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Enhancing Community Welfare through the Development of a Zero-Waste Farming System in Tebo Regency

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Abstract

Rice fields are still considered a means of food production only for rice and secondary crops. In fact, with appropriate technology, non-paddy land that can be used for single-community agriculture (single-community approach) can also be used for an integrated community farming system. and cattle breeders, then determine the area for making demonstration plots of cattle by providing animal feed in the form of processed rice straw and training on the use of straw waste as organic fertilizer and animal feed, establishing a pilot zone for cattle by providing animal feed in the form of processing rice straw, making demonstration plots for cattle using providing animal feed in the form of processed rice straw and making demonstration plots for rice cultivation that combines organic fertilizers (cow dung and urine) with inorganic fertilizers. The conclusion of this activity is that the people of Jati Belarik Village, Sumay District, Tebo Regency, especially farmer groups, are enthusiastic about the service program in this case, training on the use of straw waste as organic fertilizer and animal feed.

Keywords: beef cattle; farming system; organic fertilizer; rice; zero waste

Peningkatan Kesejahteraan Masyarakat Melalui Pengembangan Zero Waste Farming System di Kabupaten Tebo

Abstrak

Sawah masih dianggap sebagai sarana produksi pangan hanya untuk padi dan tanaman sekunder. Padahal, dengan teknologi yang tepat, lahan non-padi yang dapat digunakan untuk pertanian komunitas tunggal (pendekatan komunitas tunggal) juga dapat digunakan untuk sistem pertanian komunitas terpadu. Kegiatan ini bertujuan untuk menentukan area pembuatan petak demonstrasi ternak dengan menyediakan pakan ternak berupa jerami padi olahan dan pelatihan penggunaan limbah jerami sebagai pupuk organik dan pakan ternak, serta mendirikan zona percontohan ternak dengan menyediakan pakan ternak berupa jerami padi olahan, membuat petak demonstrasi ternak dengan menggunakan pakan ternak berupa jerami padi olahan, dan membuat petak demonstrasi budidaya padi yang menggabungkan pupuk organik (kotoran dan urin sapi) dengan pupuk anorganik. Kesimpulan dari kegiatan ini adalah masyarakat Desa Jati Belarik, Kecamatan Sumay, Kabupaten Tebo, khususnya kelompok tani, antusias terhadap program pelayanan dalam hal ini, yaitu pelatihan penggunaan limbah jerami sebagai pupuk organik dan pakan ternak.

***Kata kunci**: padi; pupuk organik; sapi potong; sistem pertanian; zero waste*

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INTRODUCTION

The crop-livestock production model, commonly known as integrated farming, combines livestock production with agricultural activities. This model is highly suitable for supplying manure to farmland; as a result, it is often cited as an example of zero-waste farming because livestock waste is used as fertilizer, and agricultural waste is used as livestock feed. The integration of livestock and crops aims to achieve optimal business output or improve soil fertility. The interaction between livestock and crops must be complementary, supportive, or mutually beneficial to increase production efficiency or achieve higher profits from agricultural output.

According to Marjaya (2016), a simple model of integrated farming, when corn is grown in a particular area, the plant residues left after harvest are waste that the farmer must dispose of. However, this is not the case if ruminants are present in that area, as the residues serve as feed for the ruminants. A reciprocal relationship occurs when livestock produce manure that is used as fertilizer for crops grown in that area. Agricultural development in Indonesia plays a crucial role in the national economy. The agricultural sector has played a vital role in contributing to GDP, generating foreign exchange, providing food and raw materials for industry, creating jobs, and increasing household income. The agricultural sector has a significant multiplier effect by increasing cross-industry input-output, consumption, and investment.

This is the case at both the national and regional levels, as most regions in Indonesia have a comparative advantage in the agricultural sector (Kementerian Pertanian, 2024). According to BPS-Statistics Indonesia, Tebo Regency (2022), Tebo Regency's GRDP in 2020 at current prices reached Rp 5 trillion, with the agricultural sector accounting for approximately 40%. In the implementation of this organization, agricultural development at the farmer level is generally still partial (within the value chain), so that farmers as agribusiness actors are grouped into those who grow food crops, engage in horticulture, fisheries, livestock, and reforestation. This has a negative impact, particularly on farmers who own or cultivate only small plots (0.1 to 0.5 ha), as they are unable to fully utilize their agricultural assets.

Rice fields are still viewed as a means of food production limited to rice and secondary crops. However, with appropriate technology, non-paddy fields suitable for single-community farming can also be integrated into community farming systems (Kurniawan et al., 2025). As land ownership becomes more limited, farming becomes more intensive, requiring greater nutrient inputs and crop protection. Intensive farming relies on external inputs such as synthetic chemicals (fertilizers, pesticides), hybrid seeds, and fuel-powered mechanization; despite the environmental complexities, high agricultural costs, and significant environmental damage, this approach is also a contributing factor. And this leads to a decline in farmers' income (Salikin, 2003). According to Jumin (2002), for example, in Indonesia, evidence shows that nitrogen fertilizer use tripled and pesticide use increased sixfold between 1970 and 1980. Unfortunately, the yield was only 1.5 times higher. Intensive monoculture, which applies high-input technologies to more fertile areas, has expanded marginal areas

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(Reijntjes, 1992). Since the late 1980s, most crops have shown signs of drought, and yields have declined. The use of high-yielding varieties requires intensive care and nutrient management through various technical packages, yet crop yields tend not to increase (Sutanto, 2002).

According to Jumin (2002), research indicates that nitrogen fertilizer used in Indonesia, for example, tripled between 2000 and 2019, while pesticide use increased sixfold. Unfortunately, crop yields only increased by half. Intensive monoculture, which applies high-input technology to more fertile areas, has expanded marginal farmland (Kusuma et al., 2025). Since the late 1980s, some crops have shown signs of drought-stressed farmland and reduced harvest yields. Crop yields tend to increase despite the use of high-yielding varieties. Daily farming activities produce manure, which serves as the primary substrate for compost/bokashi as organic fertilizer. At the same time, farming activities, including the cultivation of food crops and horticultural produce, also generate byproducts that can be reused as livestock feed, in addition to the forage crops that are grown.

Thus, it is entirely possible to meet forage requirements so that the average body weight gain of livestock continues to increase. This indicates that this cycle or sequence of operations provides high efficiency without generating waste from production activities. As an agricultural region, Tebo Regency encompasses approximately 500 hectares of rice fields and is one of the major rice-producing areas in Jambi Province, with an average annual surplus of 10,000–13,000 tons. To enhance agricultural productivity and efficiency, achieve sustainable rice self-sufficiency, and ensure an adequate supply of animal protein in Tebo Regency without harming the environment, an integrated rice-livestock system could be a viable option for agricultural development.

METHOD

The community service activities will involve identifying and evaluating the potential of the region and its farmers and cattle breeders, followed by determining the location for a cattle demonstration plot where cattle will be fed processed rice straw, and providing training on the use of rice straw waste as organic fertilizer and animal feed; establishing a livestock demonstration zone where cattle are fed processed rice straw; the establishment of cattle demonstration plots by providing processed rice straw as feed, and the creation of rice cultivation demonstration plots that combine organic fertilizers (cattle manure and urine) with inorganic fertilizers. Based on the targets and outcomes to be achieved in the community service activity regarding Improving Community Welfare Through the Development of an Integrated Rice-Beef Cattle System in Jati Belarik Village, Sumay Subdistrict, Tebo Regency.

RESULT AND DISCUSSION

The community service activities were carried out in stages, in accordance with the program's objectives. It should be noted that these community service activities are not intended to be one-time events but are expected to become regular, ongoing initiatives in Sumay Subdistrict, Tebo Regency.

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Education and Training

The educational and training sessions covered the use of rice straw as organic fertilizer and livestock feed. The extension activities were conducted using a lecture method followed by a discussion to provide solutions to the problems faced by the participants, as the objective of the extension program is to enhance participants' knowledge, while the objective of the training is to improve skills and influence attitudes and motivation to participate in farmer group activities (Kartasapoetra, 1991). The system used to conduct the extension program was a traditional classroom-based approach focused on theory and study. During the extension and training sessions, a symbolic handover of the training materials and equipment was also held and presented to the chairperson of the partner farmer group. The atmosphere of the extension session and the handover of materials and equipment are shown in Figure 1.

Figure 1. Documentation of the Educational Session and Distribution of Materials and Equipment for Processing Rice Straw into Organic Fertilizer and Livestock Feed
Source: Personal Documentation of the Team (2024)

Training on the Use of Rice Straw as Organic Fertilizer and Livestock Feed

The educational and training conducted as part of this community service initiative covered the use of rice straw as livestock feed and as a raw material for compost. The extension activities were conducted using a lecture format followed by interactive discussions, allowing participants' challenges to be identified and solutions provided on the spot. This approach aligns with the objectives of extension, namely, to enhance participants' knowledge, and with the training objectives, which focus on improving skills, changing attitudes, and fostering motivation to actively participate in farmer group activities (Kartasapoetra, 1994). The educational system employed is a traditional classroom-based approach, emphasizing the delivery of theoretical material as a foundation for understanding before practical exercises are conducted.

One of the training activities conducted focused on the use of rice straw as organic compost (Figure 2). As a byproduct of the harvest, rice straw has great potential as a raw material for environmentally friendly organic fertilizer. The use of compost has been proven to improve soil's physical, chemical, and biological properties and sustainably increase crop productivity (Megasari et al., 2024). The training activity began with a presentation on the potential and benefits of rice straw for crop cultivation, followed by a hands-on compost-making demonstration on the grounds of the Jati Belarik Village

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office, in collaboration with the Cahaya Melati Farmers' Group. Participants actively engaged in composting using materials such as chopped straw, EM-4, rice bran, molasses, and water, along with simple tools such as barrels, knives, raffia, lightproof plastic, and buckets. The process involved layering the straw in 20–25 cm-high layers, then evenly spraying water and decomposer solution over them, repeating this until the pile reached a height of about 80–90 cm. Next, the pile is tightly covered with dark plastic to maintain anaerobic conditions and is turned weekly to accelerate decomposition. Mature compost is characterized by a crumbly texture and is odorless, a state typically achieved within 3–4 weeks.

Figure 2. Training on the Use of Rice Straw as Organic Fertilizer
Source: Personal Documentation of the Team (2024)

In addition, the training program covered the use of rice straw as an alternative livestock feed, particularly to address forage shortages during the dry season (Figure 3). The use of agricultural waste as feed is an efficient strategy for providing affordable and sustainable feed (Fielding, 1985; Asra & Irwan, 2022; Ayuni & Widodo, 2023). Rice straw is abundantly available, with production reaching 10–12 tons per hectare per harvest or approximately 3–4 tons of dry matter, depending on the variety used (Asra & Irwan, 2022). However, the nutritional quality of rice straw is relatively low, necessitating efforts to improve it through various treatments, including physical, chemical, and biological methods. Physical treatments include cutting or chopping, while chemical treatments, such as alkali use, are known to improve fiber digestibility by breaking down lignocellulose bonds, although their use is limited by cost and the potential for hazardous residues (Fielding, 1985). Therefore, more environmentally friendly approaches, such as biological fermentation, are a more suitable alternative for farmers to adopt. Through this training, it is hoped that farmers will be able to optimize the use of straw waste, both as organic fertilizer and as a value-added livestock feed.

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Figure 3. Training on the Use of Rice Straw as Livestock Feed
Source: Personal Documentation of the Team (2024)

The treatment carried out in Jati Belarik Village used urea, which is a readily available source of ammonia. The advantage of this urea treatment is that, in addition to increasing nitrogen content through the addition of urea, its basic reaction can break down lignin-hemicellulose bonds (Schiere and Nell, 1993). Biological treatments for rice straw include composting, fermentation, and fungal cultivation. One easy method is open-air rice straw fermentation, where the straw is stacked in layers 20 cm thick; each layer is then sprinkled with a mixture of 2.5 kg of probiotics (e.g., Probion) and 2.5 kg of urea per ton of fresh straw, with a fermentation period of 21 days, which can increase the protein content from 3.5% to 7% and improve digestibility from 28–30% to 50–55% (Randu et al., 2024). Supplementing rice straw is crucial to meet livestock needs due to its low protein content. This protein deficiency can be supplemented with tree legumes, legume straw, or agricultural processing byproducts, all of which can serve as protein sources.

Establishment of a Livestock Pilot Zone

Through technological innovation in the “nutrient enrichment” of rice straw as livestock feed, particularly for cattle in Jati Belarik Village, a major rice-growing area and center for beef cattle production, this initiative will reduce dependence on the availability of grass and foliage. The establishment of a livestock demonstration zone using processed rice straw as feed, serving as a model for farmers and livestock breeders, is being implemented in RT 03 of Jati Belarik Village (Figure 4). The straw processing is carried out chemically using alkali, specifically NaOH and urea. The mechanism of alkali action on straw is: (1) breaking some of the bonds between cellulose and hemicellulose with lignin and silica, (2) “esterifying” acetyl groups to form uronic acids, and (3) restructuring the cell walls through the expansion of fiber networks, which in turn facilitates the penetration of microbial enzyme molecules (Komar, 1984). Processing rice straw with urea can increase its crude protein content (N × 6.25) by 1.5-9 percentage points and improve its digestibility by 10–15 percentage points.

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Figure 4. Pilot livestock zone using processed rice straw as livestock feed
Source: Personal Documentation of the Team (2024)

Establishment of a Cattle Demonstration Plot

The demonstration plot was established on land in Jati Belarik Village, measuring 50 m x 20 m (Figure 5). A demonstration plot is a method of agricultural extension for farmers that involves creating a model plot so farmers can observe and verify the demonstrated practices firsthand. The demonstration plot focused on innovations in rice straw processing technology and cattle farming. This demonstration plot activity was carried out to provide a concrete example of the rice straw processing process and the use of processed rice straw as livestock feed. The processed rice straw was fed to four cattle over a two-month rearing period. The cattle's weight gain was then measured to assess improvements in productivity and performance. The outcomes of this community service activity include the implementation of extension sessions and training on feed processing, as well as a demonstration plot for cattle rearing using processed rice straw as feed. Based on pre-test and post-test results, there was an increase in farmers' knowledge following the extension sessions. Additionally, beef cattle's body weight increased after feeding processed rice straw.

Figure 5. Demonstration Plot for Cattle Raising Using Processed Rice Straw as Feed
Source: Personal Documentation of the Team (2024)

Establishment of a Rice Production Demonstration Plot

The establishment of a rice production demonstration plot (Figure 6) that combines organic and inorganic fertilizers using the Integrated Crop Management (ICM) model, which involves thorough soil preparation, the use of new high-yielding varieties (VUB) with labels via the transplanting method (Tapin), a 2:1 staggered row planting system, planting spacing of 50 x 25 x 12.5 cm, 1–3 seedlings per hill, seedlings 18 days old after sowing, and inorganic fertilizer using NPK Kujang 30:6:8 at a rate of

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400 kg ha^{-1} applied twice, at five days and 35 days after planting. Crop management, including irrigation and pest and disease control, was conducted based on field conditions and in accordance with the Integrated Pest Management (IPM) concept. Weeding was performed manually using a hoe and a rake. Each treatment was distinguished by the use of organic fertilizer, specifically cow manure and urine sourced from livestock owned by residents of Jati Belarik Village. Based on the research results, the application of organic fertilizer increased yields by approximately 20%. This increase in yield is attributed to organic fertilizer, which improves soil nutrient content, making these nutrients available to plants and allowing them to grow optimally. Thus, the application of organic fertilizer is expected to improve both rice yield and quality in the study area.

Figure 6. A Rice Production Demonstration Plot Combining Organic and Inorganic Fertilizers
Source: Personal Documentation of the Team (2024)

CONCLUSION

The conclusion of this activity is that the community of Jati Belarik Village, Sumay Subdistrict, Tebo Regency, particularly the farmers' group, is enthusiastic about the community service program, specifically the training on utilizing rice straw waste as organic fertilizer and livestock feed. The practice of producing organic fertilizer and livestock feed has been implemented and has been successful. Furthermore, farmers can produce organic fertilizer and animal feed independently. The availability of this organic fertilizer can reduce the use of inorganic fertilizers. Additionally, with this technology, farmer groups can save on fertilizer costs and maintain soil fertility. The benefit of animal feed made from processed straw is that it increases cattle productivity through supplemental feeding, resulting in healthier, higher-quality cattle.

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