific knowledge with local feeding practices. The findings suggest that participatory extension interventions can effectively strengthen farmers' capacity for early detection and prevention of ruminal tympany, thereby contributing to more sustainable and resilient smallholder goat farming systems when supported by continued mentoring and follow-up initiatives.

Keywords: Participatory Extension, Responsible Consumption and Production, Ruminal Tympany, Smallholder Goat Farming, Zero Hunger

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INTRODUCTION

Goat farming plays a crucial role in sustaining rural livelihoods and enhancing food security, particularly in developing countries. Goats are highly adaptable to diverse agroecological conditions, require relatively low capital investment, and are able to utilize marginal feed resources efficiently, making them well suited to smallholder farming systems (Devendra & Liang, 2012). In rural communities, goats serve not only as sources of meat and

milk but also as financial assets that enhance household resilience and income security (Dubeuf & Boyazoglu, 2009; Peacock, 2005). Therefore, improving goat health management represents a strategic pathway for strengthening the sustainability of smallholder livestock production.

Despite their adaptability, goat productivity is often constrained by health-related problems, particularly digestive disorders. One of the most serious and potentially fatal conditions affecting small ruminants is ruminal tympany (rumen bloat), which occurs due to excessive accumulation of fermentation gases in the rumen as a result of impaired eructation (Smith & Sherman, 2009). Ruminal tympany may manifest as free-gas or frothy bloat, both of which are closely associated with dietary composition and feeding practices (Van Soest, 1994). Severe cases can result in respiratory distress, circulatory failure, and sudden death, while recurrent or subclinical cases negatively affect growth performance and productivity.

The economic consequences of ruminal tympany in smallholder goat systems are substantial. Mortality directly reduces herd size, while chronic digestive disturbances lead to reduced feed efficiency, delayed growth, and increased management costs (Owens et al., 1996). For rural households that depend on livestock as a primary or supplementary source of income, these losses can significantly undermine household food security and economic stability. These challenges are often intensified by limited access to veterinary services and weak preventive health management in rural areas (Perry & Grace, 2009).

In smallholder production systems, the occurrence of ruminal tympany is closely linked to inappropriate feeding management, including sudden dietary transitions, excessive provision of rapidly fermentable feeds, feeding of lush legumes with high soluble protein content, and insufficient intake of physically effective fiber (Majak et al., 2003; McAllister et al., 2011). Although these risk factors are well documented in scientific literature, they are not always well understood or properly managed at the farm level. Traditional feeding practices, combined with limited knowledge of rumen physiology, increase the likelihood of preventable digestive disorders.

Previous studies have consistently reported gaps in farmers' knowledge, attitudes, and practices related to animal health management in small ruminant systems. Limited formal education, inadequate extension coverage, and minimal exposure to evidence-based husbandry practices often result in delayed disease recognition and ineffective on-farm responses (Pradère, 2014). In the context of ruminal tympany, such limitations may prevent farmers from identifying early clinical signs or applying timely preventive measures, thereby increasing the risk of severe outcomes (Sarma, 2024).

Community-centered and participatory extension approaches have increasingly been recognized as effective strategies for addressing livestock production constraints in smallholder systems (Wang et al., 2023). Training models that integrate technical instruction with interactive discussion and hands-on demonstration have been shown to improve farmers' understanding and adoption of improved management practices (Novianti et al., 2021; Nurfathiyah & Rendra, 2019). Furthermore, sustained mentoring and follow-up support play an important role in reinforcing behavioral change and practical application of new knowledge (Jasmiarni & Trias Novita, 2022). Integrated extension programs involving farmer groups and local institutions have also been associated with broader social and economic benefits at the community level (Asniwita et al., 2017). However, documented community service interventions specifically addressing ruminal tympany in smallholder goat systems remain

limited.

Therefore, this study aims to enhance farmers' knowledge and awareness regarding the identification, prevention, and basic on-farm management of ruminal tympany in goats through a participatory extension approach. The study evaluates changes in farmers' knowledge before and after the intervention as an indicator of program effectiveness. This article is structured as follows: the Methods section describes the design and implementation of the community service activity, the Results and Discussion section presents and interprets the findings, and the Conclusion section summarizes key outcomes and implications for future community-based livestock health interventions.

METHODS

Study Design

This community service activity employed a one-group pretest–posttest quasi-experimental design to evaluate changes in farmers' knowledge following a structured participatory extension program on ruminal tympany in goats. This design was selected to assess the immediate educational impact of the intervention under real-world smallholder farming conditions, where the inclusion of a control group was not feasible. The primary outcome measured in this activity was the change in farmers' knowledge levels before and after the extension intervention.

Location and Participants

The activity was conducted in Panerokan Village, Bajubang District, Batanghari Regency, Jambi Province, Indonesia, in August 2024. Participants consisted of 30 smallholder goat farmers who were active members of the *Makmur Bersama* Farmers' Group. Inclusion criteria included ownership of at least one goat, active involvement in daily goat management, and willingness to participate throughout the activity. The participants represented a range of ages and farming experience levels typical of household-based goat production systems in the area. The activity took place at the residence of the farmer group leader, located approximately 15 km from the regency administrative center.

Extension Intervention

The intervention was implemented using a participatory and practice-based extension approach that integrated classroom instruction, interactive group discussions, and hands-on field demonstrations. This approach was designed to encourage active farmer engagement and contextual learning. The training content was structured into two main thematic modules: (1) identification, causes, and clinical differentiation of ruminal tympany from other non-fermentative bloating conditions; and (2) feeding management strategies aimed at preventing excessive ruminal gas accumulation and digestive disturbances.

Implementation of Training Activities

The educational sessions were conducted over a single day with a total duration of approximately four hours. The learning activities consisted of lectures (40%), guided group discussions (30%), and practical demonstrations (30%). Supporting materials, including illustrated educational leaflets and simple demonstration

tools, were used to reinforce key concepts. Informal mentoring and consultation were provided during and immediately after the sessions to address farmer-specific questions and on-farm conditions.

Data Collection

Farmers' knowledge was assessed using a structured questionnaire administered as a pretest prior to the intervention and as a posttest immediately after the training. The questionnaire consisted of multiple-choice and short-answer questions covering key aspects of ruminal tympany, including etiology, risk factors, clinical signs, preventive feeding practices, and basic first-response management. Each correct response was scored as one point, and total scores were converted into percentage values to facilitate comparison.

Data Analysis

Data analysis was conducted descriptively to summarize participant characteristics and knowledge outcomes. Changes in farmers' knowledge were evaluated by comparing mean pretest and posttest scores, expressed as percentage differences. The magnitude of knowledge improvement was used as the primary indicator of the effectiveness of the community service intervention. All data were tabulated to provide a clear comparison of learning outcomes following the extension activity.

RESULTS AND DISCUSSION

The community service activity focusing on the prevention and management of ruminal tympany in goats was successfully conducted in Panerokan Village with active participation from local farmers. A total of 30 farmers representing village livestock groups attended the program, indicating a strong interest in addressing persistent challenges in smallholder goat production. Initial discussions with participants revealed that digestive disorders, particularly ruminal tympany, were commonly encountered yet poorly understood. Similar constraints have been reported in smallholder livestock systems, where limited technical knowledge and restricted access to extension services contribute to preventable animal health problems (Devendra & Liang, 2012; Perry & Grace, 2009).

At the beginning of the activity, farmers' baseline knowledge of ruminal tympany was assessed through a pretest. The results showed a mean score of 45%, reflecting limited understanding of the causes, clinical signs, and preventive management of the condition. Most participants associated abdominal bloating solely with excessive feed intake and were largely unfamiliar with the underlying mechanisms of ruminal gas accumulation. This initial condition illustrates the knowledge gap targeted by the extension program and is conceptually presented in Figure 1.

Figure 1. Participatory extension activities on ruminal tympany prevention and management

The activities depicted in Figure 1 include practical demonstrations designed to reinforce the farmers' technical understanding directly in the field. This participatory approach ensures an effective knowledge transfer regarding the identification of clinical symptoms and immediate response strategies for ruminal tympany. The extension materials were designed based on preliminary field observations to ensure their relevance to local farming conditions. The first session emphasized conceptual understanding of ruminal tympany, covering its etiology, clinical manifestations, and potential impacts on animal productivity (Radostits et al., 2010). Early recognition of ruminal tympany is essential, as delayed intervention increases the risk of severe rumen distension, respiratory impairment, and mortality (Smith & Sherman, 2009). The second session focused on preventive feeding strategies, including forage management, wilting fresh forage prior to feeding, and gradual dietary transitions to maintain rumen microbial balance, in line with established recommendations for small ruminant health management (Van Soest, 1994; Majak et al., 2003).

The extension activity was delivered using a participatory approach that combined lectures, group discussions, and hands-on demonstrations. This learning process encouraged farmers to actively engage, share experiences, and relate scientific explanations to their daily management practices. Participatory and andragogical learning approaches have been shown to be effective in improving knowledge retention and problem-solving capacity among adult learners in agricultural settings (Catley et al., 2020; Davis et al., 2010). The structure of the learning process and knowledge improvement outcomes is illustrated in Figure 2.

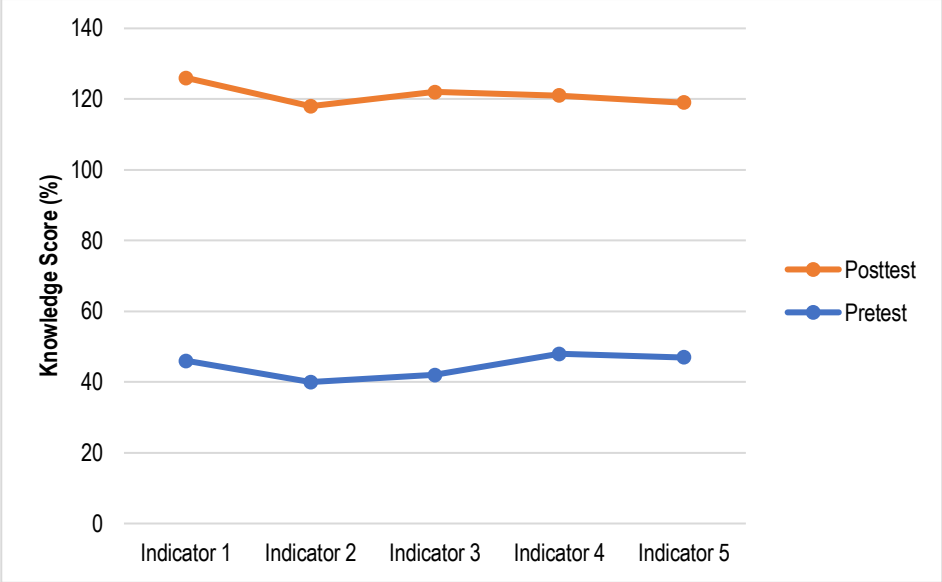

Figure 2. Farmers' knowledge of ruminal tympany before and after the extension intervention (pretest–posttest)

Figure 2 presents the quantitative shift in farmers' understanding by comparing their knowledge levels before and after the participatory sessions. The data visualizes a significant upward trend, confirming the effectiveness of the intervention in enhancing the participants' technical capacity. Following the intervention, farmers' knowledge levels increased substantially. The mean posttest score reached 77%, representing an absolute improvement of 27% compared to the pretest results. Knowledge gains were observed across all five assessed indicators, with post-intervention scores ranging from approximately 71% to 80%. Prior to the extension activity, pretest scores ranged from 39% to 48%, indicating consistently low knowledge across topics. The relatively uniform improvement across indicators suggests that the extension materials effectively addressed key knowledge gaps related to the causes, clinical signs, prevention, and early management of ruminal tympany.

In addition to knowledge assessment, field observations provided insights into feeding practices and animal characteristics associated with ruminal tympany cases. Most cases were observed in goats fed forage-only diets (88.9%), while only 11.1% received a combination of forage and concentrate. This feeding pattern reflects a strong reliance on nutritionally unbalanced diets, which are widely recognized as major risk factors for ruminal fermentation disorders in small ruminants (Van Soest, 1994; McAllister et al., 2011). Regarding forage handling practices, 54.5% of farmers supplied wilted forage, whereas 45.5% continued to provide fresh forage directly, a practice known to increase the risk of excessive ruminal fermentation and foam formation (Smith & Sherman, 2009).

Age-related susceptibility was also evident, with ruminal tympany cases equally distributed between goats aged 0–6 months and 6–12 months, each accounting for 50% of reported cases. Young goats are physiologically more vulnerable due to incomplete rumen development and unstable microbial populations (Van Soest, 1994). With respect to treatment, all reported cases (100%) were handled by veterinarians or trained para-veterinary

personnel, indicating a relatively high level of farmer awareness regarding the need for professional intervention. However, treatment outcomes varied, with 66.7% of affected goats recovering and 33.3% resulting in mortality due to advanced clinical conditions at the time of treatment.

The observed mortality rate highlights the critical importance of early detection and timely management of ruminal tympany. Previous studies have emphasized that delayed intervention remains a major determinant of mortality and economic loss associated with ruminal disorders in small ruminants (Radostits et al., 2007; Smith & Sherman, 2009). Improved farmer knowledge, therefore, plays a crucial role not only in prevention but also in reducing the severity of cases through earlier recognition and response.

From a community service perspective, this activity demonstrates the social value of participatory extension programs in strengthening local capacity. The integration of scientific knowledge with practical demonstrations enabled farmers to better understand risk factors and preventive strategies relevant to their local context. Moreover, farmer group discussions facilitated peer-to-peer learning, allowing participants to share experiences and collectively reflect on common challenges in goat management. Such collective learning environments are important for sustaining knowledge transfer beyond the duration of the intervention (Pradère, 2014; Sarma, 2016).

The activity also illustrates the role of universities in bridging scientific knowledge and community needs. By translating academic concepts into accessible and practice-oriented information, the program contributed to solving practical problems faced by rural farming communities. This approach aligns with the broader mission of community service initiatives to promote socially responsive science and to support sustainable livestock development.

Despite the positive outcomes observed, this activity was limited to short-term qualitative observations and did not evaluate long-term behavioral changes or reductions in disease incidence. Similar limitations have been noted in community-based extension programs, where sustained mentoring and follow-up are required to ensure lasting impacts (Pradère, 2014; Sarma, 2016). Nevertheless, the substantial improvement in farmers' knowledge and awareness observed in this program indicates that the primary objectives of the community service activity were successfully achieved and provides a foundation for future extension initiatives in smallholder goat production systems.

CONCLUSION

This community service activity effectively improved farmers' knowledge and awareness of ruminal tympany in smallholder goat production systems through a participatory extension approach. The intervention enhanced farmers' understanding of disease identification, preventive feeding practices, and basic management strategies, while also revealing key risk factors related to feeding patterns and animal characteristics. By integrating scientific information with local farming contexts, the program demonstrated the value of practice-based and community-oriented extension in addressing preventable livestock health problems. Although limited to short-term knowledge assessment, the outcomes indicate that such approaches can strengthen farmer capacity and provide a foundation for more sustainable livestock health management through continued mentoring and follow-up initiatives.

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DECRALATIONS

Author Contribution	:	SW: Conceptualization, Methodology, Formal analysis, Writing – original draft, Project Administration; VD: Data Curation, Investigation, Validation, Writing – Original Draft; YMV: Investigation, Data curation, Resources, Visualization; AR: Supervision, Methodology, Writing – review & editing, Project Administration; JAS: Investigation, Data curation, Visualization; DD: Formal analysis, Methodology, Validation, Writing – review & editing; AS: Resources, Investigation, Data curation; TSR: Software, Visualization, Data curation.
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