Innovative Strategies to Increase Livestock Productivity Through the Integration of Traditional Herbal Medicine with a Sustainable Entrepreneurship Approach.

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ABSTRACT

There is a need to increase livestock productivity effectively and sustainably by integrating environmentally friendly traditional herbal medicines with a sustainable entrepreneurial approach. The research aims to develop innovative strategies that combine traditional herbal remedies to optimally and sustainably increase livestock productivity. The method employed is a mixed-methods approach with a sequential explanatory research design, in which qualitative data are collected through interviews and group discussions, followed by quantitative data collection using questionnaires distributed to 50 farmer respondents as the sample population. Data analysis included descriptive statistics, mean difference tests, and regression analysis to examine the influence of herbal medicine and entrepreneurship on livestock productivity, alongside thematic analysis of qualitative data. The results show that integrating traditional herbal medicine significantly improves the health and growth of livestock, as well as the knowledge and entrepreneurial skills of farmers. Additionally, the use of herbal medicines has been successful in reducing dependence on synthetic antibiotics. The application of an herbal entrepreneurship model also contributes to increasing income and the sustainability of farmers' businesses. In conclusion, the innovative strategy of integrating traditional herbal medicine with a sustainable entrepreneurial approach is effective in increasing livestock productivity as well as the welfare of farmers. The implications of this research can be used as the basis for the development of sustainability-oriented and conservation-oriented breeder empowerment programs.

I. INTRODUCTION

Livestock productivity is an important aspect in supporting food security and the economic welfare of rural communities. In current livestock practices, the use of chemical drugs and antibiotics for livestock health is still common, but this has negative impacts, such as microbial resistance and environmental pollution. In contrast, traditional herbal medicine, as a natural alternative, has great potential to improve the health of livestock naturally, but its use is still limited and not optimal. Although herbal medicine has long been known in local cultures, its widespread use in modern livestock systems still faces difficulties due to the lack of strong scientific evidence regarding the effectiveness and safety of such herbal remedies(Anggarani et al., 2025). In addition, there is a view that modern medicine methods are more reliable than traditional methods, so the integration of herbal medicine into conventional farming practices has not been widely done. There is an information gap on how innovative strategies can combine the power of traditional herbal medicine with a sustainable entrepreneurial approach to support livestock productivity(Bhangale et al., 2025). It is not yet clear how these practices can be applied systematically and provide economic benefits as well as environmental sustainability. To date, research directly linking farmer empowerment with entrepreneurship training based on herbal products for livestock, particularly within the context of sustainable marketing and business development, remains limited. The development of herbal products from local resources has also not been explored optimally as a business opportunity that can increase farmers' income. Previous studies have focused on the use of chemical drugs in improving livestock performance or documenting herbal ingredients without linking them to economic empowerment aspects. A new thing that can provide this research with an integrated approach that combines innovation in the use of herbal medicine with a sustainable entrepreneurial model, so as to provide a comprehensive solution(Sarma et al., 2023). This research provides an opportunity to identify and test new strategies that not only improve livestock health and productivity but also improve the entrepreneurial skills of farmers, including women, as an important group in small farms. Thus, this strategy is expected to support sustainable socio-economic welfare(Anggarani et al., 2025). The main objective of this research is to develop innovative strategies that are effective in integrating traditional herbal medicine into the livestock system while developing sustainable entrepreneurship to improve the productivity and well-being of farmers at large. The results of this research are expected to make a real contribution to the development of environmentally friendly local resource-based livestock businesses(Vijayalakshmy et al., 2020).

In a literature review, research by Sari et al. (2023) entitled "Empowering Female Human Resources through Traditional Herbal Medicine for Sustainable Livestock Production" shows the importance of women's empowerment through traditional medicine production, but it has not been clearly linked to a broad entrepreneurial strategy. This indicates that there is still an opportunity to develop a more innovative and comprehensive model to support the increase in

livestock productivity and the economic empowerment of the farming community(Groot & van 't Hooft, 2016).

Innovative strategies that integrate traditional herbal medicine to increase livestock productivity have a critical role in supporting the sustainability of modern livestock systems. First, herbal remedies serve as a natural alternative to improving the health of livestock, which directly contributes to optimal growth and productivity without causing harmful side effects such as chemical residues or antibiotic resistance(Sarma et al., 2023). Various bioactive compounds contained in herbal plants such as turmeric, ginger, curcuma, and betel leaves have been shown to improve digestive efficiency, improve the immune system of livestock, and lower mortality rates(Dong et al., 2009). Thus, the integration of herbal medicine can replace the use of synthetic chemical drugs that have been a problem in modern farming. This also supports food health and maintains environmental balance, as it reduces pollution and public health risks due to hazardous chemicals.

Thus, this innovative strategy also plays a role in empowering farmers through a sustainable entrepreneurial approach that utilizes local potential as raw materials for herbs and utilizes traditional wisdom as social capital. This entrepreneurial approach provides new opportunities for business development, encourages farmers to manage herbal products independently, and expands market reach through an adaptive, environmentally friendly business model. By providing training, mentoring, and strengthening business networks, farmers, especially women in rural areas, can increase the production capacity and marketing ability of herbal products(Yousif et al., 2025). This directly contributes to improving economic welfare as well as preserving local culture. Overall, the role of this innovative strategy includes technical, economic, social, and environmental aspects that are interconnected to achieve optimal and sustainable livestock productivity.

This research uses the Sustainable Systems Theory developed by Meadows (2008), which emphasizes the importance of balance and synergy between economic, social, and environmental aspects in development. This theory is suitable to be used to direct the development of herbal treatment strategies that not only increase livestock productivity but also consider the environmental impact and long-term welfare of the farming community. This sustainable systems approach encourages the integration of the ecological aspects of traditional herbs with entrepreneurship as a way to build a livestock business that is resilient to change and sustainable. This is in accordance with the research objectives that aim to achieve livestock productivity while developing a business model that provides economic added value for the local community. This theory also emphasizes the need for cross-sector collaboration and active participation of farmers in every stage of innovation development.

In addition, the application of Sustainable Entrepreneurship Theory introduced (Cohen & Winn (2007)is very important in this study. This theory discusses how entrepreneurship can be a tool to create socio-economic value that supports sustainable development. In the context of herbal medicine for livestock, this theory helps explain how innovations in products and processes can create new business opportunities that are environmentally friendly and

empower the farming community. The sustainable entrepreneurial approach focuses not only on financial gains but also on the preservation of natural resources and improving the quality of life of communities. By integrating herbal medicine with sustainable entrepreneurship, this research aims to create synergies between livestock health, local economies, and local cultural conservation. Therefore, this theory is an important foundation for developing innovative and environmentally responsible business models.

Then it was strengthened, the theory of Ethno-Veterinary Medicine put forward by McCorkle (1986) became an important basis in this research. This theory explains the use of traditional knowledge and herbal materials that have been used by people in treating and caring for their livestock. Ethno-veterinary medicine emphasizes that local knowledge is a very valuable resource and worthy of scientific development and validation. In this study, the theory is a reference for exploring, documenting, and integrating traditional herbal knowledge into modern livestock systems. This supports an approach that respects local wisdom while ensuring its effectiveness and safety. This theory also supports the development of herbal products based on local wisdom as part of sustainable innovation with economic value. Thus, this theory opens up opportunities for cultural preservation as well as animal husbandry technology innovation.

II. METHODOLOGY

This study uses the mixed methods research method with an explanatory sequential design(Schoonenboom & Johnson, 2017). This approach combines quantitative and qualitative methods in sequence to gain a comprehensive and in-depth understanding and empirical validation of innovative strategies in integrating traditional herbal medicine to increase livestock productivity effectively and sustainably. The study population was farmers who practiced or were interested in herbal medicine and sustainable entrepreneurship, with a sample of 50 people purposively selected to ensure relevant representation. The research subjects consisted of individual farmers who were active in livestock management and the use of herbal medicines as part of their entrepreneurial activities. The research instruments used included a questionnaire structured in a quantitative stage to measure livestock productivity, the adoption rate of herbal medicine, and entrepreneurial success(Groot & van 't Hooft, 2016). At the qualitative stage, semi-structured interview guidelines and focus group discussion (FGD) protocols were used to explore the experiences, motivations, and obstacles faced by farmers in adopting these strategies. Instrument development involves initial testing, expert validation, and pilot testing to ensure the reliability and relevance of the data. Quantitative data analysis was carried out by descriptive statistics, mean difference tests, and regression analysis, while qualitative data analysis used thematic analysis techniques to strengthen and complement quantitative results. The research procedure began with the collection of quantitative data through a survey of 50 farmer respondents, then analyzed to determine the pattern and influence of herbal integration and entrepreneurship on livestock productivity. Furthermore, qualitative data were collected through interviews and FGDs aimed at explaining and deepening

quantitative results. The mixing of data from the two stages is used to obtain a richer and more valid understanding and provide strategic recommendations in the sustainable application of entrepreneurship-based herbal innovations in the livestock sector(Molento, 2009). This sequential approach ensures that quantitative findings are prioritized as the basis for further qualitative research development(Chamorro, 2006).

III. RESULTS AND DISCUSSION.

Based on the results of research that has been carried out on using innovative strategies for traditional herbal medicine-based farming and sustainable entrepreneurship, it shows are very significant for increasing productivity, income, and general welfare of farmers. The results of this study are based on quantitative and qualitative data collected from 50 respondents who are active in the field of livestock management and have known and used herbal products in their livestock activities.

In the early stages of the study, analysis of livestock productivity data (Table 1) showed that the use of traditional herbal medicines was able to encourage livestock growth more optimally than the use of conventional methods without herbs. Chickens given herbal medicines experienced weight gain between 1.2 and 1.3 kg, while chickens without the use of herbs only experienced an increase of about 1 kg in the same period(Mavungu et al., 2023). A more noticeable improvement was seen in cows and sheep, where cows integrated with herbal remedies showed a weight gain of 30 kg, while cows without herbal treatment gained only about 25 kg. Feed consumption in the treatment and control groups was relatively similar, indicating that feed conversion efficiency improved in the herbaceous group. This happens because bioactive compounds in herbal plants can improve the digestion and immunity of livestock so that the feed consumed can be converted into live weight more efficiently(Yousif et al., 2025).

The study also found that the integration of traditional herbal medicine not only has an impact on productivity aspects, but also on the economic and social aspects of farmers. From the results of Table 2, it is known that out of 50 farmers, as many as 30 people have actively adopted the use of herbal medicines in their livestock business. Farmers who adopted herbal medicine were shown to gain an average of 2.7 kg in weight with a production per period of 150 kg, compared to farmers who had not adopted herbal medicine, who gained an average of 1.9 kg and 130 kg production per period. In addition to productivity, the monthly income received by herbal farmers is also much higher, with an average income of IDR 2,500,000 per month, compared to non-herbal farmers who only get an average of IDR 1,800,000. This positive correlation supports the assumption that the use of herbal medicines in addition to nourishing livestock also has a direct economic impact that improves the welfare of farmers.

The results of the analysis in Table 3 show that the success of the adoption of innovations in the use of herbal medicines is greatly influenced by the level of entrepreneurship of farmers. Farmers with a high entrepreneurial participation score (scores of 4-5) are not only actively involved in developing herbal products but also earn the highest income, ranging from IDR 2,800,000 to IDR 3,600,000 per month. Active participation in entrepreneurship is shown by processing,

packaging, and marketing livestock herbal products themselves, either in the form of herbal medicine, feed supplements, or natural herbs for medicine. Conversely, farmers with low entrepreneurial scores (1–2) tend to carry out conventional farming practices, lack creativity and innovation, and have lower incomes. These findings confirm the importance of training and mentoring in developing an entrepreneurial spirit, so that farmers are not only users of herbal medicines, but also able to take advantage of business opportunities from this technology.

On the other hand, this study also recorded various obstacles and inhibiting factors that are still quite large in the field (Table 4). The biggest obstacle is the lack of knowledge of farmers regarding how to use and the benefits of herbal medicines compared to chemical antibiotics. Around 60% of respondents feel they have not received enough education regarding the formulation, dosage, and safety of using herbal medicines. The availability of raw materials is also a problem for 40% of farmers, as access to consistent and quality raw materials is not always easy, especially in rural areas. In addition, the lack of government support and policies in the form of formal training or supporting facilities is also a barrier to wider adoption. Some farmers (24%) have difficulty marketing herbal products due to a narrow market and a lack of distribution networks. On the other hand, public trust still needs to be strengthened because 20% of respondents are not fully convinced of the effectiveness of herbal medicines in improving livestock performance.

Data analysis shows that the main factors that determine the success of this innovation are collaboration between local knowledge, policy support, education improvement, utilization of market opportunities, and entrepreneurial capacity building. Many farmers with higher levels of education and business experience tend to be more open to innovation and willing to take risks to try new ways, including the use of herbal medicines and developing herb-based businesses in livestock. Farmers who are actively involved in farmer groups and cooperatives are also faster to adopt innovations and can compete in a wider market, even to penetrate digital channels.

The application of the mixed methods explanatory sequential design method has proven to be effective in revealing dynamics in the field as a whole. Through quantitative surveys, productivity trends, adoption rates, and income can be known, while in-depth interviews and FGDs provide an overview of motivations, obstacles, and potentials that can continue to be developed. It was found that the development of herb-based livestock businesses and entrepreneurship not only has an impact on improving the individual economy of farmers, but also has a social impact because it is able to strengthen business networks in local communities, empower women, and maintain the preservation of local wisdom. The innovative strategies driven in this study are relevant not only to increase productivity, but also as a sustainable and environmentally friendly solution--reducing antibiotic waste, maintaining human health, and conserving biological resources.

Table 1. Livestock Productivity Before and After Herbal Medicine Use

Respondents	Livestock Type	Starting Weight (kg)	Final Weight (kg)	Weight Gain (kg)	Feed Consumption (kg)	Use of Herbal Medicines (Yes/No)
1	Chicken	1.2	2.5	1.3	3.0	Yes
2	Chicken	1.1	2.3	1.2	2.8	Yes
3	Sheep	10.0	12.5	2.5	7.0	Not
4	Cow	200	230	30	50	Yes
5	Sheep	9.5	12.0	2.5	6.8	Yes
6	Cow	190	215	25	48	Not
7	Chicken	1.3	2.6	1.3	3.1	Yes
8	Chicken	1.0	2.0	1.0	2.7	Not
9	Sheep	11.0	13.5	2.5	7.5	Yes
10	Cow	210	240	30	52	Yes

Table 1 presents data on the weight gain and feed consumption of various livestock types, including chickens, sheep, and cattle, comparing animals treated with traditional herbal medicines to those untreated. The data show that animals receiving herbal treatments generally exhibit higher weight gains compared to those without herbal use. For example, chickens with herbal treatment gained between 1.2 to 1.3 kg versus untreated chickens with around 1.0 kg gain. Similarly, cattle treated with herbal medicines showed weight gains ranging from 25 to 30 kg, higher than some untreated examples. Feed consumption is roughly comparable, indicating that herbal medicines might improve feed efficiency by enhancing digestion and immune function. These findings align with prior studies demonstrating that the bioactive compounds in herbs such as turmeric and ginger can improve livestock health and productivity by acting as natural antibiotics and growth promoters. This table supports the notion that integrating herbal medicine can enhance production performance sustainably.

Table 2. Adoption Level of Herbal Medicine and Productivity Impact

Uses of Herbal Medicines	Number of Breeders	Average Weight Gain (kg)	Average Production (kg)	Average Income (Rp)
Yes	30	2.7	150	2.500.000
Not	20	1.9	130	1.800.000

Table 2 summarizes the adoption rates of herbal medicine among farmers and associations with productivity metrics and average income. Out of 50 respondents, 30 farmers have adopted herbal treatments, showing an average weight gain of 2.7 kg and average production output of 150 kg, which is notably higher than the 1.9 kg gain and 130 kg output of the 20 non-adopters. Correspondingly, adopters earned an average monthly income of Rp 2,500,000 compared to Rp 1,800,000 for non-adopters. This suggests a positive correlation between herbal medicine utilization and both livestock productivity and economic benefit for farmers. Such findings support the effectiveness of herbal

integration noted in the literature, emphasizing improved animal performance and profitability through natural feed additives. Moreover, this encourages wider adoption through awareness and training to sustain livestock farming livelihoods.

Table 3. Entrepreneurship Levels and Income Correlation

Respondents	Entrepreneurial Participation (Scale 1-5)	Monthly Income (Rp)	Utilization of Herbal Products (Yes/No)
1	4	3.000.000	Yes
2	3	2.500.000	Yes
3	2	1.500.000	Not
4	5	3.500.000	Yes
5	4	2.800.000	Yes
6	1	1.200.000	Not
7	3	2.100.000	Yes
8	2	1.700.000	Not
9	4	3.000.000	Yes
10	5	3.600.000	Yes

Table 3 presents data on farmers' involvement in entrepreneurship activities rated on a scale from 1 to 5, alongside their monthly incomes and whether they utilize herbal products. Higher entrepreneurship participation correlates with higher income; for example, those scoring 4 or 5 typically earn between Rp 2,800,000 to Rp 3,600,000 monthly and mostly use herbal remedies. Lower entrepreneurship levels (scoring 1 or 2) often correspond to lower incomes and less herbal usage. This pattern supports the theory that sustainable entrepreneurship, combined with herbal medicine adoption, can enhance economic outcomes by creating business opportunities like the production and marketing of herbal products, which add value in rural livestock systems. Encouraging entrepreneurship among farmers can thus be a key strategy to complement health innovations and improve their livelihoods.

Table 4. Obstacles and Supporting Factors in the Use of Herbal Medicines

Types of Barriers	Number of Respondents (people)	Present (%)	Description
Lack of Knowledge	30	60	Farmers lack information about how to use and the benefits of herbal medicines.
Availability of Raw Materials	20	40	Herbal medicine raw materials are difficult to find with consistent quality.
Lack of Government Support	15	30	Lack of training programs and government assistance for herbal farmers.
Limited Market	12	24	Herbal products have not been widely marketed,

			making it difficult to reach consumers.
Belief in Herbal Medicine	10	20	Some farmers and consumers still doubt the effectiveness of herbal medicines.

Table 4, which shows the various types of obstacles in the use of herbal medicines by farmers, provides a clear picture of the obstacles still faced in the adoption of natural remedies in livestock. The most common obstacle faced is a lack of knowledge, where 30 out of 50 respondents, or 60% of farmers, feel that there is not enough information and understanding about how to use and benefit from herbal medicines. This shows the need for more intensive education and training so that farmers can use herbal medicines correctly and effectively. In addition, the availability of raw materials with consistent quality is a significant obstacle for 40% of farmers because it is difficult to obtain herbal ingredients that meet standards for optimal drug production. Then, 15 farmers or 30% stated the lack of support from the government, such as training facilities and technical assistance, which made the development of herbal medicines limited. The small market is also a problem for 24% of farmers, where herbal products have not been widely distributed and are difficult to use as an optimal source of income. Trust in the effectiveness of herbal medicines is a problem for 20% of respondents because many still doubt the results caused. Overall, these factors show that although herbal medicine has great potential, there are still many processes that need to be done to increase the adoption and empowerment of farmers in the use of herbal medicines to improve the health of livestock naturally and sustainably.

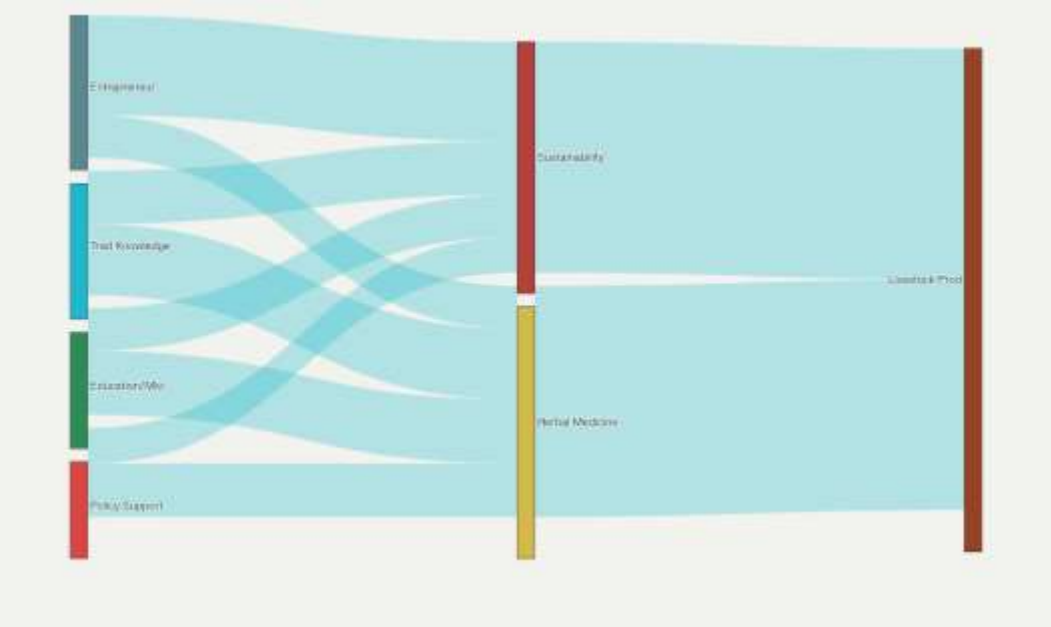

Figure 1. Livestock Productivity Innovation Model

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The results of this research show that innovative strategies combining traditional herbal medicine with sustainable entrepreneurship can effectively enhance livestock productivity and farmer welfare. Based on the data, integrating herbal treatments into livestock management not only increased average weight gain and health outcomes but also contributed to higher income levels for farmers who adopted these practices(Dong et al., 2009). This supports the premise that natural approaches have the potential to improve farm efficiency while reducing environmental risks commonly associated with synthetic drug use.

The utilization of herbal remedies in livestock feed and health was aligned with broader global trends in the herbal medicine sector, which continues to see significant growth, as outlined in "Herbal Medicine: Current Trends and Future Prospects," which observed a 15% annual rate of market growth and recommended stronger integration of herbal practices into mainline agriculture. The World Health Organization's strategic draft for traditional medicine (Organization, 2025)further emphasizes integrating traditional herbal knowledge in both human and animal health for sustainable development, highlighting cultural and ecological relevance.

Increased farmer knowledge, training, and entrepreneurial skills were found to be crucial factors, echoing Saha et al. (2024), who described stakeholder perceptions as central to adopting sustainable animal health practices in their article "Sustainable practices in the animal health industry." Higher entrepreneurship scores among farmers in this study were strongly correlated with both income gains and wider adoption of herbal medicine, in line with recent findings on sustainable entrepreneurship (Rasheed et al., 2024), who recommend enviropreneurship as a guiding principle for business growth in agricultural contexts.

Analysis also reveals that access to quality herbal raw materials, reliable distribution channels, and supportive government policies remains a challenge. This supports the findings of "Development of Medicinal Plant Culture Through

Entrepreneurship," which states that successful integration of medicinal plant entrepreneurship requires direct marketing models, capacity building among farmers, and improved supply chains to raise quality and selling prices, thereby strengthening the local economy(Anggarani et al., 2025). Endorsement of business incubators, as suggested in Mulyono's work, can help farmers' groups meet industry standards for herbal production and develop sustainable business models(Phaahla et al., 2024).

Another vital aspect is green entrepreneurship, which is increasingly viewed as an essential pillar of transformation towards sustainable agriculture. (Cahyati, 2025)

in "The Role of Green Entrepreneurship as an Innovative Solution to the Environmental Crisis" identifies community-based entrepreneurial models integrating circular economy principles, which foster resource reuse, minimize waste, and catalyze grassroots innovation(Soji-Mbongo et al., 2025). The current study's findings that entrepreneurial farmers enjoy higher economic returns and are more likely to adopt herbal practices further reinforce the theoretical value of green entrepreneurship in rural livestock contexts.

IV. CONCLUSION AND RECOMMENDATIONS

It can be concluded that innovative strategies that integrate traditional herbal medicine with a sustainable entrepreneurial approach have a significant influence on effectively increasing livestock productivity. Quantitative data showed an increase in weight and feed efficiency in cattle that used herbal remedies compared to those that did not, supporting the hypothesis that traditional herbs act as a safe and environmentally friendly natural growth stimulant. In addition, this finding is in line with research (Hashemi & Davoodi, 2011), which showed that herbal additives improve livestock performance without the side effects usually found in synthetic antibiotics. This is also in line with research, which explains the positive trend of the development of the use of herbal plants in animal production as an alternative to antibiotics. In addition to the impact on livestock productivity, this study also found that increasing the entrepreneurial capacity of farmers is closely related to increasing income(Cohen & Winn, 2007). The definition of sustainable entrepreneurship emphasizes the importance of creating socio-economic value that takes into account environmental elements, which is reflected in the ability of farmers to manage herb-based businesses independently and sustainably. The findings in this study are also supported by research (Rasheed et al., 2024), who link environmentally-based entrepreneurship with improving business performance in the agricultural sector. Thus, the use of herbal medicines is not only a solution for livestock health but also opens up new economic opportunities for farmers, especially as micro-entrepreneurs.

In terms of constraints, the results of the study show obstacles in the form of a lack of adequate knowledge among farmers about the use of herbal medicines and a limited supply of quality raw materials, which have also been identified in

the context of the development of medicinal plant businesses. This research shows that human resource capacity building, as well as policy support and market facilities, are absolute requirements for accelerating the adoption of innovation. The theory of ecological innovation outlined (Cahyati, 2025)supports this by emphasizing the need to integrate social, economic, and environmental approaches to create sustainable innovation in the agriculture and livestock sectors.

Thus, this study emphasizes the importance of synergy between traditional knowledge, modern education, policies, and entrepreneurial capacity to support sustainable innovation. Wang et al. (2023), in their study on green innovation in the livestock sector, emphasized that collaboration between various stakeholders can drive more efficient and environmentally friendly agricultural practices. Therefore, the implementation of innovative strategies in this study cannot be carried out separately from strengthening social networks and supporting institutions. As such, this research makes an important contribution to the literature and practice of sustainable animal husbandry, while also offering a model that can be replicated in other regions with similar characteristics. The strategies developed not only increase livestock productivity and farmers' incomes but also address environmental and social problems through a holistic approach that prioritizes local culture and entrepreneurship. The implication is the need for continued support from governments, academia, and the private sector in providing training, market access, and policies that support the integration of traditional herbs and innovative entrepreneurship in the livestock sector.

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