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Community Empowerment Through Processing of Fermented Rice Straw with the Addition of Minerals

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ABSTRACT

Limited access to quality feed remains a major constraint in smallholder livestock systems, particularly due to the low nutritional value of untreated rice straw. To address this challenge, a community empowerment program was implemented to enhance farmers' knowledge and skills in processing mineral-enriched fermented rice straw as an alternative feed. Using a participatory approach, the program involved technical training, hands-on demonstrations, and five months of field mentoring with 25 participants from the Kelompok Tani Lereng Sago. Evaluation through pre- and post-tests showed a significant improvement in knowledge, with average scores rising from 60 to 85. Supplementation with fermented rice straw increased average daily weight gain from 200–350 g to 555 g/head/day. Reproductive performance also improved: service per conception (S/C) decreased from 3.5 to 1.8, conception rate rose from 40% to 65%, and pregnancies doubled. Participant satisfaction averaged 4.66 on a 5-point Likert scale, indicating strong acceptance. The results confirm that this locally adapted and low-cost feed innovation is effective in improving cattle productivity and farmer capacity. The empowerment model developed offers high potential for replication in similar rural livestock systems.

Keywords: community empowerment; fermented rice straw; mineral supplementation; participatory approach; sustainable livestock system

INTRODUCTION

Indonesia, as an agrarian country, relies heavily on its agricultural and livestock sectors to support national economic development, particularly in rural areas. Among these, beef cattle farming remains a critical commodity, serving as a primary source of animal protein and livelihood for many farming communities. However, the productivity of smallholder livestock systems remains low, primarily due to the limited availability of high-quality feed, both in terms of quantity and nutritional adequacy.

One of the most prevalent challenges observed in the field is the limited understanding among farmers regarding the importance of mineral supplementation in local feed sources. Rice straw, a widely available agricultural by-product, is often used in its raw or dried form without any additional treatment. In this form, it contains low nutritional

value, poor digestibility, and is deficient in essential minerals. These deficiencies are directly linked to reduced animal performance, including poor growth, low weight gain, suboptimal reproductive efficiency, and increased vulnerability to metabolic diseases (McDowell, 2003; Khalil, 2015).

The use of rice straw as animal feed, especially for beef cattle, can be a viable solution to support the sustainability of livestock enterprises managed by farmer groups (Pudyartono & Arisandi, 2018). However, rice straw provided in its raw form has low nutritional content and is difficult for livestock to digest due to high fiber and lignin content (Syahrir, 2023). One effective method to improve the quality and durability of rice straw is through fermentation with the addition of minerals (Syahrir, 2023). This technique not only enhances the nutritional value and shelf-life of rice straw but also improves its palatability, thereby increasing feed intake and ultimately livestock productivity (Khalil et al., 2023). Although several studies and technologies have been developed to improve rice straw quality—such as fermentation and mineral enrichment—the adoption rate among smallholder farmers remains low. This reflects a significant research-to-practice gap between available scientific knowledge and the capacity of farmers to access and apply these innovations.

To address these challenges, a community empowerment program was implemented using a participatory approach based on the framework developed by Chambers (1997), which emphasizes active community involvement throughout all phases of the initiative. This approach shifts the focus from one-way technology transfer to a collaborative process in which farmers play a central role in problem identification, planning, implementation, and evaluation. Therefore, empowerment in this context is not limited to technical training but also includes building farmer capacity, self-reliance, and decision-making power.

This service program was conducted in collaboration with the *Kelompok Tani Lereng Sago*, aiming to enhance farmers' understanding of the importance of mineral content in feed and their technical skills in processing mineral-enriched fermented rice straw. The activities included technical training, practical demonstrations, and field mentoring—all designed and delivered through a participatory model. Baco et al. (2023) explain that well-designed training and extension activities significantly improve farmers' knowledge and skills in managing quality livestock feed. This is also supported by Ratriyanto et al. (2023), who stated that feed management training improves production efficiency and feed quality, directly impacting livestock performance. Furthermore, participatory training approaches have been shown to increase farmer engagement and adoption of innovations (Chambers, 1997).

It is expected that this intervention will increase farmers' capacity to produce higher-quality and cost-effective feed, thereby improving livestock productivity and strengthening local economic resilience. The key contribution of this program lies not only in the technical improvement of feed processing practices but also in strengthening farmer institutions and developing a replicable model of participatory empowerment. This model could serve as a reference for similar interventions in other rural livestock communities, supporting more inclusive and sustainable smallholder livestock systems.

METHOD

This community empowerment program was implemented using a participatory approach based on Chambers' (1997) empowerment framework, which emphasizes active and collaborative involvement of community members throughout the process to promote sustainable social and economic transformation. This approach extends beyond mere technology transfer by enhancing farmers' capacities to make decisions independently,

manage their resources, and identify structural barriers affecting livestock productivity. The program was conducted at the *Kelompok Tani Lereng Sago*, located in Kenagarian Sungai Kamuyang, Kecamatan Luak, Kabupaten Lima Puluh Kota, involving 25 participants comprising farmer group members, lecturers, and students. The program comprised several systematic stages: planning, extension, demonstration of rice straw fermentation with mineral supplementation, mentoring for field application, and evaluation.

Planning involved conducting surveys and in-depth interviews with farmer members to identify the main challenges they faced, particularly concerning mineral deficiencies in beef cattle feed and its impact on livestock productivity. Initial findings revealed limited farmer knowledge about the importance of minerals in feed and difficulties in accessing quality feed. During the extension phase, participatory training sessions were held to convey the critical role of minerals in cattle health and productivity, the effects of mineral deficiencies, and the fermentation technique of rice straw enriched with minerals as an alternative feed innovation. The sessions utilized facilitated group discussions to encourage farmers to share experiences, express obstacles, and collectively build their knowledge and capacity. The **demonstration** phase involved hands-on training where farmers were taught to process rice straw through fermentation with added minerals such as lime and molasses, which have been theoretically and practically shown to improve the nutritional value and digestibility of the feed. The process included material preparation, mixing, and anaerobic fermentation in sealed containers over several days. Farmers observed cattle responses to the fermented feed, reinforcing experiential learning. For **evaluation**, a pre-post survey method involving 15 key livestock farmers, using standardized instruments to assess improvements in knowledge and skills related to feed processing. The questionnaire was designed to evaluate farmers' understanding of the importance of mineral supplementation in animal feed and the techniques of rice straw fermentation. Each question offered multiple-choice answers (A to E), with only one correct option. The list of questions is presented in Table 1.

Table 1. List of questions for assessing farmers' knowledge level

No	Question
1	What is the function of minerals in the diet of beef cattle?
2	Why is raw rice straw considered suboptimal as cattle feed?
3	What are the benefits of fermenting rice straw?
4	What types of minerals are commonly added during rice straw fermentation?
5	How does mineral supplementation affect feed digestibility?
6	What are the consequences of mineral deficiency on beef cattle health?
7	How is the rice straw fermentation process carried out?
8	What is the role of molasses in the rice straw fermentation process?
9	How can farmers observe cattle responses to fermented feed?
10	What is the relationship between feed quality and beef cattle productivity?

In addition to knowledge assessment, the sustainability and quality of the program were evaluated through a participant satisfaction survey. The survey employed a 5-point Likert scale, where 1 indicated "strongly disagree" and 5 indicated "strongly agree." The statements used to measure participant satisfaction are presented in Table 2.

Table 2. List of statements used to measure participant satisfaction

No.	Question
1	This community service activity has broadened my knowledge and understanding in the field of livestock farming.
2	The content and delivery method of the training were highly relevant to my practices as a farmer.
3	I am motivated to adopt the mineral-enriched rice straw fermentation technique after participating in this activity.
4	The schedule of the activity was appropriate, and the implementation was efficient.
5	I am enthusiastic about participating in similar activities in the future.

The achievement indicators for the educational and evaluation processes are outlined in Table 3.

Table 3. Achievement indicators of the community service program

Indicator	Performance Criteria
Number and category of participants	At least 80% of participants completed the entire evaluation process, including the pre-test, post-test, and satisfaction survey.
Level of understanding after the program	• A minimum score of 60 out of 100 must be achieved by each participant to be considered as having passed. • The average score of all participants must be at least 75. • At least 50% of participants must show improvement between the pre-test and post-test.

The **mentoring** phase was carried out periodically through field visits conducted by the community service team, which consisted of lecturers and students. This mentoring served as both technical support and a means of monitoring the implementation of the fermented rice straw innovation. In addition, field-level challenges such as limited capital, time constraints, and restricted access to raw materials were discussed, as these were identified as barriers to farmers' adoption of the technology. Quantitative data were systematically collected over a five-month period following the implementation of the program. These data included indicators of livestock performance, such as changes in body weight, service per conception (S/C), conception rate (%), and the number of pregnancies (head). The purpose of data collection was to evaluate the extent to which the introduced innovation was adopted by the farmers and to assess its impact on livestock productivity. Furthermore, field observations and focus group discussions were conducted to gain a comprehensive understanding of the technology adoption process, the challenges encountered, and the factors influencing the success of the program. Through this approach, the applied methods were not solely focused on technology transfer, but also aimed at empowering farmers in a participatory manner to enhance self-reliance and livestock productivity sustainably. Intensive mentoring and continuous evaluation were identified as key success factors of the program, while also providing valid quantitative and qualitative data for objectively measuring its impact.

RESULTS AND DISCUSSION

The community service program was initiated by conducting a **survey and needs assessment** of the *Kelompok Tani Lereng Sago* regarding issues related to beef cattle feed, carried out on June 5, 2024. This preliminary identification phase was considered essential to determine the actual needs of the community prior to implementing the program. This approach is in line with Sari et al. (2019), who stated that an initial assessment of community needs is a crucial step in designing a well-targeted and problem-oriented program. A discussion was conducted with Mr. Edrinal, the head of the *Kelompok Tani Lereng Sago*, during which several complex issues were identified. These included challenges related to reproduction, animal health, feed availability, and the management of production and marketing (Figure 1).



Figure 1. Discussion and problem identification with the *Kelompok Tani Lereng Sago*

The most prominent issue identified was delayed estrus and a high incidence of miscarriage in female cattle. These conditions were considered indicative of possible deficiencies in essential nutrients, particularly minerals, in the feed provided. Deficiencies in minerals such as calcium, phosphorus, and selenium have been shown to affect the reproductive system and hormonal metabolism of cattle, leading to disrupted estrous cycles and an increased risk of miscarriage. This condition was further exacerbated by the poor body condition of the livestock due to the low nutritional quality of the available feed. A third problem that was identified was the frequent infestation of ticks, especially during the rainy season. Ticks not only cause skin irritation and stress in livestock but also serve as vectors for various diseases such as babesiosis and anaplasmosis. Cattle suffering from mineral deficiencies were observed to have weakened immune systems, making them more susceptible to tick infestations and secondary infections. A fourth issue was the difficulty in ensuring a consistent supply of fresh forage, particularly during the dry season or when rainfall patterns were unpredictable. Most farmers were found to rely on underproductive natural pastures and lacked adequate feed storage systems. As a result, the availability of forage feed remained unstable, adversely affecting overall livestock performance and productivity. The final issue raised was the difficulty faced by farmers in accessing markets and their limited understanding of livestock product marketing management. Overall, the problems encountered by the *Kelompok Tani Lereng Sago* indicated that technological interventions, such as the use of mineral-enriched fermented rice straw, addressed only a part of a much broader challenge. A more holistic and sustainable approach was deemed necessary—one that includes strengthening technical capacity, institutional development of farmer groups, and improved market access—in order to promote empowered and self-reliant smallholder livestock farming.

As a follow-up to the problem identification conducted with the *Kelompok Tani Lereng Sago*, an **extension** activity was carried out by the community service team, focusing on enhancing farmers' knowledge and technical skills. The extension sessions

were designed using a thematic approach, with each topic tailored specifically to address the key issues identified in the field. The activity was not only informative but also practical, aiming to encourage the adoption of innovations relevant to the local context (Figure 2).



Figure 2. **Extension** activities for the kelompok tani lereng sago

The extension topics began with a session on **Mineral Deficiency Diseases and Parasites in Livestock**, delivered by Dr. drh. Yulia Yellita, MP. This session provided a detailed explanation of various diseases in beef cattle caused by mineral deficiencies, such as reproductive disorders (delayed estrus and miscarriage), weakened immune function, and increased susceptibility to parasitic infestations, particularly ticks. Clinical symptoms and preventive methods through improved feed management and environmental sanitation were also described. This material was considered essential in raising farmers' awareness of the importance of minerals in animal feed and their direct connection to livestock health and productivity. The next topic focused on the **Introduction of Mineral-Enriched Fermented Rice Straw**, presented by Prof. Dr. Ir. Khalil, M.Sc. The session explained the innovation of fermented rice straw fortified with minerals as a strategic solution to the lack of quality feed, especially during the dry season. The presentation covered the fermentation process, the benefits of mineral additions such as lime, and their effects on improving the nutritional value and digestibility of rice straw. This innovation was designed to directly address issues such as delayed estrus, miscarriages, tick infestations, and limited forage availability. Farmers were introduced to a simple technology that could be independently applied, thereby enhancing self-reliance in livestock feed production. The third topic, **Beef Cattle Business Management**, was delivered by Ir. Andri MS and focused on strategies for managing beef cattle farming in an economically viable and sustainable manner. This topic was particularly relevant in response to farmers' concerns about market access difficulties. The session included training on livestock performance recording, pricing based on live weight and animal quality, as well as collective marketing strategies and the use of digital technology. Farmers were also introduced to the economic potential of livestock waste, such as manure, which can be processed into compost. The final session addressed **Improved Forage Development and Planting Techniques**, presented by Dwi Ananta, S.Pt., M.Sc. The importance of diversifying forage sources was discussed through the introduction of superior grass species such as *Brachiaria decumbens*, *Setaria splendida*, and *Taiwanese Pennisetum purpureum* (Napier grass). Techniques for land rehabilitation, soil preparation, planting, and forage maintenance were also provided to improve land productivity. This session directly responded to farmers' challenges in cultivating quality forage and aimed to strengthen feed system resilience at the farmer group level. These four extension topics collectively formed a synergistic framework of practical knowledge essential for livestock farmers. In addition to providing in-depth understanding, the sessions created a platform for open discussion between presenters and participants to address specific on-farm

challenges. Thus, the extension activities served not only as a medium for knowledge transfer but also as a catalyst for mindset transformation and capacity strengthening, enabling farmers to manage their livestock operations more professionally and adaptively in the face of evolving challenges.

The success of the extension activities encouraged the next step, which involved a **demonstration** of the preparation of fermented rice straw with the addition of minerals (specifically lime) and molasses as an energy source. This stage served as the practical component of the community service program, during which farmers were introduced to the technique of fermenting rice straw with mineral enrichment. The method involved mixing straw with fermentation agents and minerals, where molasses and lime functioned to enhance the fermentation process, feed digestibility, and nutritional value (Prihanto & Haryanto, 2018). Farmers were taught how to mix rice straw with lime and fermentation materials. This process began with the preparation of ingredients, followed by the mixing of straw with fermentation additives and mineralization using lime, and concluded with storage in sealed containers for several days to allow fermentation to occur (Figure 3). The processed rice straw was expected to improve the palatability and digestibility for beef cattle, thereby increasing feed intake and productivity. Khalil (2023) stated that the addition of minerals to rice straw can enhance calcium content, which plays a crucial role in bone structure development in cattle. Furthermore, the fermentation of rice straw using molasses helps to break down the fibrous content of the straw, making it more digestible for cattle, as explained in the findings of Setiawan et al. (2020).



Figure 4. Demonstration of fermented rice straw preparation

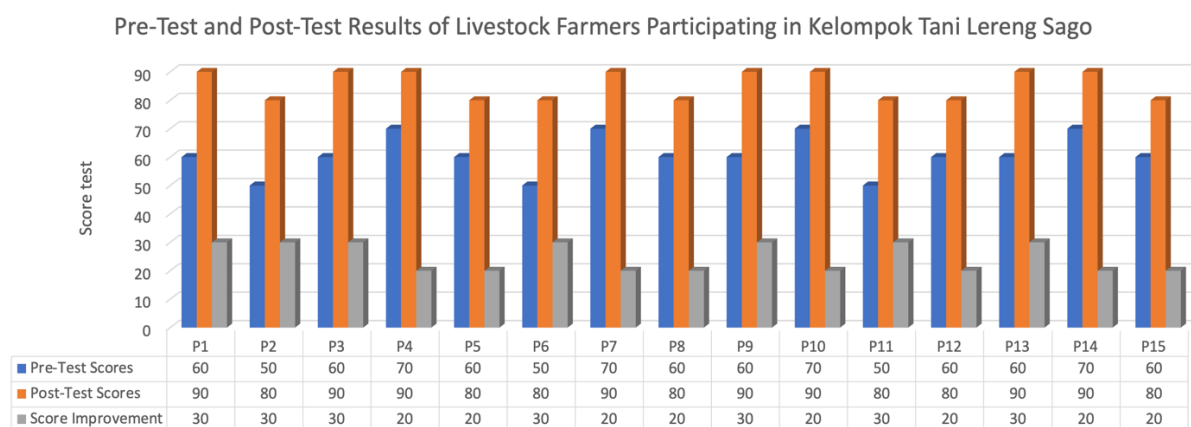


Figure 5. Grafik pre-test and post-test results of livestock farmers participating in kelompok tani lereng sago (P = Participant)

Through Based on the data presented in the table, pre-test scores among participants ranged from 50 to 70, with an average of 60,00. These scores indicate that participants' initial knowledge levels were generally low to moderate, particularly in relation to basic concepts of feed processing, the benefits of rice straw fermentation, and the importance of mineral supplementation in beef cattle diets. This limited understanding aligns with previous findings suggesting that access to technical information and hands-on training among smallholder farmers remains insufficient (Hopid et al., 2023).

Following the training, post-test results demonstrated a highly positive improvement, with participant scores increasing to between 80 and 90, and an average score of 85,00. All participants experienced a score increase ranging from 20 to 30 points, which in this evaluation is categorized as a "significant improvement." These results suggest that the training materials and methods were effective in addressing the existing knowledge gap. The improvement indicates that:

- The training materials were relevant and well-targeted, addressing the specific needs and local conditions of the farmers;
- The use of demonstration-based and interactive discussion methods proved effective in enhancing technical understanding, in line with Nugroho & Iskandar (2020), who emphasized that participatory approaches are more effective for technology transfer in the livestock sector;
- Participants exhibited strong motivation and positive engagement, as evidenced by their enthusiasm during hands-on practice sessions and satisfaction questionnaire responses.

Overall, the average score increase of 25 points reflects the substantial success of the program in transferring practical knowledge and enhancing farmers' capacity in processing and improving the quality of local feed resources. The effectiveness of this activity was further supported by the results of the satisfaction survey, in which the majority of participants reported being satisfied to highly satisfied with the training program—specifically in terms of content, scheduling, and its practical benefits. These findings reinforce those of Abadi et al. (2023), who concluded that systematic, locally grounded extension programs can significantly increase technology adoption and livestock productivity, particularly when local resources such as rice straw and molasses are readily accessible to rural farmers.

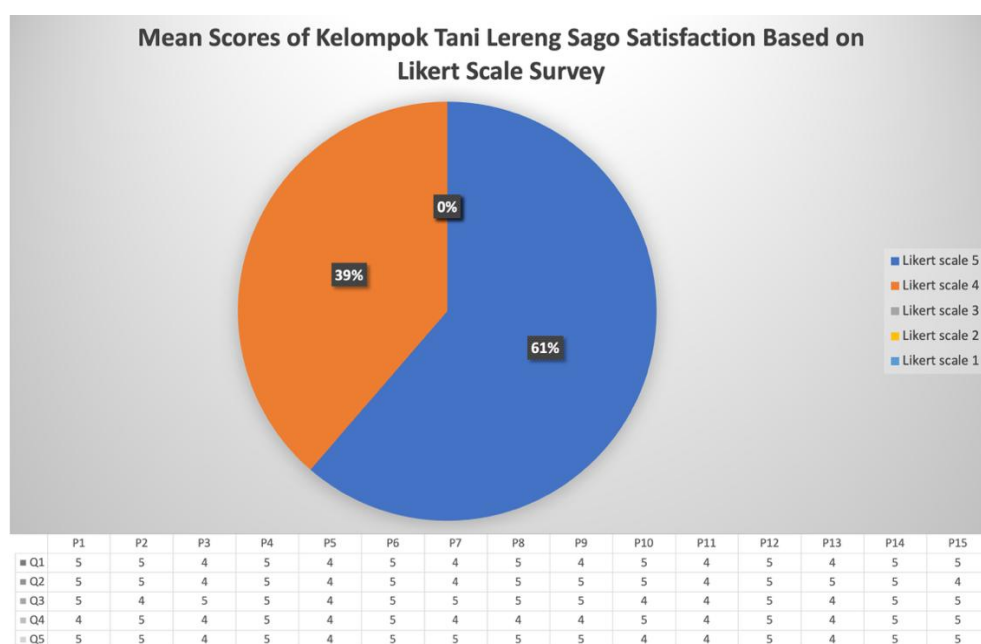


Figure 6. Grafik mean scores of kelompok tani lereng sago satisfaction based on likert scale survey (P = Participant – Q = Question)

The survey results indicate a high level of participant satisfaction with the community service activity, as reflected in an average overall score of 4.66 out of a maximum of 5.00 on the Likert scale. Figure 6 presents the distribution of participant responses across the five-point scale. Notably, no scores below 4 were recorded, suggesting that all respondents either agreed or strongly agreed that the activity was beneficial and aligned with their needs as livestock farmers. Out of a total of 75 responses (15 participants × 5 statements), 46 responses (61.3%) were scored as 5 (strongly agree), while the remaining 29 responses (38.7%) were scored as 4 (agree). These findings demonstrate that the program successfully established a positive alignment between the training content and the actual expectations and realities faced by the farmers. The highest average scores were recorded on statements related to:

1. This community service activity has broadened my knowledge and understanding in the field of livestock farming.
2. The content and delivery method of the training were highly relevant to my practices as a farmer and
3. I am motivated to adopt the mineral-enriched rice straw fermentation technique after participating in this activity.

This supports the premise that extension programs grounded in participatory, practical, and needs-based approaches can significantly enhance both knowledge absorption and commitment among farmers (Azuzi et al., 2024). The application of hands-on methods and interactive dialogue is likely to have fostered not only better understanding but also greater trust in the innovation introduced. Moreover, the survey revealed that the majority of participants expressed a willingness to engage in similar activities in the future. This is a critical indicator of program sustainability, given that long-term commitment is often a key challenge in the successful diffusion of agricultural innovations. The high levels of participation and satisfaction also suggest that this community service program holds strong potential for social transformation, particularly in shaping farmers' attitudes and behaviors toward more efficient and environmentally sustainable feed technologies (Rusli et al., 2024). In summary, the data strongly support the effectiveness of the extension approach adopted in this program. In addition to demonstrating significant improvements in participants' knowledge—as shown in the pre- and post-test results—the activity was well-received in terms of its content, timing, and perceived impact on practical farming practices.

Based on the results of the community service program implementation, all key performance indicators (KPIs) established for education and evaluation objectives were successfully achieved. First, in terms of participation, 100% of the members of the *Kelompok Tani Lereng Sago* (15 participants) were actively involved in the entire series of activities, including the completion of the pre-test, post-test, and satisfaction survey. This reflects the strong enthusiasm and commitment of the participants toward the extension program. Second, regarding knowledge acquisition outcomes, all participants achieved a post-test score of at least 80, far exceeding the minimum passing threshold of 60. Moreover, the average post-test score reached 85, surpassing the program success criterion of a minimum group average score of 75. Individually, 100% of participants demonstrated an increase in knowledge, with score improvements ranging from 20 to 30 points. This outcome exceeds the benchmark requiring at least 50% of participants to show measurable improvement in test scores.

These results affirm that the program was not only well-executed from a technical standpoint but was also highly effective in transferring knowledge and practical skills to the livestock farmers. This achievement is further supported by the satisfaction survey, which showed a mean score of 4.66 out of 5 on the Likert scale, with no participant giving a

score below 4, indicating a very positive reception to the program's content, methods, and perceived benefits. In conclusion, the community service program successfully fulfilled all of its targeted performance indicators and demonstrated strong potential for replication and upscaling, particularly in areas with similar agricultural and livestock development challenges. The positive outcomes also underscore the importance of participatory and context-sensitive approaches in agricultural extension, which can contribute significantly to farmer empowerment and sustainable innovation adoption.

Regular **mentoring** activities were conducted by the community service team to ensure that farmers were able to independently apply the introduced techniques and to verify the outcomes of the fermented rice straw process. The mentoring was carried out through field visits and discussions with farmers to evaluate the feed processing activities they had implemented autonomously, as well as to collect data on body weight gain, average service per conception (S/C), and the number of pregnant cows recorded during the five-month mentoring period. According to Sukoco et al. (2021), continuous assistance is essential in community empowerment programs to ensure the sustained transfer of knowledge and skills.



Figure 7. Inspection of bagged fermented straw and ongoing mentoring activities

As shown in Figure 7, field visits and technical discussions were conducted by the service team to provide technical support and to address issues arising in the implementation of feed processing methods. This mentoring process also contributed to strengthening farmers' autonomy in producing high-quality feed. The regular assistance aimed not only to deepen the farmers' understanding but also to evaluate behavioral changes and improvements in their technical capacity to process rice straw independently. This stage is consistent with the empowerment framework proposed by Hidayati & Pramono (2019), which emphasizes the importance of ongoing supervision to ensure the effectiveness of program implementation at the field level.

Table 4. Effects of improved forage supply and supplementation with fermented rice straw on cattle body weight gain

Cattle number :	Body Weight (kg/head)		Weight Gain	
	Initial (29/07/2024)	Final (30/09/2024)	kg/head	g/head/day
1	390	420	30	476,19
2	170	190	20	317,46
3	307	327	20	317,46
4	530	580	50	793,65
5	87	107	20	317,46
6	398	428	30	476,19

7	311	381	70	1111,11
8	167	207	40	634,92
Mean	295.00	330.00	35.00	555.56

The community service program implemented in the *Kelompok Tani Lereng Sago* demonstrated a significant impact on improving the growth performance of beef cattle. Prior to the intervention, the average daily weight gain, based on farmers' records, ranged between 200 to 350 grams per head per day. Following a two-month intervention involving improved forage supply and the introduction of fermented rice straw as supplementary feed, the average daily weight gain increased to 555.56 grams per head per day, equivalent to 35 kg per head. This improvement serves as a strong indicator of the program's success in optimizing livestock productivity through a locally-based feed technology approach. The main factor underlying this improvement was the enhancement of feed nutritional quality through the diversification of high-quality forage and the utilization of fermented rice straw. Fermented straw was found to offer additional benefits by increasing palatability, reducing lignin content, and improving fiber digestibility. The fermentation process also produced organic acids, such as lactic acid, which supported the activity of rumen microbes and enhanced feed conversion efficiency into body weight. This was particularly evident in cattle number 7, which exhibited the highest weight gain of 1,111.11 grams per day, indicating a highly favorable physiological response to the applied feeding strategy. These findings are consistent with previous studies suggesting that simple yet targeted feed manipulation can significantly improve growth performance in smallholder beef cattle systems. The success of this program also fostered a better understanding among farmers of the importance of sustainable feed management, while demonstrating that locally adapted feed technologies can be effectively and economically applied. Therefore, this approach—centered around the use of fermented feed such as rice straw silage—has considerable potential to be replicated in other areas facing similar challenges, as a strategic measure to enhance livestock productivity and smallholder income.

Table 5. Effects of improved forage supply and supplementation with fermented rice straw on the reproductive performance of breeding cows

Observation Period	Number of Breeding Cows (head)	Service per conception (S/C)	Conception rate (%)	Number of Pregnancies (head)	Observation Period Duration
Before the program	6	3.5	40	2	Before implementation
After the program	6	1.8	65	4	5 months (post-innovation)

The implementation of the forage improvement program combined with the supplementation of fermented rice straw resulted in notable enhancements in the reproductive performance of breeding cows in the *Kelompok Tani Lereng Sago*. Prior to the intervention, reproductive efficiency was relatively low, as indicated by a service per conception (S/C) rate of 3.5 and a conception rate of only 40%. Out of six breeding cows, only two were confirmed pregnant during the observation period before the program. These indicators reflect a suboptimal reproductive environment, likely associated with inadequate nutritional intake and imbalanced feed quality, which are known to affect ovarian function, estrus expression, and embryo viability. Following the five-month implementation of the nutritional intervention, significant improvements were observed.

The S/C value decreased from 3.5 to 1.8, indicating that cows required fewer insemination attempts to achieve successful conception. Additionally, the conception rate increased from 40% to 65%, and the number of pregnancies doubled from 2 to 4 cows. These outcomes suggest that the improved dietary regime—especially through the inclusion of digestible, protein-rich fermented rice straw—may have supported better hormonal balance and reproductive cyclicity. The provision of consistent forage supply further ensured that cows maintained their body condition score (BCS), a key factor influencing reproductive success in ruminants. These results are in agreement with prior studies indicating that nutritional interventions can significantly influence reproductive parameters in beef cattle. By addressing the deficiencies in energy and protein intake common in smallholder systems, this program was able to enhance reproductive efficiency without relying on advanced reproductive technologies. The success of this locally adapted and low-cost strategy highlights the potential scalability of the approach in similar agroecosystems. In conclusion, the integration of improved forage with fermented rice straw supplementation presents a practical and effective model for enhancing reproductive outcomes and increasing the productivity of smallholder breeding herds.

This activity strengthened the relationship between the service team and the local community, particularly the *Kelompok Tani Lereng Sago*. Through this collaboration, mutual trust was established, which proved beneficial for future community engagement activities. A positive response was observed from the community, who perceived the program as genuinely contributing to their well-being, as outlined by Hidayati & Pramono (2019) in their guide to rural community empowerment. Based on the positive outcomes of this program, a community empowerment model based on fermented feed supplemented with minerals was successfully developed by the service team and is considered applicable to other farmer groups. This model includes all essential stages, from needs assessment, education, and training, to evaluation and ongoing assistance. The success of this initiative serves as a foundation for the development of similar programs aimed at enhancing the independence and welfare of livestock farmers in various regions.

CONCLUSION

The community service program conducted at the *Kelompok Tani Lereng Sago* significantly enhanced farmers' capacity in producing locally adapted feed through mineral-enriched rice straw fermentation. All 15 participants completed the full cycle of activities—from extension to evaluation—with average knowledge scores increasing from 60 to 85 following the training. The application of the fermented feed resulted in improved livestock performance, as evidenced by the increase in average daily weight gain from a baseline of 200–350 grams to 555 grams per head per day within two months. Reproductive performance also improved; among six observed cows, the number of pregnancies doubled (from 2 to 4), the service per conception rate decreased from 3.5 to 1.8, and the conception rate increased from 40% to 65% during the five-month mentoring period. In addition to these technical improvements, the participant satisfaction level averaged 4.66 out of 5.00, indicating a strong positive response to both content and delivery. These results demonstrate that the program effectively empowered farmers to utilize local materials such as rice straw, molasses, and lime to improve feed quality and livestock productivity. To ensure program sustainability, further policy support is needed in the form of continued training, improved access to feed additives, and institutional strengthening of farmer groups to support innovation diffusion and market integration. The empowerment model developed in this initiative offers high replicability for other

rural areas facing similar challenges, serving as a strategic approach to strengthen smallholder resilience and improve livestock sector outcomes.

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