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Application of phytobiotics and straw fermentation for sheep feed in Mulawari Village, Karo Regency

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ABSTRACT
The "Subur Tani" Farmer Group in Mulawari Village, Karo Regency, North Sumatra, faces significant challenges, including limited scientific and technological knowledge, environmental pollution from burning agricultural waste, and suboptimal livestock productivity exacerbated by disease threats. These issues directly hinder farmer profitability and highlight a critical need for improved skills in disease prevention. This community service program primarily aimed to enhance farmer capabilities in sustainable livestock management. The community service team delivered practical training on producing multifunctional phytobiotics and implementing fermented feed technology using agricultural waste. Key achievements include significant skill improvement among participating farmers: 86.7% became proficient in phytobiotic production, and 93.3% became skilled in fermented feed preparation. The program successfully demonstrated that applying these innovations enhanced livestock productivity, increased farmer income by reducing feed and medicine costs, and notably improved overall farmer skills. In conclusion, integrating phytobiotics and fermented feed offers a viable and impactful strategy for boosting livestock productivity, profitability, and skill development within agricultural communities like Mulawari Village.
Keyword: Phytobiotics, Farmer, Livestock, Feed, Technology

ABSTRAK
Kelompok Tani "Subur Tani" di Desa Mulawari, Kabupaten Karo, Sumatera Utara, menghadapi tantangan, termasuk keterbatasan pengetahuan ilmiah dan teknologi, polusi lingkungan akibat pembakaran limbah pertanian, serta produktivitas ternak yang belum optimal akibat ancaman penyakit. Permasalahan ini dapat mengurangi keuntungan petani dan membutuhkan keterampilan petani dalam pencegahan penyakit. Program pengabdian masyarakat ini bertujuan untuk meningkatkan kemampuan petani dalam pengelolaan ternak berkelanjutan. Tim pengabdian masyarakat melaksanakan praktik pelatihan tentang pembuatan fitobiotik multifungsi menggunakan rempah dan penerapan teknologi pakan fermentasi menggunakan limbah pertanian. Ketercapaian meliputi peningkatan keterampilan yang signifikan di antara petani peserta 86,7% menjadi lebih terampil dalam pembuatan fitobiotik, dan 93,3% terampil dalam pembuatan pakan fermentasi. Program pengabdian masarakat ini menunjukkan bahwa penerapan inovasi tersebut dapat meningkatkan produktivitas ternak, menambah pendapatan petani melalui pengurangan biaya pakan dan obat-obatan, serta meningkatkan keterampilan petani. Disimpulkan bahwa kombinasi fitobiotik dan pakan fermentasi merupakan strategi yang layak dan berdampak besar untuk meningkatkan produktivitas ternak, keuntungan, dan peningkatan keterampilan pada kelompok tani di Desa Mulawari.
Keyword: Fitobiotik, Petani, Peternakan, Pakan, Teknologi

1. Introduction

The "Subur Tani" Farmer Group in Mulawari Village, Karo Regency, North Sumatra Province, operates both agricultural and livestock businesses. Mulawari Village has significant agricultural potential, evidenced by its production of 25.96 tonnes of corn and 230.75 tonnes of field rice, alongside various vegetables, herbs, and

fruits [1]. The region also boasts well-developed herbal plants such as garlic, ginger, turmeric (Curcuma longa), and lemongrass. While crop productivity is high, it concurrently generates substantial agricultural waste (straw/residue) that's commonly burned or fed to livestock without proper processing. This practice not only contributes to environmental pollution but also leads to reduced livestock productivity due to the high fibre content of the unprocessed feed. Initial surveys indicated that farmer-livestock groups in Mulawari Village lack awareness regarding the potential of utilising this abundant agricultural waste through appropriate science and technology, hence their reliance on burning.

Despite its agricultural potential, the "Subur Tani" Farmer Group faces critical challenges in livestock management. The well-developed livestock sector in Mulawari, with a population including 1,353 sheep and 1,949 goats in the Tigapanah sub-district [1], is continually threatened by disease outbreaks, such as the 2022 Foot and Mouth Disease (FMD) epidemic and common bacterial, parasitic, and viral infections that escalate during the rainy season. Furthermore, current feed management practices are suboptimal, resulting in reduced livestock productivity and low average body weights, which directly impact farmers' income and overall animal health. The growing concern regarding antibiotic residues in livestock products and the increasing issue of pathogen resistance further underscores the urgent need for sustainable and effective alternatives to enhance livestock health and productivity [2]. If livestock are affected by disease, productivity can decrease because livestock health directly impacts it [3]. In response to these challenges, phytobiotics emerge as a promising natural alternative. Derived from plants like those abundant in Mulawari (garlic, ginger, Curcuma longa, lemongrass), probiotics contain bioactive components that act as antibacterials, prevent disease, and boost immunity, offering a viable substitute for synthetic antibiotics in improving livestock health and production [4]. Their local availability and affordability make them highly suitable for farmer adoption. For instance, according to [5], various spices like garlic contain allicin and scordinin, which function as antioxidants, suppressing cholesterol, increasing endurance, spurring growth, and preventing cell damage. Phytobiotics can also serve as an alternative to antibiotics [6]. Indonesian herbal plants, classified as food herbs (ginger, garlic, Curcuma longa, turmeric, galangal, cinnamon, lemongrass, and betel are safe for long-term consumption by humans and livestock. Curcuma longa (Curcuma xanthorhiza Roxb) is a known appetite enhancer and antioxidant, accelerating small intestine function to increase hunger and feed intake and preventing or reducing worm eggs in the digestive tracts of livestock [3]. These phytobiotics can also prevent and treat diseases like diarrhea, virus-induced illnesses, and improve livestock reproductive performance [7-8]. Cattle-consuming probiotics may exhibit higher immunity by stimulating the central nervous system, improving liver and kidney function, increasing white blood cell production, and inhibiting virus replication [9]

Concurrently, the utilisation of agricultural waste, particularly straw, presents another significant opportunity, given its abundance in Mulawari Village. While agricultural waste generally has low nutritional value, it can be significantly improved through fermentation technology [10]. Fermentation, requiring microbial starters, facilitates oxidation, reduction, and hydrolysis reactions, transforming organic substrates and reducing crude fibre while increasing digestibility and protein content [11]. This process, typically taking 15 days, involves chopping the straw for easier consumption and digestion, often using a knife or chopper machine. This approach transforms low-nutrition waste into a viable and cost-effective animal feed source, aligning with effective feed management in ruminants [6]. The community service program was designed with clear objectives, considering the existing local challenges and available resources. It aimed to increase the skills of farmer group members in producing multifunctional phytobiotics for proactive livestock disease prevention. Additionally, the program sought to improve farmer group proficiency in applying appropriate technology for processing agricultural waste into fermented feed, thereby diversifying sustainable and cost-effective feed sources. Ultimately, these efforts were designed to contribute to the overall increase in community income and economic well-being through enhanced livestock productivity and reduced feed-related expenditures.

2. Methods

The community service program in Mulawari Village followed a structured approach, ensuring effective knowledge transfer and sustainable impact to achieve its planned objectives. It began with a preliminary assessment and in-depth problem identification through interviews with the "Subur Tani" farmer group, helping to understand local potential and pinpoint challenges like disease threats and limited skills. This was followed by a crucial socialisation phase where the program team introduced project goals and proposed interventions, fostering community participation and aligning solutions with farmer needs [12-13]. Solutions were always chosen for their practicality and local applicability. Subsequently, practical training sessions and

demonstrations were conducted with all 15 active farmer group members, aiming to develop both technical and soft skills. This comprehensive training involved multiple interactive sessions on two main technological applications: phytobiotic production (covering ingredient identification, mixing, and fermentation using local herbs like Curcuma longa for disease prevention and appetite stimulation, with immediate application as a drinking water supplement for their sheep and goats in real farm settings) and fermented feed processing (demonstrating how to chop corn stover with a chopper machine and mix it with molasses, bran, water, and EM4 for a seven-day fermentation to create valuable feed, which was then directly fed to their sheep on local farms). To ensure sustained adoption, a comprehensive three-month mentoring program included regular follow-up visits and meetings, providing ongoing guidance and troubleshooting. Program success was evaluated through questionnaires, direct skill assessments, and monitoring qualitative feedback on livestock outcomes (health, productivity, weight gain). Finally, the program was designed for sustainability by strengthening organisational capacity, highlighting local resource availability, providing documentation, and emphasising economic viability to encourage the group's independence and continued practice.

3. Results and Discussion

Community service consists of 2 activities: training in making phytobiotics from Curcuma longa for sheep drinking water intake and making fermented feed using an abundant agricultural straw. The training was accompanied by counselling and a presentation of material from lecturers and students for 5 hours, followed by a question and answer session. Here are some results of community service activities:

3.1. Improved farmer skills in phytobiotic application

The community service activities that have been carried out, namely making phytobiotics for sheep and goats and making fermented feed from agricultural waste, have been adopted or practised by farmers. Farmers also carried out practices and training during the activity, and the community service team answered various questions about making phytobiotics and fermented feed. The farmer group consists of 15 active members with an age range between 25 years and 60 years. After the activity, the community service team filled out questionnaire data to find out which farmers had applied and were skilled in making probiotics and fermented feed. The adoption and innovation of farmers can occur after the training process. Profiles of Subur Tani Farmer Group Members in Mulawari Village, Karo Regency, are presented in Table 1.

Table 1. Subur Tani farmer group member profiles in Mulawari Village, Karo Regency

Name	Age	Gender	Primary Occupation	Livestock Owned
Beres Tarigan	32	Male	Fruit Farmer	Sheep
Bergiat Giting	45	Male	Corn Farmer	Goats
Rudi Ginting	58	Male	Vegetable Farmer	Cattle
Andreas Ginting	60	Male	Corn Farmer	Goat
Amri Ginting	50	Male	Coffee Farmer	Sheep, Goats
Giat Tarigan	39	Male	Corn Farmer	Cattle, Sheep
Bukti Tarigan	60	Male	Spice Farmer	Sheep
Jode Ginting	35	Male	Corn Farmer	Goats, Sheep
Saul Sitepu	25	Male	Farm Laborer	Sheep
Raider Purba	48	Male	Cocoa Farmer	Cattle
Melky Ginting	25	Male	Vegetable Farmer	Sheep
Diyus Pinem	55	Male	Fruit Farmer	Goats, Cattle
Lot Girsang	30	Male	Coffee Farmer	Sheep
Maro Ginting	53	Male	Vegetable Farmer	Sheep, Cattle
Aspin Tarigan	37	Male	Corn Farmer	Goats

Figure 1. Counselling and practice of phytobiotic production.

The criteria for technology adoption among farmers emphasise simplicity, practicality, and ease of application. Practical and straightforward innovations significantly facilitate the adoption process, as easier implementation directly leads to faster uptake of new techniques by farmers [14]. For instance, preparing probiotics from Curcuma longa and garlic is straightforward, enabling farmers to apply this skill effectively. Similarly, producing fermented feed from corn stover is relatively easy: it involves chopping the straw, mixing it with molasses, bran, water, and EM4, and then ensiling the mixture for seven days, after which the fermented straw can be harvested. Questionnaire data reveal that out of 15 farmers, 12 have successfully implemented both phytobiotics and fermented feed for their livestock, while 2 remain hesitant, and 1 has not yet applied these innovations due to a lack of understanding regarding probiotics. Table 1 presents the improvement of farmers' skills in producing and applying phytobiotics to livestock.

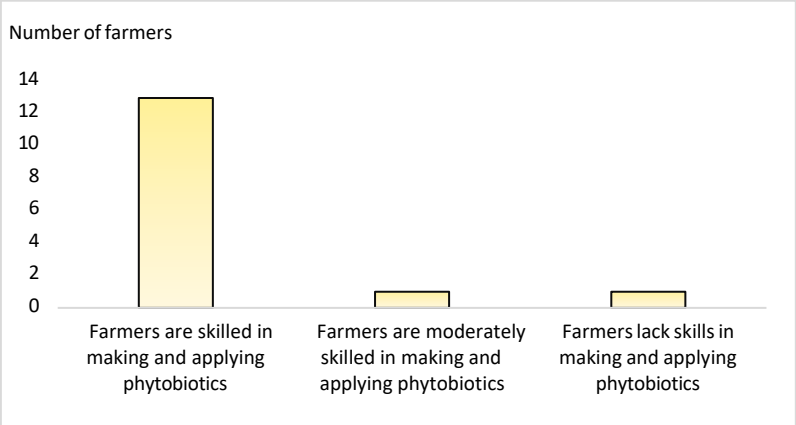

Figure 2. Improved farmer skills in phytobiotic application.

Figure 2 vividly illustrates the impact of the community service program on farmer skills in phytobiotic application. The data, derived from questionnaires completed by all 15 participating farmers, shows that 13 individuals (86.7%) demonstrated a significant increase in their skills related to producing and applying phytobiotics. Furthermore, one farmer (6.7%) exhibited a moderately increased skill level, while one farmer (6.7%) showed no immediate improvement in skills. To address these varied outcomes, follow-up coaching sessions were subsequently explicitly re-implemented for these three farmers to further enhance their capabilities. This quantitative breakdown underscores the high rate of skill improvement achieved within the farmer group. The success of adopting new practices, such as those taught in our extension activities, largely depends on the relevance of the information and its delivery method. Factors influencing this adoption include the appropriateness of the information, ensuring technology aligns with farmer needs, and farmer characteristics like education, culture, and beliefs, which shape how knowledge is received. Furthermore, motivation and perceived benefits are crucial; farmers are more likely to adopt practices when they understand the advantages. Effective extension requires a clear strategy to achieve its goals. Our program successfully met its objective of improving farmer group skills, demonstrating a high rate of achievement. The service team

continued to support these initiatives until the community experienced tangible benefits, including increased livestock productivity, enhanced disease resistance, and improved animal weight gain.

Disease prevention in the management of a farm is crucial. Livestock disease prevention is an effort to protect livestock from disease. Uncontrolled use of antibiotics can cause some bacteria to be resistant to antibiotics. In community service activities, the material was presented, which stated that we can apply natural drugs that weaken bacteria to overcome the abuse of antibiotics. The material presented to farmers includes the definition of phytobiotics and the function of phytobiotics to increase farmers' insight. Some spices used for phytobiotics include Curcuma longa, turmeric, black cumin, garlic and ginger. Making phytobiotics has been conducted well, and various discussions have been held. The community service team explained the importance of preventing livestock diseases safely and practically. The provision of phytobiotics for sheep drinking water can be given as much as 25% of sheep's total drinking water requirement. According to [15], adding phytobiotics can stimulate the digestive process to increase ration digestibility. Good digestion will increase the amount of nutrients the livestock body absorbs to produce better final weight. Farmers understand the presentation of the service team, and the practice of making is carried out to clarify the information that the service team has done. The service team also assists farmers who have not applied or cannot make phytobiotics. Assistance is expected to be adequate to improve the achievement of this community service programme.

3.2. Enhanced farmer skills for appropriate technology application based on straw fermentation

Fermented feed from agricultural straw has been implemented in the Subur Tani farmer group in Mulawari Village. The training conducted by the community service team has been implemented well. The practice of making fermented feed was attended by 15 farmers from the Subur Tani group. Material presentation, brochure distribution, and practice were carried out simultaneously at one stage. Discussions, interviews, and deepening of the material also went well, and farmers seemed enthusiastic about following the training events on making fermented feed using corn straw. The results of corn straw fermentation have been given to sheep so that the forage is more easily digested. Based on the questionnaire filling, fermented feed based on agricultural straw can increase animal feed consumption. Corn straw is categorised as agricultural crop waste with low nutritional content and digestibility [16]. Straw has cell walls that have undergone lignification so that cellulose and hemicellulose bind lignin so that other ingredients, such as activators, are needed [17]. Fermentation technology is a feed preservation process using lactic acid bacteria to produce certain compounds that inhibit decaying bacteria. Fermented straw in community service has a softer texture, good nutritional quality, and benefits from feed. The increase in sheep's feed consumption using fermentation technology proves that farmers' knowledge has increased. The increase in knowledge and technology can be seen in Figure 3.

Figure 3. Maise straw chopping process using chopper machine for fermented feed making.

Farmers' skills can be improved by training based on their understanding when the programme is implemented. The training practice of making phytobiotics and fermented feed based on agricultural waste through technology has been carried out in Mulawari Village, Karo Regency. The number of participants was 15 farmers. The service activities were directed at the training practice of making phytobiotics and fermented feed based on corn straw agricultural waste. The theory on phytobiotics and fermented feed was delivered, accompanied by the provision of reading materials in the form of activity brochures. The training practice

begins with training farmers to use straw chopping machines, namely choppers, and then mixing grass with sugar, water, bran, and EM4. Data on the service results was obtained in the questionnaire from as many as 15 farmers who have participated in community service, and 14 people have been skilled in making fermented feed using corn straw. A total of 1 farmer is quite skilled. The age factor of community service participants influences their level of understanding. Farmers under the age of 50 find it easier to understand the training practices compared to farmers with ages above 50. Suggests that farmers over 50 years old tend to face challenges in accepting and adopting new increased income and economy of the community [18-19]. Integration between agriculture and livestock can occur from livestock-producing manure used for crop fertilisation to crop waste, such as corn straw being reused for animal feed through fermentation technology. In livestock management, feed costs constitute 80% of the costs used for maintenance. Using agricultural straw waste can cut costs that must be spent on animal feed so that farmers can obtain maximum profit. Based on questionnaire data, farmers felt a positive impact from implementing community service by loading the theme of phytobiotics and fermented feed. Farmers feel that the sheep they raise, which are usually disease-resistant, are more immune, especially in the rainy season. Farmers also stated that the livestock had good meat posture during community service activities. This is due to Curcuma longa and fermented feed, which increase the appetite of livestock.

The farmer group has planned to use various agricultural wastes for fermentation. Various kinds of straw are available, such as groundnut, rice, long bean, and others. This can reduce feed costs so that farmers' income can increase. Based on questionnaire data, farmers stated that there was a reduction in expenditure on feed ingredients and medicines because they were replaced by fermented feed based on agricultural waste, namely corn straw and phytobiotic drinks. Various studies have shown that Curcuma longa can be used in traditional medicine. Curcuma longa is used in livestock medicine and as a feed additive [20]. Curcuma longa can be given as a supplement in drinking water to increase cattle appetite because the essential oil can increase the number of rumen microbes and inhibit pathogenic microbes. Overall, it was found that using fermented feed and Curcuma longa reduced the cost of feed, vitamins and medicines. Livestock experienced weight gain due to increased appetite caused by the phytobiotic curcuma longa given. The increase in livestock weight can be a benefit for farmers.

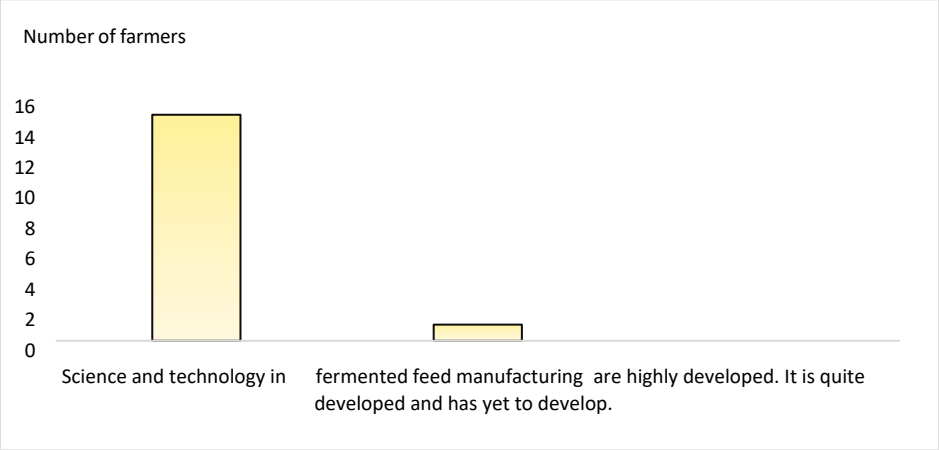

Figure 4. Farmer skills for appropriate technology application based on agricultural straw fermentation.

Based on Figure 4, obtained from questionnaire data, all 15 participating farmers were assessed regarding their ability to apply agricultural waste-based fermented feed technology. The results clearly indicate a high level of proficiency, with 14 individuals 93.3% demonstrating strong capability in implementing this science and technology. One farmer, 6.7%, was assessed as being sufficiently skilled. Questionnaire responses confirmed that the farmers who adopted these practices found the learned science and technology to be highly useful, particularly in effectively utilising corn straw waste, which was previously often burned and caused environmental pollution. Following the training, farmers readily recognised the practical benefits of the acquired knowledge and its application to their livestock.

The proficiency of farmers has significantly increased following their participation in practical training and mentorship focused on the production of fermented feed. Agricultural by-products, traditionally disposed of through burning, are now utilized as livestock feed, thereby adding substantial value. During harvest seasons,

fermented feed is systematically prepared, and subsequently, in the dry season when the availability of grasses and legumes is limited, this fermented feed can be effectively employed as an alternative feed source for livestock.

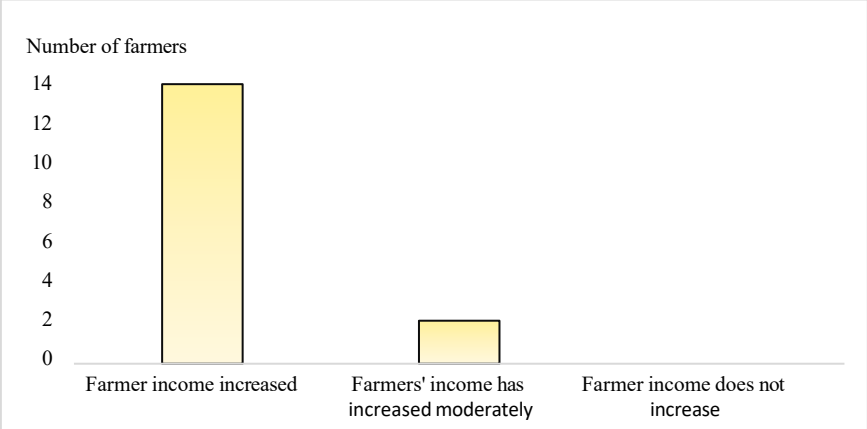

Figure 4. Income and economy of the farmer.

Based on questionnaire data, 14 farmers, 93.3%, reported that the community service activities, focusing on fermented feed and phytobiotics, significantly benefited both their livestock and their overall business. In terms of long-term achievements, these 14 farmers also indicated an increase in their income and improved economic well-being. This is primarily because phytobiotics help maintain livestock health and boost appetite, directly leading to improved livestock body weight and, consequently, higher selling prices. Furthermore, fermented feed notably saves on feed costs. Farmers clearly recognised the substantial benefits of the technology provided by the community service team, seeing increased income as an opportunity to enlarge their livestock businesses sustainably.

4. Conclusions

This community service program, which focused on providing phytobiotics and fermented feed, significantly engaged the "Subur Tani" farmer group in Mulawari Village, Karo Regency. The program yielded tangible results: 86.7% of farmers greatly improved their skills in phytobiotic application, and 93.3% became highly skilled in fermented feed preparation. These interventions effectively showed that applying phytobiotics and fermented feed boosts livestock productivity, increases farmer income, and significantly enhances farmer skills. Beyond immediate gains like better animal health and weight, this initiative offers crucial long-term sustainability by turning agricultural waste into valuable feed, cutting costs, and reducing reliance on harmful antibiotics. This fosters an economically viable and environmentally friendly livestock system. The program's success highlights the importance of targeted training and ongoing support. Continued monitoring and potential expansion of these accessible technologies are vital for ensuring their lasting impact and broader adoption across other farming communities, promoting sustainable agricultural practices in the region.

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