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Community empowerment of beef cattle farmers through probiotic-based silage technology and reproductive management training in Perreng Village, Bangkalan, Madura Island

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Abstract

This community service program aimed to improve cattle productivity in Perreng Village, Bangkalan, Madura, by introducing feed technology and reproductive management training for smallholder farmers. The activity was conducted on July 14, 2025, through a participatory approach combining education, hands-on practice, and evaluation. Farmers were trained to prepare silage from local grasses using molasses through a layered method, as well as to ferment rice straw with EM4 to enhance its nutritional quality. Representative samples of fresh grass, silage, rice straw, and fermented rice straw were collected for proximate analysis to determine dry matter, crude protein, ether extract, crude fiber, ash, and nitrogen-free extract. The analysis revealed that fermentation and ensiling improved feed quality, with silage showing higher crude protein and lower crude fiber compared to fresh forage, while fermented rice straw demonstrated increased protein and reduced fiber content compared to untreated straw. The evaluation used a pre-test and post-test design. Knowledge of feed technology increased substantially, with awareness of probiotics rising from 13.3% to 100%, knowledge of silage benefits from 23.3% to 96.7%, and understanding of straw fermentation from 30% to 100%. Practical skills improved markedly, with the ability to chop forage increasing from 36.7% to 93.3%, mix additives from 16.7% to 96.7%, and store silage properly from 30% to 100%. Knowledge of reproductive management also showed significant gains: recognition of estrus signs rose from 40% to 96.7%, understanding the importance of reproductive health rose from 6.7% to 100%, and awareness of artificial insemination rose from 3.3% to 100%. Overall, the program demonstrated that participatory training effectively enhanced both knowledge and technical competencies of smallholder farmers. Nutritional improvements from silage and rice straw fermentation further validated the program's contribution to feed sustainability, food security, and rural livelihoods.

Keywords: Beef Cattle; Farmer Empowerment; Food Security; Probiotic; Rice Straw Fermentation; Silage; Reproductive Management

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1. Introduction

Bangkalan Regency, located on Madura Island, East Java, spans an area of 1,260.14 km^2 and is divided into 18 districts [1]. Burneh District, particularly Perreng Village, has significant potential in agriculture and livestock farming. The local farmer group Kelompok Tani Harapan Tiga engages in food crops, horticulture, plantation, and livestock activities, with beef cattle serving as one of the most important assets for the community's livelihood. According to the East Java Provincial Livestock Service, the beef cattle population in Bangkalan reached 276,476 in 2021, while the goat population stood at 86,607 [2]. These figures highlight livestock farming, particularly beef cattle, as a crucial sector for supporting local economic growth and food security.

Despite this potential, several challenges hinder optimal livestock productivity. A major issue is the limited availability of quality forage during the dry season. Farmers often depend on rice straw, weeds, and crop residues, which are nutritionally inadequate to support growth and reproduction. This problem leads to seasonal declines in cattle performance. Furthermore, reproductive management remains a critical barrier. Farmers' limited knowledge of estrus detection, artificial insemination (AI), and reproductive health care results in low conception rates and extended calving intervals, ultimately reducing herd productivity [3]. To address these constraints, innovative feed technologies such as probiotic-based silage and fermented rice straw can be introduced. Silage technology enhances the nutritional quality of forages, ensuring feed availability throughout the year [4,5]. Meanwhile, rice straw fermentation improves digestibility by breaking down lignocellulose components and reducing anti-nutritional factors [6]. Both technologies provide sustainable alternatives for optimizing feed supply, especially in the dry season. Additionally, reproductive management training, including estrus detection, AI techniques, and reproductive health practices, is essential to improve calving rates and accelerate herd population growth [6,7].

Through the integration of feed innovation and reproductive management training, this program is expected to strengthen local livestock productivity, improve farmers' welfare, and contribute to sustainable food availability. The involvement of both academic staff and students in the implementation further ensures that knowledge transfer is carried out effectively while also fostering practical learning experiences that benefit both the farming community and the university.

2. Material and methods

2.1. Location and Participants

The community service activity was conducted on July 14, 2025, in Perreng Village, Burneh District, Bangkalan Regency, East Java. The participants were members of Kelompok Tani Harapan Tiga, a local farmer group engaged in crop and cattle farming, along with other villagers who were actively involved in livestock raising. The activity was facilitated by lecturers from the Faculty of Veterinary Medicine, Universitas Airlangga, supported by students.

2.2. Design of Activities

The intervention was implemented through a participatory approach consisting of surveys, educational sessions, hands-on practice, and evaluation. A quasi-experimental design using pre- and post-test questionnaires was employed to assess the improvement of farmers' knowledge and skills. The initial stage involved a field survey and discussions with community leaders to identify local problems in cattle farming, particularly the shortage of quality forage during the dry season and the low conception rates of beef cattle. Permissions were obtained from relevant authorities to ensure compliance with local regulations. The survey also functioned as a needs assessment, aimed at determining the most urgent issues to be addressed through training and demonstration.

2.3. Educational Sessions

The second stage consisted of educational sessions that provided farmers with theoretical knowledge about forage conservation and reproductive management. Before the session began, participants completed a pre-test questionnaire to measure their baseline understanding of feed processing and cattle reproduction. During the session, interactive presentations were delivered on two feed technologies: probiotic-based silage and fermented rice straw. The educational material was prepared in simple language and adapted to the farmers' level of knowledge. Farmers were encouraged to ask questions and engage in discussions with the facilitators. Reproductive management topics, including estrus detection, the principles of artificial insemination, and cattle health care, were also presented in an interactive manner. After the classroom session, a hands-on practice was conducted to demonstrate the preparation of probiotic-based silage.

2.4. Hands-on Practice of Feed Technology

2.4.1. Silage Preparation

The silage-making practice used only local grasses available in the village. The grasses were chopped into 3–5 cm pieces and briefly wilted by sun-drying to reduce excess moisture. The chopped forage was then layered alternately with rice bran inside the container. At each layer, a diluted molasses solution (250 ml per 10 kg of forage) was sprinkled evenly to support fermentation. The prepared material was compacted tightly to expel air and stored under anaerobic conditions in both plastic drums and plastic bag silos, which served as alternative storage methods. Fermentation was maintained for 14–21 days. Good-quality silage was characterized by a pleasant sour aroma, fresh appearance, and absence of mold.

2.4.2. Rice Straw Fermentation

The second practice focused on rice straw fermentation. Rice straw was chopped and mixed with molasses and EM4 solution (250 ml per 10 kg straw). The treated straw was then compacted firmly into airtight plastic drums or silo bags to exclude oxygen. Fermentation lasted for 21–28 days, producing feed with improved digestibility and protein availability. This technology allowed farmers to better utilize agricultural by-products as cattle feed during the dry season. Both demonstrations were conducted interactively, with farmers directly engaged in every step under the supervision of lecturers and students. This ensured that participants not only understood the procedures but also gained confidence to replicate the process independently.

2.5. Nutritional Composition Analysis

Representative samples of fresh local grass, grass silage, untreated rice straw, and fermented rice straw were collected and analyzed at the Animal Feed Laboratory, Division of Animal Husbandry, Universitas Airlangga. The nutritional composition was determined through proximate analysis in accordance with the procedures of the Association of Official Analytical Chemists [8]. The parameters analyzed included dry matter (DM), crude protein (CP), ether extract or crude fat (EE), crude fiber (CF), ash, and nitrogen-free extract (NFE). Dry matter was determined by oven-drying at 105 °C until constant weight. Crude protein was measured using the Kjeldahl method, with nitrogen content multiplied by 6.25 to obtain protein concentration. Ether extract was determined through Soxhlet extraction using petroleum ether as a solvent, while crude fiber was analyzed by sequential acid and alkali digestion. Ash was obtained by incinerating dried samples in a muffle furnace at 550 °C until a stable mineral residue was achieved. Nitrogen-free extract (NFE) was calculated by difference, representing soluble carbohydrates and readily digestible organic matter. This complete proximate profile provided an evaluation of the nutritional improvements achieved through silage and fermentation processes.

2.6. Evaluation

The final stage involved evaluation using a pre-test and post-test design to measure knowledge improvement on silage, rice straw fermentation, and reproductive management. The same questionnaire was administered before and after the sessions, and the increase in post-test scores served as an indicator of successful knowledge transfer. This quasi-experimental approach, though without a control group, allowed for a reliable comparison of learning outcomes [9]. In addition, brief discussions were conducted to capture participants' feedback, which confirmed greater confidence and readiness to apply the introduced technologies in their daily farming practices.

3. Results and discussion

3.1. Profile of Community Service Activity Participants

The participants of the community service activities consisted of two main groups, namely ruminant farmers (cattle and buffalo) and poultry farmers. The total number of participants involved was 50 people, with details of 30 ruminant farmers and 20 poultry farmers. To obtain a clearer picture of the participants' characteristics, a mapping was conducted based on age, length of time as a farmer, and type of livestock managed. Participant profiles are presented in Table 1 below.

Table 1 Distribution of participants based on characteristics

Characteristic	Category	Ruminant (n=30)	Poultry (n=20)
Age	<30 y. o	1 (3.33%)	1 (5.00%)
	30–50 you	18 (60.00%)	13 (65.00%)
	>50 y. o	11 (36.67%)	6 (30.00%)
Length of time as a farmer	<10 years	24 (80.00%)	18 (90.00%)
	10–30 years	5 (16.67%)	1 (5.00%)
	>30 years	1 (3.33%)	1 (5.00%)
Livestock Type	Cattle	17 (56.67%)	–
	Buffalo	13 (43.33%)	–
	<25 ducks	–	14 (70.00%)
	25–50 ducks	–	3 (15.00%)
	>50 ducks	–	3 (15.00%)

The data in Table 1 shows that the majority of participants were in the 30-50 years age group, both for ruminant farmers (60.00%) and poultry farmers (65.00%). This indicates that most of the participants were at a productive age and therefore relatively more adaptive to the application of technological innovations in the livestock business. According to Adi [10], productive age groups have a higher level of involvement in rural economic activities and play an important role in the success of community empowerment programs.

In terms of experience, most participants were relatively new to the livestock business, with the proportion of <10 years reaching 80.00% for ruminants and 90.00% for poultry farmers. This fact shows that the majority of participants still need capacity building, both in terms of mastering feed technology, reproductive management, and animal health. Previous research also mentioned that livestock business experience affects management skills and farmers' courage in adopting new technologies [11].

Based on the commodity, there are differences in characteristics between the two groups. Ruminant farmers keep more cattle (56.67%) than buffaloes (43.33%), reflecting the role of cattle as the main commodity in Bangkalan. Meanwhile, poultry farmers are dominated by small-scale businesses with <25 animals (70.00%). This limited number of livestock ownership is generally still a side business for households, thus requiring intervention to increase the scale of the business to make it more productive and competitive [12].

In general, this profile shows that community service participants have great potential to be developed through capacity building, especially since most are still of productive age but relatively new to the livestock business. Therefore, community service activities that focus on feed technology and reproductive management for ruminant farmers, as well as strengthening business management for poultry farmers, are expected to have a real impact on increasing productivity and community welfare.

3.2. Knowledge about Feed and Fermentation Technology

The pre-test and post-test comparisons demonstrated a clear increase in farmers' knowledge about feed conservation and fermentation (Figure 1). Before the intervention, less than one-third of participants reported familiarity with probiotics and their role in animal feed, and similarly low awareness was recorded for straw fermentation and silage production. After the training sessions, knowledge scores rose markedly, with more than 80% of participants able to identify the materials used, recognize the benefits of straw fermentation, and explain the steps in silage preparation. These findings highlight the value of participatory learning, where interactive discussions coupled with field demonstrations enable farmers to grasp technical knowledge more effectively. This result is consistent with reports that farmer-centered training significantly enhances adoption of feed technologies [13, 14]. Figure 1 illustrates the improvement in knowledge indicators before and after the training program. Complementary documentation of the educational activity is presented in Figure 2, showing the educational session delivered to the farmer group.

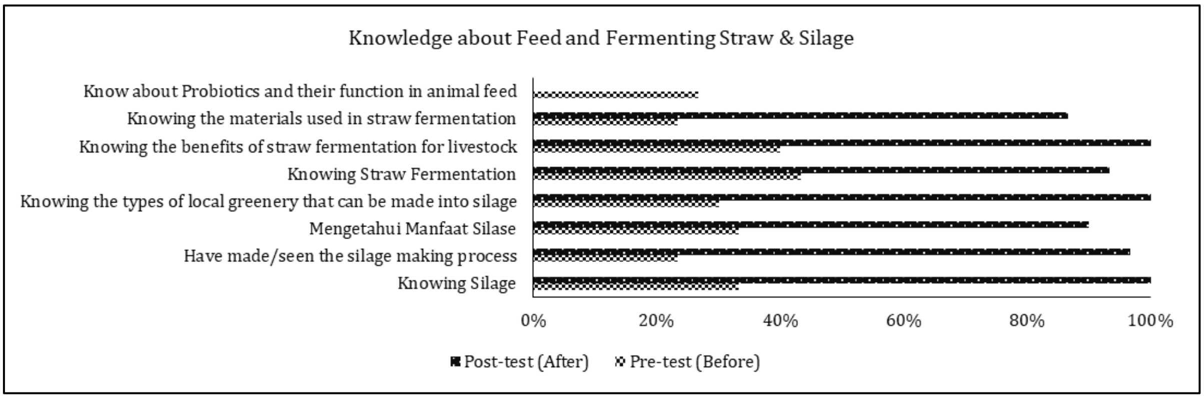

Figure 1 Knowledge about Feed and Fermentation Technology

Increased knowledge of silage and straw fermentation is important, given that the availability of forage is strongly influenced by the season. Innovations such as silage and straw fermentation have proven effective in overcoming fluctuations in feed availability, improving nutritional quality, and extending shelf life [15]. In addition, the use of probiotics in feed fermentation can improve crude fiber digestibility and nutrient utilization efficiency by livestock [16]. Thus, training activities not only improve the theoretical knowledge of farmers, but also provide practical skills in utilizing local potential to support the sustainability of ruminant farming. These results support previous research that a participatory approach through practice-based training can increase the adoption of feed innovations in small-scale farmers [17].

Figure 2 The educational session was delivered to the farmer group

3.3. Practical Skills in Silage and Rice Straw Fermentation

The training program also produced significant improvements in participants' practical skills (Figure 2). Before the intervention, less than half of the farmers were able to cut and chop forage uniformly, store silage in airtight containers, or feed fermented materials properly. Their ability to mix additives such as molasses and EM4 was particularly low, with fewer than 20% demonstrating knowledge of the correct procedure. Skills related to observing signs of parturition in cattle were also limited, as reflected by pre-test scores of less than 60%. After the participatory practice sessions, post-test scores indicated a dramatic rise across all skill domains. More than 90% of the participants were able to chop forage and straw adequately, mix molasses and probiotics uniformly, and store silage in drums or plastic bags under airtight conditions. Similarly, the ability to feed silage and fermented hay gradually, as well as the capacity to observe signs of parturition in cattle, improved to nearly universal mastery. These findings underscore the effectiveness of combining classroom-based education with hands-on practice. Farmers not only gained theoretical understanding of feed technology but also translated that knowledge into practical competency. Such an approach reflects the principles of experiential learning, where technical demonstrations and guided practice accelerate skill acquisition and confidence

[18]. As presented in Figure 3, skill scores showed significant post-test improvements. Field practice activities are further documented in Figure 4, which captures farmers actively preparing silage and fermented rice straw under direct supervision. The completion of training was followed by a group photo (Figure 5) to mark the collaborative effort between farmers, lecturers, and students.

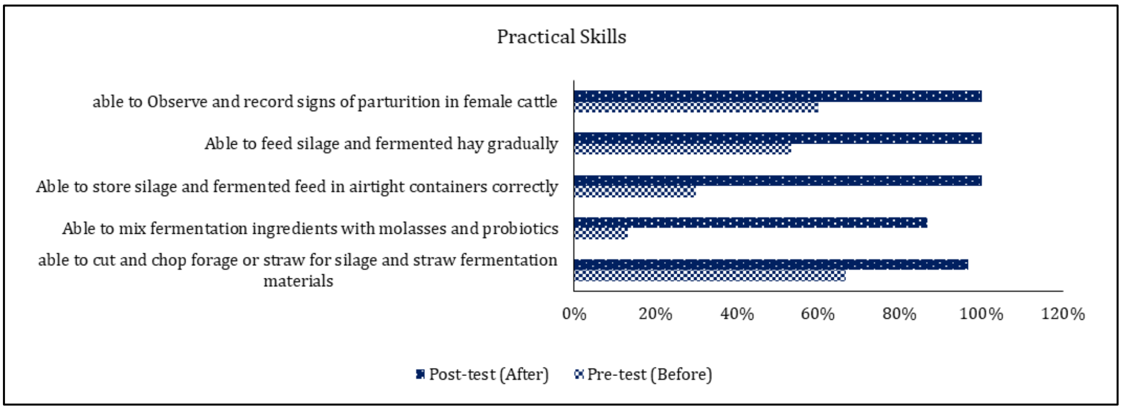

Figure 3 Practical Skills in Silage and Rice Straw Fermentation

In addition to increasing knowledge, the service activities also evaluated farmers' practical skills in processing feed and livestock reproduction management. The pre-test and post-test results shown in Figure 3 show significant improvements in all skill indicators. Before the training, most farmers were not familiar with the techniques of cutting forage for fermentation, mixing ingredients with molasses and probiotics, and storing silage in airtight containers. However, after the training, almost all participants were able to perform these practices correctly.

The results in Figure 3 show a significant improvement in all aspects of skills after the training (post-test) compared to the condition before the training (pre-test). Initially, most participants only had a basic to intermediate understanding of technical skills in ruminant rearing, especially in the aspects of feed processing and reproductive management. However, after the training, the percentage of skills increased to close to 100% in almost all indicators.

The most notable improvements were seen in the ability to mix fermented ingredients with molasses and probiotics and to properly store silage and fermented feed in airtight containers. Before the training, these two aspects were relatively low (around 10-30%), indicating that participants had not had much exposure to modern fermented feed technology. After the training, the percentage of these skills increased drastically to close to 100%, indicating that the training method was effective in providing applicable technical skills. This is in line with the research of Pretty [18] who confirmed that field practice-based training can accelerate the transfer of feed technology knowledge to farmers.

Figure 4 Hands-on practice session on silage and rice straw fermentation supported by students

Figure 5 Group photo of farmers, students, and faculty after the training session

3.4. Knowledge of Livestock Reproduction Management

The evaluation of reproductive management knowledge showed significant gains across all indicators (Figure 3). Prior to the training, less than 20% of farmers reported having ever received instruction related to livestock reproduction. Similarly, knowledge of the importance of maintaining reproductive health and the benefits of artificial insemination was almost absent, with pre-test scores close to 0–10%. Awareness of estrus signs was slightly higher at around 40% in the pre-test, but still limited. Following the intervention, post-test results demonstrated a near-universal improvement, with 90–100% of participants correctly identifying key aspects of reproductive management. Farmers expressed stronger confidence in recognizing estrus signs, understanding the advantages of artificial insemination, and appreciating the importance of reproductive health in herd management. This improvement is critical because reproductive efficiency directly influences cattle productivity. Enhanced capacity for estrus detection and informed decision-making regarding artificial insemination can contribute to shorter calving intervals and higher conception rates. Such outcomes are consistent with previous studies showing that farmer-focused reproductive training programs improve herd fertility performance, which in turn supports food security and household income stability [14]. As depicted in Figure 6, the pre-test and post-test contrast underscores the effectiveness of the intervention in bridging knowledge gaps. The practical component of the activity is further illustrated in Figure 7, where the community service team conducted demonstrations on estrus detection techniques and administered vitamin B-complex injections to cattle owned by local farmers.

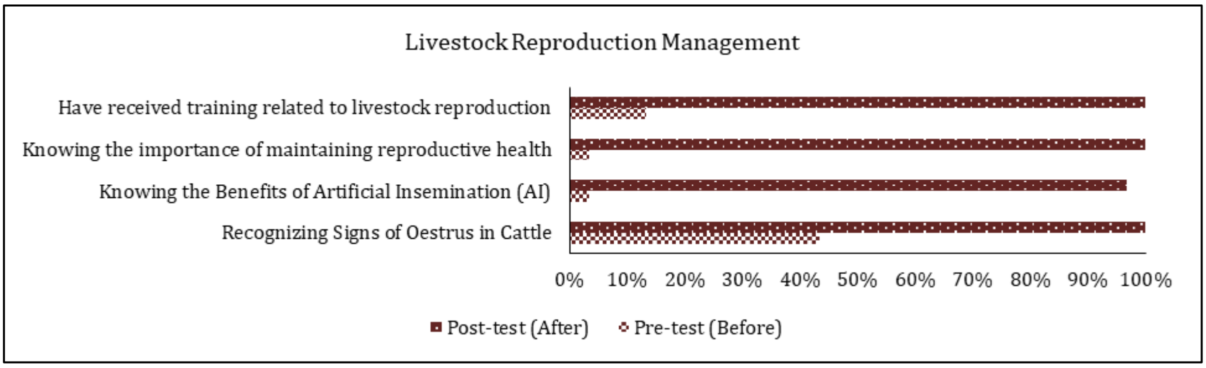

Figure 6 Knowledge of Livestock Reproduction Management

This result is in line with the findings of Yusuf et al. [19], who mentioned that practice-based reproduction training can improve farmers' skills in estrus detection and AI application. Knowledge of reproductive health is crucial, as failure to recognize estrus and poor understanding of reproductive management are often the main causes of low pregnancy rates in cattle [20]. In addition, the increased awareness of farmers regarding the benefits of the training is also evident from the high percentage of respondents who stated that they had attended training related to livestock reproduction after this activity took place. This community service program plays a strategic role in increasing the capacity of human resources in the field of animal husbandry, especially in the aspect of ruminant reproduction. This success can be the basis for expanding similar activities in other areas, with the hope of increasing reproductive efficiency as well as productivity of smallholder farms [21].

The ability to observe and record signs of parturition in cows also showed a significant improvement, from around 60% in the pre-test to almost 100% in the post-test. This is important because reproductive observation skills are directly related to successful reproductive management, livestock health, and production efficiency. With this increased understanding, it is expected that farmers will be able to reduce the risk of birth failure and increase livestock productivity [22]. Overall, the pattern of improvement in this graph proves that the training not only improved the theoretical aspects, but also successfully internalized the practical skills needed in ruminant rearing. This finding strengthens the argument that field practice-based training programs are an effective strategy to increase the capacity of smallholder farmers, so that they are better prepared to face the challenges of productivity and efficiency of livestock businesses.

Figure 7 Counselling session on reproductive management and vitamin B-complex injection

3.5. Nutritional Composition of Feed Resources

The proximate analysis of fresh local grass, grass silage, untreated rice straw, and fermented rice straw will provide direct evidence of nutritional improvements (Table 2). The analysis, conducted according to AOAC [8], includes dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), ash, and nitrogen-free extract (NFE). Although the laboratory results are pending, earlier studies suggest that silage and fermentation treatments can increase crude protein and reduce crude fiber, thus improving digestibility and feed utilization efficiency [23].

Table 2 Proximate composition of fresh grass, silage, rice straw, and fermented rice straw on a 100% dry matter (DM) basis

No	Feed Sample	DM (%)	Ash (%)	Crude Protein (%)	Ether Extract (%)	Crude Fiber (%)	NFE (%)	TDN (%)
1	Rice straw	100	18.44	–	14.95	30.48	17.18	75.34
2	Fermented rice straw	100	19.49	18.46	13.64	29.03	19.38	73.65
3	Fresh grass	100	15.89	19.70	14.79	24.52	25.09	79.47
4	Silage	100	14.78	13.59	16.18	23.16	24.54	80.11

The results of the proximate analysis on a 100% dry matter (DM) basis revealed notable differences in nutrient composition among the feed samples. Crude Protein (CP) content for rice straw was left blank, as requested, while other nutrient fractions were recalculated relative to total DM. For fermented rice straw, the analysis showed a CP concentration of 18.46% DM, accompanied by a reduction in Crude Fiber (CF) to 29.03% DM. These findings are consistent with previous studies reporting that fermentation improves the nutritional value of rice straw. Suningsih et al. [24] demonstrated that fermentation with local microorganisms (e.g., banana corm-based MOL) increased CP to 8.46% and reduced CF by 18.87% on an as-fed basis. Similarly, Widiarso et al. [25] found that fermentation with Saccharomyces cerevisiae elevated CP from 6.65% to 9.64% while decreasing CF from 53.02% to 36.50%. When expressed on a 100% DM basis, our data support these findings, highlighting that microbial fermentation effectively enhances the availability of protein while reducing indigestible fiber fractions in rice straw, thereby improving its potential as ruminant feed.

In contrast, the silage sample exhibited a CP content of 13.59% DM and a CF content of 23.15% DM, alongside the highest Ether Extract (EE, 16.18% DM) among treatments. These results align with previous reports that ensiling preserves the nutritive value of forage through anaerobic fermentation, maintaining energy-rich components and preventing extensive nutrient losses during storage [26,27]. Although the CP content of silage was lower than that of fresh grass, its fiber fraction was comparable, confirming that ensiling provides a stable feed resource with adequate energy density suitable for long-term storage. Meanwhile, fresh grass demonstrated the highest CP concentration (19.70% DM) and the lowest CF (24.52% DM), underscoring its role as the primary basal feed for ruminants. The balance between protein and fiber in fresh forage further emphasizes its superior nutritive profile compared to crop residues such as straw, making it highly valuable for supporting rumen microbial activity and animal performance.

Overall, when expressed on a 100% DM basis, the comparative analysis indicates that microbial fermentation substantially improves the nutritional quality of rice straw, in agreement with earlier studies. Furthermore, silage serves as a reliable preserved feed resource that retains essential nutrients and energy during storage, while fresh grass remains the most balanced feedstuff, providing the highest protein concentration along with relatively low fiber.

4. Conclusion

The community empowerment program implemented in Perreng Village, Bangkalan, successfully enhanced farmers' knowledge and practices in probiotic-based silage preparation, rice straw fermentation, and reproductive management. Pre- and post-training evaluations showed significant improvements in farmers' understanding of feed conservation technologies, silage and fermentation processes, estrus detection, and artificial insemination practices. Laboratory analysis further confirmed that fermented rice straw and silage offered better nutritional quality, with increased crude protein and reduced crude fiber compared to untreated rice straw. Overall, the program proved effective in strengthening feed security, improving cattle reproductive performance, and empowering local communities to adopt sustainable livestock management practices. Continued assistance is recommended to ensure consistent application of these technologies, enhance livestock productivity, and support long-term resilience of smallholder farming systems in Bangkalan.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Bangkalan Regency Government [Internet]. Overview of Bangkalan Regency. 2023. Available from https://www.bangkalankab.go.id/site/gambaranumum.

[2] Livestock Service Office of East Java Province [Internet]. Statistics on Livestock Population in Bangkalan Regency in 2021. Available from https://disnak.jatimprov.go.id/web/data/statistikpopulasiternak.

[3] Gicheha MG, Akidiva IC, Cheruiyot RY. Genetic and economic efficiency of integrating reproductive technologies in cattle breeding programme in Kenya. Trop Anim Health Prod. 2019;51:473–5.doi:10.1007/s11250-018-1689-1

[4] Lamid M, Wahjuni RS, Nurhajati T. IbM Pengolahan Silase dari Hay (Haylase) sebagai Bank Pakan Hijauan dengan Konsentrat untuk Penggemukan Sapi Potong di Kecamatan Arosbaya Kabupaten Bangkalan-Madura. Agroveteriner. 2016. 5(1): 74–81.

[5] Molina A. Probiotics and their mechanism of action in animal feed. Agron Mesoam. 2019;30(2):601–11. doi: /10.15517/am.v30i2.34432

[6] Fithri L, Febriyanto L, Asmarani O, Sanjaya RE, Nurrohman AI, Lamid M, Murad AMA, Puspaningsih NNT. Fermentation of rice straw raw material to bioethanol using consortium enzyme. AIP Conference Proceedings. 2023. 2679: 050006. doi: 10.1063/5.0111387

[7] Suganda A, Salman D, Baba S, Fahmid IM. Cattle corporation village program as small-scale farmer group empowerment to support National beef self-sufficiency. IOP Conf Ser Earth Environ Sci. 2022;1114:012041. doi: 10.1088/1755-1315/1114/1/012041

[8] AOAC. Official Methods of Analysis. 18th ed. Association of Official Analytical Chemists, Gaithersburg, MD, USA. 2005

[9] Mulyani E. Application of quasi-experimental design in evaluating community training activities. Journal of Social Science Methodology. 2021. 10(3): 203–212.

[10] Adi, IR. Intervensi Komunitas dan Pengembangan Masyarakat sebagai Upaya Pemberdayaan Masyarakat. Jakarta: Rajawali Pers. 2013.

[11] Sodiq A, Yuwono P. Manajemen Peternakan Rakyat dalam Meningkatkan Produktivitas Ternak. Jurnal Ilmu Ternak. 2019. 19(1), 25–34. https://doi.org/10.24198/jit.v19i1.22355

[12] Priyanti A, Ilham N, Winarso B. Analisis Sosial Ekonomi Usaha Ternak Skala Kecil di Pedesaan. Jurnal Sosial Ekonomi Peternakan. 2018. 11(2), 45–55. https://doi.org/10.24843/jsep.2018.v11.i02.p05

[13] Vaarst M, Byarugaba DK, Nakavuma J, Laker C. Participatory livestock farmer training for improvement of animal health in rural and peri-urban smallholder dairy herds in Jinja, Uganda. Trop Anim Health Prod. 2007 Jan;39(1):1-11. doi: 10.1007/s11250-006-4439-8.

[14] Umutoni C, Ayantunde A. Awareness and use of improved livestock feed technologies among agro-pastoral households in the West African Sahel. Research Square [Preprint]. 2024 Mar 13. Version 1. doi:10.21203/rs.3.rs-4017463/v1

[15] McDonald P, Henderson AR, Heron SJE. The Biochemistry of Silage (2nd ed.). Chalcombe Publications. 2010.

[16] Khan RU, Naz S, Dhama K, Saminathan M,Tiwari R. Probiotics and poultry production: an update. Poultry Science Journal. 2016. 4(2), 89–101. https://doi.org/10.22069/PSJ.2016.2951

[17] Nisa MU, Sarwar M, Khan MA. Effectiveness of farmer training programs on silage making and feeding practices in smallholder dairy farms. Pakistan Journal of Agricultural Sciences. 2020. 57(3), 723–730.

[18] Pretty JN. Participatory learning for sustainable agriculture. World Development. 1995. 23(8): 1247–1263. doi: 10.1016/0305-750X(95)00046-F

[19] Yusuf M, Siregar TN, Siregar TN, Nasution Z. The effectiveness of training in improving cattle reproductive management. IOP Conference Series: Earth and Environmental Science, 788. 2021. 012157. https://doi.org/10.1088/1755-1315/788/1/012157

[20] Diskin MG, Kenny DA. Managing the reproductive performance of beef cows. Animal Reproduction Science. 2016. 172, 66–75. https://doi.org/10.1016/j.anireprosci.2016.05.012

[21] Kumar N, Bhakat M, Mohanty TK, Raina VS. Capacity building of dairy farmers on reproductive management through training programs. Indian Journal of Dairy Science. 2020. 73(1), 84–89.

[22] Keshipour H, Bahonar A, Vodjgani M, Anassori E. Effectiveness of training parturition and dystocia management on days open of dairy cows in traditional farming systems: a field trial. Vet Res Forum. 2024. 15(3): 139–144. doi: 10.30466/vrf.2023.2007348.3945

[23] Kang J, Tang S, Zhong R, Tan Z, Wu D. Alfalfa silage treated with sucrose has an improved feed quality and more beneficial bacterial communities. Front Microbiol. 2021. 12: 670165. doi:10.3389/fmicb.2021.670165

[24] Suningsih N, Ibrahim W, Liandris O, Yulianti R. Kualitas fisik dan nutrisi jerami padi fermentasi pada berbagai penambahan starter. J Sain Peternak Indones. 2019;14(2):191-200.

[25] Widiarso BP, Khoirunnisa, Perdinan A. Pengaruh fermentasi menggunakan Saccharomyces cerevisiae terhadap kualitas fisik, potential hydrogen (pH) dan kandungan nutrien jerami padi. J Peternak Pertan Terpadu (JPPT). 2023;5(1):51-60.

[26] Zayed MS. Enhancement the feeding value of rice straw as animal fodder through microbial inoculants and physical treatments. Int J Recycl Org Waste Agricult. 2018. 7(2): 105–113. doi: 10.1007/s40093-018-0197-7.

[27] Ali N, Suhartina, Muktiani A, Pangestu E. Quality of crude protein and crude fibre wafer complete feed based on rice straw fermented with Effective Microorganism 4 (EM-4). IOP Conference Series: Earth and Environmental Science. 2020. 492(1):012028. doi:10.1088/1755-1315/492/1/012028