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Empowerment of Cattle Breeder Groups in an Effort to Improve Welfare through Fermented Feed Processing

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Abstract

Sumbawa cattle play an important role in meeting the needs of local, regional, and national markets. However, the increase in demand has not been balanced with the quality of livestock, management skills, distribution network, and the fulfillment of meat quality standards according to SNI 3932-2008. Farmers still depend on wild feed whose nutrients do not support productivity, thus having an impact on health, fattening, and economic stagnation of livestock groups. This activity aims to identify problems, empower farmers, and formulate training strategies to improve independence and welfare. The output produced is in the form of a manual for processing silage and ammonia feed, utilizing traditional feed ingredients that are abundant during the rainy season and can be stored for 6-12 months. Feed fermentation technology training is expected to be able to increase productivity up to 1.5–2 times compared to before. In addition, the formation of livestock business groups with a good management system is carried out through socialization and workshops related to business management, product packaging, and selling price determination. The program is carried out through three stages: (1) preparation in the form of problem identification, coordination, and socialization with partners of the Keban Jamu Hamlet Hamiri Breeder Group; (2) implementation in the form of socialization, planting grass feed banks, as well as fermented feed training and business management; (3) monitoring and evaluation to assess the improvement of knowledge, skills, and marketing capabilities oriented to long-term livestock growth.

Keywords: Process Efficiency; livestock productivity; Fermented Feed Technology; Green Economy; Independence and Progress

1. Introduction

Sumbawa cattle are one of the local livestock commodities that play a strategic role in supporting the animal protein needs of the community at the local, regional, and national levels. The potential of Sumbawa cattle lies not only in their function as meat producers, but also in their cultural and social value deeply ingrained in the lives of the community. Poto Village, Moyo Hilir District, Sumbawa Regency, is one of the centers for Sumbawa cattle development with a significant population. According to data [1], the cattle population in Moyo Hilir District reaches 22,472 head, while in Poto Village itself, there are approximately 6,680 head of cattle, most of which are raised by smallholder farmers. Administratively, Poto Village has an area of 13.67 km² with a population of 2,809 people [1]. Beside being a livestock center, Samiri Hamlet, which is part of Poto Village, is also known as an iconic weaving tourism area, making the presence of Sumbawa cattle an additional attraction for tourists. However, despite its abundant potential, cattle farming governance in this region is still dominated by traditional patterns, which impacts the low quality and productivity of the cattle.

The system of cattle maintenance that is still done by letting them roam freely in the pasture leads to uncontrolled feed consumption patterns. Farmers generally rely on weeds and whatever green fodder they can find, which is not nutritionally balanced to meet the needs of their livestock. This condition results in low livestock productivity, slow growth, susceptibility to disease, and ultimately reduces the selling price of cattle in the market. In fact, feed quality is a dominant factor in livestock farming. According to [2], feed contributes approximately 60%–

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70% of the total cost of meat and milk production. This means that even tho the genetic potential of Sumbawa cattle is quite good, if feed is not provided optimally, the quality standards for beef, including those outlined in SNI 3932:2008, will not be met. As a result, farmers find it difficult to improve their economic well-being because the selling price of cattle tends to be low and fluctuates.

The fundamental problem for partners is the low level of knowledge and skills among farmers in managing modern feed. For over 50 years, the group of cattle farmers in Samiri Hamlet has relied on traditional methods without significant innovation in feed processing. The lack of processing technology often leads to agricultural waste such as rice straw and dried corn stalks being discarded, even tho they have great potential to be processed into high-quality animal feed. Additionally, farmer groups also face challenges in business management, ranging from calculating production costs and financial bookkeeping to efficient product marketing strategies. This condition has implications for the slow development of the economic scale of the group of farmers, with some of them even falling into the category of extreme poverty due to their inability to increase the added value of their livestock farming businesses.

The purpose of this community service activity is to empower cattle farmers in Samiri Hamlet thru a series of training and mentoring sessions. First, on the technical aspect, farmers will be trained on fermentation feed processing technology, silage, and ammoniation, utilizing local raw materials such as agricultural waste. This technology has been proven to increase the protein content of feed, facilitate digestion, reduce the odor of livestock waste, and provide a feed reserve during the dry season [3]. With the implementation of this technology, livestock productivity is expected to increase 1.5 to 2 times compared to before the intervention. Second, from an institutional perspective, farmer groups will be strengthened thru training in business management, bookkeeping, and marketing strategies, including the digitalization of livestock product marketing. This is important considering research [4] confirms that strong group management and the use of digital technology can expand market access and improve the competitiveness of livestock products. Third, this activity supports the achievement of the university's key performance indicators (KPIs), namely students gaining experience outside the campus, lecturers being directly involved in community activities, and research results being tangibly utilized by the community. Additionally, this activity aligns with the sustainable development goals (SDGs), particularly the goals of No Poverty and Life on Land.

Recent literature reviews support the urgency of this program. According to [5], feed fermentation technology based on local materials not only increases cattle productivity but also reduces production costs by up to 30%. Research [6] from the Community Partnership Program in Timbuseng Village, Takalar, introduced feed and barn technology to traditional beef cattle farmers; the results showed an increase in livestock productivity and farmers' skills in business management. Meanwhile, an empirical study by [7] in Sumbawa Regency examined strategies for producing livestock feed from local waste and found that these strategies were able to reduce feed costs and increase livestock income by utilizing local materials more efficiently. These findings show that feed modernization and strengthening business management are appropriate strategies to address the issues in Poto Village. Furthermore, applying the principles of a green economy in cattle farming, thru the utilization of organic waste, also contributes to environmental sustainability, reduces emissions, and creates a sustainable farming ecosystem.

Thus, this service activity is of high urgency to be carried out. Practically speaking, this program will address the issues of limited feed availability, weak business management, and minimal technological innovation among cattle farmers. Academically, this activity serves as a form of downstreaming research results that are directly implemented for the benefit of the community. This program is expected to enhance the capacity of livestock farmer groups in feed management, improve institutional systems, and open up wider market opportunities, including the meat processing industry. Ultimately, this activity is not only aimed at increasing livestock productivity, but also at improving the welfare of farmers, strengthening the local economy, and achieving sustainable development based on local wisdom. Here is the problem statement: (1) What is the current state of Sumbawa cattle farm management in Samiri Hamlet, Poto Village, Moyo Hilir District, specifically regarding feeding patterns and livestock productivity? (2) What are the factors causing the low knowledge and skills of farmers in modern feed processing and livestock business management? (3) How can fermentation-based local feed processing technology be effectively applied to improve the quality and productivity of Sumbawa cattle? (4) To what extent can empowerment thru technical training (feed fermentation) and institutional management strengthening (bookkeeping, marketing, and digitalization) improve the welfare of cattle farmer groups? (5) What is the impact of implementing the cattle farmer empowerment program thru fermented feed technology on increasing group capacity, the economic value of livestock businesses, and the sustainability of the livestock ecosystem?

2. Methods

This community service activity was carried out in Samiri Hamlet, Poto Village, Moyo Hilir District, Sumbawa Regency, an area with great potential in the

livestock sector, particularly in Sumbawa cattle farming. This village has a fairly high cattle population, but most of the raising is still done traditionally. The main partner for the activity is the Keban Jamu Farmers Group, which consists of approximately 20 farmer-breeders. They raise cattle using a semi-intensive system and have access to agricultural waste such as rice straw and corn stalks, which could potentially be used as fermented feed. The main constraints for the partner groups are the limitations in feed processing technology, low capacity for livestock business management, and the suboptimal marketing of livestock products. Therefore, this service activity is aimed at improving farmers' skills in processing local feed, strengthening group management, and opening access to digital marketing. This community service activity is carried out in three main stages: preparation, implementation of mentoring, and evaluation and monitoring.

Preparation

The preparation stage is carried out to ensure that the mentoring activities run effectively and according to the needs of the partners. The steps taken include: (a) An initial survey of local feed potential, identifying the availability of raw materials such as rice straw, corn stover, and other agricultural waste. (b) Development of training modules, covering theory and practice regarding feed processing (fermentation, ammoniation, and concentrate production). (c) Coordination with partner groups to agree on activity schedules, mentoring mechanisms, and achievement targets.

Implementation of Mentoring

The assistance was provided in the form of counselling, demonstrations, and direct practice involving the farmers. The main activities include: (a) Theoretical education on the importance of fiber-rich feed, processing techniques, and its benefits for livestock productivity. (b) Practices for making corn stover silage (Zea mays), which involves fermenting green forage using a barrel (mobile silo) with a capacity of 48–50 kg dry matter (DM 30–35%) and incubating it for 28 days. (c) Practices for making ammoniated urea straw, which involves soaking straw in a urea solution (15 kg straw : 500 liters water), followed by incubation for 7 days to increase its nutritional content. (d) The practice of making locally-based concentrate feed, using rice bran, pollard, coconut meal, molasses, and mineral mix with a formulation adjusted to the needs of the cattle. (e) Group management training, including task division, simple financial record-keeping, calculating the selling price of cattle, and digital marketing of livestock products.

This activity is fully supported by the faculty and student team from the University of Technology Sumbawa, who provided intensive mentoring throughout the program.

Evaluation and Monitoring

To measure the effectiveness of the activities, an evaluation was conducted in several ways: (a) Pre-tests and post-tests were used to assess the improvement in farmers' understanding after the training. (b) Feed quality analysis, by comparing results before and after fermentation (silage and ammoniation), and estimating the nutrient content of the concentrate. (c) Feed trials on livestock, to assess the palatability and acceptance of processed feed by cattle. (d) Laboratory analysis, consisting of proximate analysis on silage and ammoniated straw samples at the Animal Nutrition and Feed Laboratory.

The approach method used in this Community Partnership Empowerment for Training and Mentoring is Fact Finding & Focus Group Discussion (FGD)-Teamwork, Project Based, and Practicum. Activity Objectives: To enable and independently develop fermented feed; to increase the capacity and management of cattle farmer-breeder groups; to facilitate digital market access and expansion, determine selling prices, and increase farmers' income. Target Audience: Cattle Farmers, BUMDes Managers, and the General Public. The output is the creation of fermented feed products (silage and ammoniation). It increases the capacity of farmers and cattle group managers independently; makes it easier to access capital and increases the income/welfare of cattle-raising farmers by up to 1.5 times.

This program implements silage technology for livestock feed processing and ammoniation of agricultural waste, improving nutrition and addressing feed shortages during the dry season. Innovations in fermented feed banks allow for storage of up to 4–8 months, ensuring year-round feed availability. Technical training on grass choppers supports farmer independence, efficiency, and livestock productivity, while also reducing waste. This technology is cost-effective, environmentally friendly, easy to implement, and adaptable to partner capacity.

3. Results and Discussions

This activity is carried out with the intention of providing an overview of the program to be implemented, conveying initial information about fermented livestock feed technology and innovation, and feed banks to ensure the availability and sustainability of livestock feed throughout the year, with the aim of providing solutions to the problems faced by partners. The activity was carried out in the form of a Focused Group Discussion (FGD) for 1 day, with the target participants being one group leader and 5 members or officials of the Keban Jamu Farmer-Breeder Group. This FGD activity was conducted to explore basic perceptions, enthusiasm, and to measure

and ensure the location for planting the livestock feed bank by visiting or surveying the land where the feed bank will be planted, and the willingness of partners to support the smooth running of this program. This service activity was carried out in several systematic stages aimed at improving farmers' skills and independence in processing local feed. The activity stages can be described as follows:

Socialization of the Activity Plan and Delivery of Initial Materials on Science and Technology Innovations Used in Community Service Activities.

The socialization of the activity plan and the delivery of initial science and technology materials in the community service program were carried out with the involvement of two representatives from the Keban Jamu Farmer Group, namely Mr. Hasyim, and the Deputy Head of Poto Village, Mr. M. Jayadi. These partners have been actively involved from the proposal development stage to the implementation of the activities. This socialization aims to provide an overview and detail the Community Partnership Program (PKM) that will be implemented. Applying a participatory rural empowerment approach. In community empowerment theory according to [8], communities will be able to increase their capacity if they are involved from the planning stage to the program implementation. The involvement of partners from proposal development to field activities illustrates a co-creation relationship between the service team and the farmers, rather than a top-down one. This aligns with the concept of community engagement, which emphasizes equal partnerships in solving community problems.

Figure 1. Socialization of the Activity Plan and Delivery of Initial Materials on Science and Technology Innovations Used in Community Service Activities.

The first meeting was held on August 2, 2025, at the residence of Mr. H. Hasyim, the group leader, and 5 members of the Keban Jamu farmer-breeder group, as well as at the group's cattle shed. The activities continued with a second meeting on August 9, 2025, at the Poto Village Office with the Village Head, Mr. Fathul Muin, SP, and representatives from the local farmer-breeder group. During the meeting, the condition of the partner cattle was also checked. The next agenda is training, practice, and empowerment, which will be held at the Poto Village Hall on August 26–27, 2025. The location selection in two different places was done because of the partners' busy activities during the land clearing season, livestock feed provision, and planting preparations. This makes it quite difficult to bring all participants together in one opportunity, especially since the distance between hamlets is up to 3 km, even tho road access is relatively adequate.

The Poto Village Hall was chosen as the training location because it was considered representative and in accordance with the Head of the Village's recommendation. This also aims to involve farmer-breeders from other hamlets so that knowledge and skills regarding fermented feed processing can be disseminated and practiced independently by more people after the training.

The socialization stage also reflects the application of diffusion of innovation theory [9]. The process of innovation adoption must begin with the knowledge stage, thru the dissemination of information and the introduction of science and technology to potential adopters (farmers). The initial presentation of materials regarding the training plan and fermented feed processing allows farmers to understand the benefits and urgency of the innovation before technical practices are provided. This is important because the acceptance of innovation among agrarian communities is highly influenced by their initial level of understanding and perception of the technology's benefits.

The results of the meeting and FGD, which showed full support and high motivation from the farmers, confirmed the findings of previous research. [10], the success of empowerment in the livestock sector is highly influenced by the enthusiasm and sense of ownership of the community toward the program. Similarly, [11] found that training on fermented feed processing for cattle farmer groups only resulted in increased capacity when the accompaniment was participatory and tailored to the partners' needs. The choice of socialization and training locations in two different places (the farmer's house/cattle shed and the Poto Village Hall) demonstrates the application of a contextual-based empowerment approach. [12], empowerment activities must be adapted to the social conditions and workload of the community. This was evident in this activity, where the schedule and location were arranged flexibly considering the high activity of partners during the land clearing and planting preparation season. Such actions enhance the effectiveness of participation and the achievement of training objectives.

The training activity, which was centered in the village hall and involved several hamlets simultaneously, reflects the application of the multiplier effect principle. The results of study [13] indicate that strengthening the capacity of farmers at the community level will be more sustainable if skills technology is disseminated to more people to facilitate learning diffusion and peer learning among group members. Additionally, identifying additional training needs related to livestock health and reproduction management is an implementation of the principle of continuous needs assessment within the Human Capital Empowerment model. Research [14] confirms that cattle productivity depends not only on feed management but also on health and reproduction, making comprehensive training more effective in increasing farmers' income.

Socialization of the Program and Initial Materials for Science and Technology Innovation

This socialization event and material presentation was held at the Multi-Purpose Building, Poto Village, Moyo Hilir District, Sumbawa Regency, with a target of at least 20 participants representing the Keban Jamu Farmer-Breeder Group. The attendees consisted of 20 men who are farmer-breeders. This activity was opened with a welcome speech from the head of Poto village, represented by Mr. M. Jayadi, who stated he was very pleased with the continuation of this community service development program because this service could develop the herbal garden livestock farmer groups in Poto village. Then, there was a speech from the head of the community service program, Mr. Abdul Salam, S.E., M.M., who stated he was very happy to be able to carry out this continuation activity and also announced some of the materials that would be discussed in this socialization. After the last community service program head, there was a speech from the head of the herbal garden livestock farmers, Mr. H. Hasyim, who stated he was pleased with the continuation of this activity and very grateful because the material provided in the previous service had led to an increase in setting the selling price of cattle in Poto village.

Figure 2. Presentation of material on Livestock Business Management and Effective Teams by Mr. Abdul Salam, S.E., M.M.

After the welcome remarks, the first material was presented by Mr. Abdul Salam, S.E., M.M. This material highlighted the effective application of business management and teamwork as the key to facing livestock challenges in Sumbawa Regency. The main problems include low productivity due to the system of rearing, lack of feed during the dry season, and the threat of diseases such as anthrax. The proposed strategies include utilizing corn waste, planting lamtoro taramba, establishing feed banks, and strengthening vaccination programs. The success of the program heavily relies on a solid team effort with clear goals, open communication, effective leadership, and a collaborative culture. The follow-up plan includes technical training, livestock performance recording, regional group development, and productivity evaluation. With integrated business management and policy support, Sumbawa's livestock farming is expected to sustainably increase the independence and welfare of farmers.

The results of the activity implementation show that increasing farmers' capacity thru strengthening business management and teamwork has a significant impact on the readiness of farmer groups to adopt sustainable livestock management innovations. The material presented on the utilization of corn waste, planting lamtoro taramba, establishing feed banks, and strengthening vaccination was enthusiastically received by the participants because it aligned with the real needs that had been the main obstacles, especially regarding feed scarcity during the dry season and the risk of livestock diseases such as anthrax. These findings are consistent with agribusiness management theories that emphasize the importance of business planning, resource management, performance recording, and periodic evaluation as determinants of increased productivity [15]. This implementation is also in line with the findings of [16], which state that production management based on recording improves feed efficiency and the selling price of livestock at the smallholder level. Furthermore, the success of innovation transfer not only depends on mastering technical aspects, but also on the synergy and effectiveness of teamwork within the group of farmers. This reinforces the theory of team effectiveness by [17], which states that open communication, clear goals, participatory leadership, and shared commitment are determinants of group performance. The results of the FGD and participant responses confirm that a collaborative spirit and a more solid work structure enhance the group's readiness to implement program follow-up activities, such as regional-based group development, livestock performance recording, and productivity evaluations. Additionally, the feed resilience strategies offered align with the research findings of [18] and [19], proving that utilizing local waste and fermented feed technology can significantly reduce production costs and increase livestock productivity. Thus, it can be concluded that the

application of business management integrated with teamwork synergy and local feed innovation can serve as a community-based empowerment model for Sumbawa cattle farmers, which is not only focused on increasing productivity but also on strengthening the economic independence and well-being of farmers sustainably.

Figure 3. Presentation of material on Digital Marketing Management for Livestock by Mrs. Hartini, S.E., M.M.

After that, the second material was presented by Ibu Hartini, S.E., M.M., who stated that the material presented on digital marketing for livestock businesses in the village aligns with modern marketing theory, which emphasizes the importance of utilizing digital technology to expand market access and increase product competitiveness. According to [20], digital marketing allows businesses to reach consumers more broadly, quickly, and accurately thru visual content and online interaction. This supports the livestock product branding strategy thru group logos, storytelling, and digital content as explained in the material, because branding is able to increase consumers' perceived value of a product and differentiate it from competitors.

The implementation of marketplaces, social media, and websites introduced to the farmer groups is also relevant to the findings of previous research. Study [21] showed that using social media for livestock marketing can significantly increase consumer demand because the dissemination of information about livestock quality, maintenance processes, and customer testimonials builds trust in transactions. Furthermore, research by [22] found that business storytelling and visual content are dominant factors in influencing consumer purchasing decisions in the online agribusiness sector, aligning with the material's emphasis on the importance of engaging content and business narratives.

In terms of pricing, according to cost-based pricing and market-driven pricing theory [23], a fair and competitive price must consider production costs, product quality, and market demand. This is identical to the pricing approach in the material. The differentiation strategy based on livestock quality and organic feed is also consistent with the findings of [24], which state that quality-based and maintenance process-based differentiation increases customer loyalty and allows products to be sold at a higher price. The digital marketing challenges faced by farmers in the village, such as consumer trust and the distribution of live cattle, are issues also found in previous research. [25], asserts that trust in digital agribusiness transactions can be enhanced thru animal health certification, shipping transparency, and customer service facilities. The material offering solutions in the form of health certifications and specialized distribution services aligns with these empirical recommendations. Additionally, price competition in the online market can be overcome thru quality-based positioning strategies and value-added products, not just price alone, as emphasized in research by [26]. Thus, the digital marketing strategies presented in the second material are not only theoretically relevant but also supported by empirical evidence, making them a strategic approach to strengthening the village farmers' economy. Integrating branding, quality-based pricing, product differentiation, and consumer trust management is an important foundation for strengthening farmer independence and increasing income based on the rural digital economy.

Figure 4. Material presentation by Mr. Husni, S.Pt, M.Si, on silage and ammoniation feed.

The material on silage and ammoniation of feed technology presented by Mr. Husni, S.Pt., M.Si., aligns with animal nutrition theory, which emphasizes the importance of a sustainable supply of quality feed to maintain animal productivity and health. According to [27], silage is the result of anaerobic fermentation of green fodder, producing feed with stable energy content, high storage life, and better digestibility compared to fresh, easily perishable green fodder. This explanation supports the utilization of corn stover and other agricultural waste as fermentation material to ensure feed availability during the dry season. Ammoniating straw with urea also has a strong scientific basis for improving the quality of fibrous materials. The basic principle of ammoniation, as explained by [28], is the breaking of lignocellulosic bonds, thereby increasing the accessibility of digestive enzymes and raising the crude protein content. This approach aligns with the material emphasizing improved digestibility, palatability, and nutritional value of straw thru urea treatment.

The results of previous studies support the effectiveness of silage and ammoniation technology for smallholder farms. Research [29] shows that feeding corn stover silage increases daily weight gain and feed efficiency in beef cattle compared to fresh forage. Additionally, a study by [30] confirmed that ammoniation of straw is able to improve feed consumption and livestock production performance due to the high availability of nitrogen and metabolic energy. The cost efficiency benefits presented in the material are also consistent with the findings of [31], which states that ammoniation and silage technology reduces feed costs by 35%–45%, especially for farmers who utilize local agricultural waste.

From the perspective of sustainable livestock business development, feed technology based on local resources has a significant impact on feed security, productivity, and farmers' income. [32] stated that the sustainability of community-based livestock farming can be achieved thru the use of appropriate technology to reduce dependence on expensive commercial feed. Therefore, silage and ammoniation technology are not only beneficial in the technical aspects of livestock nutrition, but also serve as practical strategies for improving business efficiency, mitigating the risk of seasonal feed shortages, and strengthening farmers' economies in the long run.

Thus, the material presented demonstrates strong theoretical and empirical relevance, and provides strategic solutions for the main challenges of dryland-based livestock farming, such as in Sumbawa Regency. The integration of silage and ammoniation technology can be the foundation for strengthening livestock food security and increasing the productivity and sustainability of livestock businesses based on local resources.

Figure 5. Socialization regarding livestock health and reproductive management counselling

The material on livestock health and reproduction management presented by Dr. Rayjib Haeriyawan Azhar is highly relevant to the theory of livestock animal health, which emphasizes that the sustainability of livestock farming is heavily influenced by health conditions and reproductive efficiency. According to [33], animal health is the foundation of productivity because infectious diseases can lead to weight loss, reproductive disorders, and even death, causing significant economic losses for farmers. The emphasis on cage cleanliness, feed quality, access to clean water, and deworming and vaccination programs aligns with the concept of preventive herd health management, which is the prevention of disease thru systematic environmental management and immunization.

Reproductive aspects emphasized in extension programs, such as heat detection, cycle recording, and artificial insemination, are also supported by scientific foundations and empirical findings. [34], reproductive success is highly influenced by the accuracy of estrus detection and record management, as delayed conception can increase the calving interval, reduce lifetime productivity, and increase maintenance costs. This is supported by research findings [35], which show that heat detection training and the implementation of digital reproductive record-keeping increased pregnancy rates by up to 21% in beef cattle farmer groups.

Furthermore, the implementation of artificial insemination presented in the material has been proven to support the improvement of livestock genetic quality in smallholder farms. Research [36] shows that the success of the artificial insemination program in beef cattle can improve the quality of offspring and meat productivity by utilizing semen from superior bulls, thus increasing the efficiency of the business and the income of farmers. The material on managing pregnant cows and postpartum care is also consistent with the findings of study [37], which states that a good calf management system reduces calf mortality and increases calf growth rate by up to 18%. In addition to technical aspects, the health and reproductive management extension provided also has implications for changes in farmer behavior. Based on the diffusion of innovation theory [9], the adoption of innovation is highly influenced by understanding, direct experience, and perceived benefits. The high participation of participants in discussions and field practice indicates that the material was not only understood but also accepted as a real solution to the livestock farming problems they have faced so far. This finding aligns with study [10], which found that active farmer involvement in training significantly increases the adoption rate of livestock health innovations. Thus, this material plays a role in strengthening the capacity of farmers toward a productive and sustainable modern farming system. The combination of health, reproductive management, and feed technology, as discussed in the series of activities, forms a holistic approach that not only focuses on increasing livestock production but also on cost efficiency and improving farmer welfare. The future success of the program heavily relies on the sustainability of mentoring, evaluation, and the cultivation of innovative practices to ensure that knowledge-based farming systems are truly embedded in the farmers' work culture.

Partner Support

The production of fermented animal feed was carried out at the cattle shed owned by the Keban Jamu Farmer Breeder group. This green economy-based fermented feed assistance aims to maximize the added value of corn stover and rice straw waste by turning them into highly nutritious fermented feed for cattle; and to empower and train livestock farmer groups so they can independently make, mix, and regularly produce fermented livestock feed such as silage and ammoniated feed based on the Green Economy. In principle, making livestock feed in the form of silage is similar to the fermentation process in general. The materials used are divided into three groups or components: green fodder, which is the main ingredient; concentrate feed; and feed additives. Silage is made from livestock feed or agricultural waste preserved in a fresh state (with a water content of 60%-70%) thru fermentation in a silo (where silage is made), while ensiling is the process of making silage.

Figure 6. The process of making silage feed by members of the Keban Jamu cattle farmer group.

Silage is made by chopping local green fodder such as elephant grass, odot grass, rice straw, or corn stalks, then mixing it with rice bran, molasses, water, and lactic acid bacteria starter until the moisture content is balanced. This mixture is placed in a tightly sealed container, such as a plastic drum or silage bag, and fermented for approximately three weeks. This fermentation process produces lactic acid, which acts as a natural preservative, ensuring that the green nutrients remain intact and are easily digestible by livestock. Thru the training provided, farmers not only learned about feed preservation techniques but also gained an understanding of the benefits of fermentation, such as increased nutritional value, reduced anti-nutritional substances, and improved rumen microflora conditions. With the application of silage technology, livestock are healthier, digestive efficiency increases, and the productivity of livestock farming can continue to develop sustainably.

Figure 7. The process of making Ammoniated Feed by members of the Keban Jamu cattle farmer group.

Thru community partnership activities, Keban Jamu cattle farmers are invited to understand how to maintain a sustainable supply of forage without damaging the environment, while also utilizing agricultural waste to create more nutritious ammoniated feed that can be used year-round. According to [38], the basic principle of the ammoniation process is the addition of ammonia to rice straw with the aim of breaking the very strong lignin and cellulose bonds that make it difficult to digest. Thru this process, these complex bonds are converted into simpler carbohydrate forms, making the ammoniated straw easier for livestock to digest. Ammoniation is included in alkaline treatment, which serves to improve the digestibility of rice straw. The sources of ammonia that can be used in this process consist of three forms: liquid ammonia (NH_3), ammonium hydroxide solution (NH_4OH), and solid urea.

The process of processing straw thru the ammoniation technique begins by weighing the straw according to need, then cutting it into pieces about 10 cm long. Urea was weighed at 6% of the straw's weight, then clean water was prepared in an amount proportional to the straw's weight. From that volume of water, one-third is used to dissolve urea. Next, a hole was made in the ground with a depth of 1 meter, a width of 0.75 meters, and a length adjusted to the amount of chopped straw to be processed. The bottom of the hole was then lined with plastic. The chopped straw was layered into the hole with a thickness of 10–20 cm. Each layer of straw was sprayed evenly with a urea solution, followed by spraying with clean water, and then compacted by treading on it. After all the straw was piled up, the surface was tightly covered with plastic to keep the conditions anaerobic. After an incubation process of 21–30 days, the plastic can be opened and the

ammoniated straw is ready to be used as animal feed. Before being given to cattle, the straw needs to be aired first to reduce any remaining ammonia odor.

Results of Improved Skills in Silage and Ammoniation Feed Management

The tools and materials for making fermented feed produced from this PKM activity have been tested to dry approximately 200 kg of straw waste, corn waste, and peanut waste. This waste is more hygienic and free from nutrient deficiencies, so the resulting fermented feed contributes to increased production and improves partner income by increasing the selling price of cattle, improving their health, and boosting productivity. Additionally, after the trial and practical production process went well, leading to the handover of the fermented feed production equipment on August 27, 2025, our team returned on September 3, 2025, or exactly on the 7th day, to conduct further monitoring and evaluation. They directly observed the results of the silage fermentation by opening the silo (barrel), which showed consistency in aroma, nutrient content, no mold, no spoilage, and the product was immediately tested on cattle, with the cattle found to consume it well. In other technical aspects, farmers have been able to make feed approximately 7 times in the 7 days following training, mentoring, and practical sessions, first chopping, stirring, mixing, and then directly feeding the results to the cattle. The results have also been able to increase livestock weight, weight productivity, production/birth productivity, and livestock health levels. Based on the results of the FGD we conducted for this monitoring and evaluation, we found optimal results. Cows that were initially purchased for around Rp. 6 million were fed regularly three times a day for approximately one month. As a result, these cows were sold again for around Rp. 9-10 million. This led to increased income, improved welfare, and increased trust from buyers, village-owned enterprises, and the livestock farming community that purchased the cattle seedlings. This condition indicates the process toward self-sufficiency for the livestock farmers in the Keban Jamu farmer group.

Figure 8. Monitoring and Evaluation Activities after the Production of Fermented Feed in the Cattle Pen of the Keban Jamu Cattle Farmers Group

The activities of our PKM team were met with strong enthusiasm and willingness from the residents of Dusun Samiri, Poto Village. They made time to attend even tho they were preparing animal feed and participating in local community activities on the weekend. The process of making good fermented feed, including its quality and storage, was explained so that it could meet the nutritional needs of the livestock. Therefore, the following are the results of the evaluation and monitoring we conducted by distributing satisfaction surveys and feedback from this PKM activity, focusing on four key points: materials, speakers, tools and materials, activity location and refreshments, as well as recommendations from Keban Jamu farmers. For that, it can be seen as follows:

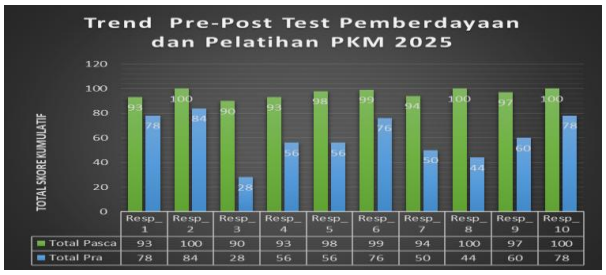

Figure 9. PKM Pre-Post Test Survey and Trends

Based on the total pre and post-training and mentoring measured thru a situational survey, the average pre-training and mentoring score was 61, indicating their ability to grow and their existing application of theory and practice in livestock business management, livestock marketing, and determining livestock selling prices. This increased to 96 after this training and mentoring, meaning that the Keban Jamu Farmer Group has become independent, prosperous, and competitive, provided they continue to apply knowledge transfer, methods, and feed processing or livestock business management in the future. (all other

things being equal). Then, on average, for each main indicator in the pre-test, it was 3 (C) or Able to Grow, and after applying the theory and practice, it increased in the post-test to 5 (A) or Independent, Prosperous, and Competitive. Therefore, it can be categorized that the improvement in the partner group's understanding in absorbing the training material, empowerment, and practice in this activity was quite varied. This is indicated by the average score for each derivative indicator, with the lowest score being 1 and the highest being 3. This is directly proportional to the post-test scores, which were the lowest at 4 and the highest at 5, or Independent, Prosperous, and Competitive.

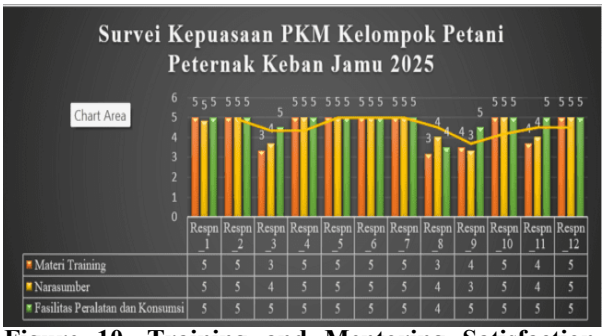

Figure 10. Training and Mentoring Satisfaction Survey

Based on the data obtained, the majority of participants gave the highest score of 5 and the lowest score of 3. This indicates that the training materials covering business management and marketing, pricing, livestock feed production practices, marketing digitalization, and the use of tools and materials are considered beneficial for supporting the future business improvement of partners in Dusun Samiri. On the other hand, participants also hoped for advanced technical training, particularly regarding seaweed management to improve productivity, analysis of raw material quality, and strategies for managing market potential to reach a wider market. All participants expressed their desire for continuous training that could help them scale up their businesses, make fermented feed a flagship product of Poto Village, and expand their livestock farming business diversification.

Despite the limited training facilities and media due to the activity's location being relatively far from the government center with unpaved dirt road access, participant satisfaction levels remained very high. This is reflected in the maximum score of 5 on almost every indicator measured. As many as 98% of respondents stated that the training materials and practice of making fermented feed were very beneficial and met their needs (green economy). Similarly, the majority of participants found the training on business management, marketing digitalization, and tool usage very helpful, while 98% of respondents stated that the speakers delivered the material accurately and understandably.

Additionally, most participants were satisfied with the equipment and refreshments provided during the training. The materials and speakers were also considered suitable for recommendation to others in need, including local governments and relevant organizations. Thru this training, participants gained additional knowledge and new skills that can boost production quality and the income of partner farmers. This means that the results of the satisfaction survey show that the majority of respondents (98%) are satisfied and benefit from the training, which includes business management, setting selling prices, creating customer databases, digital marketing, and processing fermented feed. Participants also expressed their willingness to recommend the resource person to relevant parties and showed a renewed enthusiasm for improving business productivity and quality. The positive impact of this activity is not only felt in the increased sales and well-being of Keban Jamu farmers, but also in meeting domestic beef needs and export opportunities. Demand for Sumbawa cattle seedlings managed by partners continues to increase, with buyers coming from various regions, including Sulawesi, Kalimantan, NTB, and even Java Island.

The implementation of the Community Partnership Program (PKM) activities in Dusun Samiri, Poto Village, showed high enthusiasm from the community, even tho participants had to divide their time between routine farming activities and other community activities. This active participation demonstrates the farmers' awareness of the importance of capacity building and innovation adoption in their livestock businesses, aligning with the theory of innovation diffusion by [9], which states that innovation adoption is influenced by individual motivation, perceived benefits, and direct experience with new practices. The results of the satisfaction survey collected from participants show the highest score of 5 and the lowest score of 3 across various indicators, including materials, speakers, tools and materials, activity location, and refreshments. This indicates that training including business management, marketing digitalization, pricing, and fermented feed production practices has a significant positive impact on farmers' readiness to adopt innovations [35]; [29]. The high level of participant satisfaction, with 98% stating that the material and practice were very beneficial, confirms that training based on the real needs of farmers is able to directly improve their knowledge and skills, in accordance with the principles of experiential learning [39].

Training on fermented feed production based on the green economy has proven relevant to local needs. Participants gained an understanding of silage and ammoniation techniques, including mixing green materials, concentrates, and additives, as well as the anaerobic fermentation process that produces highly nutritious and durable feed [27]; [28]. These findings are consistent with studies [30] and [31], which show

that utilizing agricultural waste thru fermented feed technology improves digestibility, livestock performance, and feed cost efficiency by up to 35–45%. From a marketing perspective, digitalizing livestock businesses has a positive effect on farmers' ability to reach a wider market. The implementation of branding, visual content, business storytelling, and cost-of-production-based pricing reflects modern marketing principles [20] and value-based differentiation strategies [24]. This aligns with research [21], which found that the use of social media and marketplaces increases consumer demand because information about product quality and customer testimonials boosts trust. Consumer trust, distribution, and product differentiation remain challenges, but solutions like health certifications and specialized delivery services can strengthen the integrity of the digital market [25]; [40].

Additionally, the evaluation results show a tangible economic impact. Active participation and the readiness of farmers to adopt innovations have an impact on increased production, quality, and income. Demand for Sumbawa cattle seedlings from various regions, including Sulawesi, Kalimantan, NTB, and even Java, has increased, indicating export potential and a contribution to local food security [32]. This finding supports the idea that integrating fermented feed technology, business management, and digital marketing can strengthen farmers' economic independence and enhance the sustainability of community-based livestock businesses. Overall, the evaluation analysis shows that the combination of technical training, business digitalization, and a green economy approach is able to create a multiplier effect for farmers. Beside boosting productivity and well-being, this training fosters a knowledge-based culture of work, innovation, and collaboration, thus supporting the transformation of the smallholder farming system toward modernization and sustainability.

Activity Sustainability Plan

The sustainability of the livestock mentoring program based on animal health-reproductive management and fermented feed technology is a crucial aspect to ensure that the capacity building of farmers does not stop at the training stage, but develops into a permanent working system in livestock business management. The program's sustainability is designed thru comprehensive interventions that include improving farmers' skills, feed independence, strengthening group institutions, and building strategic partnership networks.

First, sustainability is aimed at strengthening the capacity of farmers thru advanced training and tiered learning. Continuous education is needed to ensure mastery of health and reproductive management, including heat detection, recording, artificial insemination, and care for pregnant mothers. This aligns with the concept of continuous capacity building, which emphasizes repeated education so that innovation can be ingrained as a work culture [9]. In the context of livestock farming, continuous training has been shown to improve the accuracy of estrus detection and the pregnancy rate of beef cattle farmers by up to 21%, as reported by [35].

Second, sustainability is achieved thru the routine implementation of silage fermentation and ammoniation for feed production as a strategy for feed self-sufficiency based on a green economy. Processing agricultural waste into fermented feed has been proven to increase digestibility, feed intake, and livestock production performance [29]; [30]. Producing fermented feed regularly is an effort to avoid dependence on commercial feed, while also minimizing feed costs, which have historically been the largest component of livestock farming expenses. This approach aligns with the findings of [31], which state that fermentation technology can reduce total feed costs by 35–45% and increase farmers' income.

Third, animal health and reproduction remain a sustainability priority given their contribution to the stability of livestock farming operations. Preventive herd health management based on vaccination, barn hygiene, water sanitation, and routine treatment is believed to reduce the risk of disease and livestock mortality [33]. In the field of reproduction, the success of artificial insemination, calving interval management, and calf management are important aspects to ensure the productivity of the next generation of livestock. [37] shows that good calf rearing management increases calf growth rate by up to 18% and reduces calf mortality.

Fourth, the program's sustainability is also directed toward strengthening institutions and partnership networks. A structured business institution will increase the efficiency of the group's organization and promote financial sustainability thru the fermented feed business unit. [36], confirms that the availability of business institutions encourages increased adoption of livestock innovations and accelerates the modernization of smallholder livestock businesses. Additionally, a network of partnerships with universities, livestock services, and animal health practitioners is needed to facilitate technical consultations, access to technology, and funding support opportunities.

Fifth, the sustainability of activities needs to be supported by a performance-based monitoring, evaluation, and incentive system to ensure consistent implementation of innovations. Periodic evaluation of pregnancy rates, daily weight gain, calf mortality, and cost-benefit ratios will provide objective data for the farmer group to measure the economic and technical benefits of the program. Evaluation-based and performance-based reward approaches have proven

effective in increasing innovation adoption on smallholder farms [41].

Overall, this activity's sustainability plan not only aims to increase livestock production but also to empower farmers to become key players in the transformation of knowledge-based livestock systems, feed efficiency, and animal health. With a combination of advanced training, institutional strengthening, the application of fermentation technology, and cross-agency collaboration, the Keban Jamu Farmer-Breeder group has the potential to become a model for modern and sustainable independent smallholder farming. The successful implementation of this plan will impact increased livestock productivity, reduced operational costs, and the tangible realization of farmer welfare in the long term. [42], The community service program implemented at the Keban Jamu Cattle Farmers Group in Poto Village successfully empowered farmers in the independent and sustainable management of livestock feed. Training that combines theory, hands-on practice, demonstrations, discussions, and mentoring enhances farmers' understanding of fermented feed production (silage, complete feed, ammoniation, hay) and innovations in livestock vitamins based on the green economy. The evaluation results show an increase in farmers' capacity for feed processing, livestock quality and nutritional value, and cattle productivity. Additionally, farmers are able to implement better livestock business management, develop a variety of fermented feed products, and demonstrate a commitment to natural resource and environmental management, as well as the sustainability of community partnerships. This program significantly contributes to improving the independence of livestock businesses, the sustainability of feed production, and the welfare of farmers in Poto Village.

4. Conclusions

The community service program implemented in Poto Village, Samiri Hamlet, successfully increased the capacity of the Keban Jamu cattle farmer group thru the application of fermented feed technology in the form of silage and ammoniation, business management training, and digital marketing strategies. The results of the activity show an improvement in farmers' skills in processing local feed based on agricultural waste, ensuring a more stable feed supply throughout the year and reducing production costs. The application of this technology not only improves livestock productivity and health but also increases the selling price of cattle and the income of farmers. The evaluation showed a high level of participant satisfaction, with 98% of respondents stating that the training materials were beneficial, the speakers were competent, and the supporting facilities were adequate. This indicates that feed technology-based interventions and group management strengthening are capable of promoting independence, well-being, and opening up wider market opportunities for local cattle farmers. (1) There was an increase in the effectiveness of improving partners' problem-solving skills, knowledge transfer of innovation and technology, partner knowledge, and the impact on partners' independence and empowerment, with an average increase from 3 to 5 points after the activity; (2) Partners applied 98% of the material and practices from the training provided, meaning this activity addressed crucial issues for partners such as production, marketing, finance, and distribution; (3) Partners were able to apply fermented feed processing on average, and they continuously and independently practiced the correct methods of making silage and ammoniated feed; (4) Socioeconomic impacts such as increased mutual cooperation, boosted business productivity, and high community conduciveness were observed. Program sustainability needs to be consistent so that the innovations introduced can become sustainable practices within the livestock system and support national meat needs in government programs related to Free Nutritious Meals (MGB).

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