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COMPARATIVE OF GENERATED INCOME BETWEEN INTEGRATED AND NON-INTEGRATED FARMING IN BENGKULU PROVINCE, INDONESIA

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ABSTRACT
Combining crops and livestock can help farmers earn more money. The integrated rice and cattle farming system process livestock and rice waste into organic fertilizer and feed that is then repurposed in agriculture. This study aimed to compare the income generated by integrated and non-integrated rice-cattle agricultural businesses in Bengkulu Province. This study employed a survey method and was conducted in the Regencies of Seluma and Rejang Lebong, Bengkulu Province. We collected primary data from 200 rice and cattle farmers. The analysis of data used was the income function and the t-test. The integrated system earned Rp. 35,296,162.79/hectare/year, while the non-integrated system earned Rp. 30,213,253.52/hectare/year, a significant difference in income. The contributions and policies resulting from these findings are that integrated farming systems can be developed to boost farmer income, produce competitive agricultural products, and conserve natural resources.

KEY WORDS
Integrated farming, income, rice, cattle.

Rice is a critical national strategic commodity because it is the primary source of nutrition for the majority of the Indonesian population. Rice cultivation has developed into the primary source of income for the majority of the population and has eve n become ingrained in the culture. Beef cattle are ruminants that contribute significantly to the livestock sector as meat producers and to meeting food needs, particularly animal protein.

Through a cycle of rice fields, straw, cows, organic fertilizers, and back to rice fields, the cattle business integration system in rice fields aims to maximize the potential of regional resources in order to maintain land fertility. Each harvest season, abundant rice straw can be used as feed for cattle, while cows produce the basic ingredients for organic fertilizer that will be used to maintain the fertility of paddy fields. Thus, a rice field area can produce various products, including rice as the primary crop and rice waste in the form of bran and straw for processing into cattle feed. Additionally, it can produce livestock products such as meat and organic fertilizer as a by-product of its livestock business (Priyanti et al., 2001).

Soni et al., (2014) stated that the main characteristic of the integration of crops and livestock is a synergistic and mutually beneficial relationship between plants and livestock. Animal manure and urine are processed into compost, and plant waste such as straw and leaves can be processed into animal feed.

Through the Bengkulu Agricultural Technology Assessment Agency, the Ministry of Agriculture has conducted studies and pilot projects on integrated crop and livestock farming systems in Bengkulu Province. This study was conducted from 2014 to 2015 in Seluma Regency to apply rice and cattle integration and in Rejang Lebong Regency to integrate vegetables, rice and cattle.

Increasing farm production can be done by developing and adopting new technology and increasing farm cost efficiency. This is in line with Yotopoulos and Nugent (1976) in Kurniati et al. (2020). Production efficiency is the achievement of maximum output for using a certain amount of resources, where if the output produced is greater than the resources used, the higher the income achieved. Theoretically, maximum income can be increased by minimizing inputs or maximizing outputs (Coelli, 1998 in Kurniati et al.,(2021).

Although numerous studies have been conducted on the benefits of integrated farming, the reality on the ground is that many farmers have not implemented integrated farming, resulting in low farmer income. As a result, further research into developing an efficient and profitable integrated farming system and comparing the income of integrated and non-integrated systems is necessary, as one of the factors influencing farmers' decision to adopt technology is whether the technology is more profitable than alternative technologies.

The purpose of this study was to examine the income generated by integrated and unintegrated rice and cattle farming systems in Bengkulu Province and the income disparities between the two farming systems.

METHODS OF RESEARCH

This study employed the survey method, which is defined as research that draws samples from a single population and primarily collects data via questionnaires. (Singarimbun dan Effendi, 1989 in Kurniati et al., (2019). Questionnaires and structured interviews were used to collect data.

The research was conducted over an eight-month period in 2020, with locations purposefully representative of Bengkulu Province's agricultural area, namely the rice field center area in Seluma Regency and Rejang Lebong Regency, Bengkulu Province.

The study collected primary data directly from sample farmers via interview techniques and questionnaires, as well as secondary data from related institutions and agencies. Three methods are used to collect data: observation, interviewing, and recording.

Purposive sampling is a sampling technique that selects farmers who raise rice and cattle and meet the criteria for data sources. The number of samples taken is in accordance with the opinion of Roscoe in Sukiyono (2018), which states that if the sampling frame of the population is not clearly known, then the sample size is at least ten times the number of independent variables used. The study sampled up to 200 paddy rice farmers who also kept their own and rowdy cattle.

To calculate the costs, revenues and income of integrated and non-integrated farming, the profit function was used, referring to Hidayati et al., (2020) as follows:

$$\pi = TR - TC \quad (1)$$

$$TR = Q \times PQ \quad (2)$$

$$TC = FC + VC \quad (3)$$

Where: TR is the total revenue, Q is the total production of rice and cattle, PQ is the price of rice and cattle, TC is the total cost, FC is the fixed cost, VC is the variable cost, and π is the income.

Meanwhile, to analyze the comparison of income in integrated and non-integrated farming, a two-sample T test was used, which aims to compare the averages of two unrelated groups.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \quad (4)$$

Where: X1, X2 is the average income of integrated and non-integrated, n1, n2 is the number of integrated and non-integrated samples, and S1, S2 is the standard deviation of integrated and non-integrated.

RESULTS AND DISCUSSION

In the research location, the average area of rice farming land controlled by respondent farmers is 0.70 hectares. Owner farmers use their land not only for farming as a primary source of income but also for residential buildings and yards. They use the garden area to grow a variety of plants for family consumption, including ornamental plants, vegetables, oil palm plantations, and food crops. Table 1 shows the area of rice farming land.

Table 1 – Rice Farming Area (Hectares), the Year 2021

No.	Land area (Ha)	Number of Samples	Percentage (%)	Average (Ha)
1.	0,10 – 0,5	125	62,5	
2.	0,51 – 1,0	58	29,0	0,70
3.	1,10 – 1,5	10	5,0	
4.	1,51 – 2,0	7	3,5	
Total		200	100	

Source: Primary Data, 2021.

Farmers own an average of 4.99 head of cattle. Farmers who own cattle also use their yards to construct simple cages for their livestock and to construct simple structures for storing animal feed that will be given during the dry season when the grass is scarce. Generally, farmers keep beef cattle for fattening because they sell in a relatively short period, approximately 8-10 months. Additionally, beef cattle are not difficult to market because every Eid al-Adha, many cattle traders purchase farmers' cows; in fact, some of the cows were ordered long before Eid al-Adha.

Beef cattle production systems are typically semi-intensive, utilizing relatively permanent cages and consistent feeding. However, in some Semidang Alas Maras Subdistrict areas, farmers continue to raise cows to sell their calves. In general, this area's cattle ownership consists primarily of female cattle for breeding, and the cattle are either left loose in the field or at the edge of the garden. Table 2 shows the average number of cattle owned by farmers.

Table 2 – Cattle Ownership, the Year 2021

No.	Number of Cows	Number of people	Percentage (%)	Average
1.	1 – 5	142	71,0	
2.	6 – 10	41	20,5	
3.	11 – 15	12	6,0	4,9
4.	15 – 20	3	2,5	
5.	20 – 45	2	1,0	
Total		200	100	

Source: Primary Data, 2021.

The success of a farm can be determined by the farming process carried out by farmers in their capacity as producers. Agricultural production or farming entails various activities, each of which necessitates the sacrifice of what are commonly referred to as factors of production or inputs. Additionally, farmers' skills in input allocation are required to ensure that the production process runs smoothly and that the previously established goals are met. Farmers' abilities can be demonstrated through their experience managing farming, but they can also be demonstrated through other factors such as education, capital support, and the use of technology.

Farmers cultivate an average of 0.7 and 0.6 ha of land during the first and second planting seasons, respectively, with an average annual rental value of IDR 3,667,500. Meanwhile, the average annual depreciation cost for tools such as hoes, machetes, sickles, handsprayer, wheel ticks, and handtrackers is Rp 502,440. As a result, the total fixed cost for two seasons of rice planting is Rp. 4,169,940.

Seed is a critical input because it determines the amount of output farmers will obtain at the end of the farming season. Although the quality of the seeds will determine the level of output produced, efforts must still be made to coordinate the use of other inputs such as fertilizer and labor in the appropriate amounts and at the appropriate times. On the other hand, either non-existent or poor quality seeds will contribute to the crop's low yield.

Respondents used local rice seeds of the Sintanur and Inpari varieties at the research site. The average seed consumption during the first and second planting seasons was 39.48 kg and 32.30 kg, respectively, for a total of Rp. 662.665. Seeds were purchased from seed distributors by farmers individually or in groups through farmer associations. The *Legowo 2:1* and 4:1 *Jajar* Systems were used in the planting system.

Farmers have been unable to completely abandon the use of chemical fertilizers and pesticides until now. This is because land conditions are less fertile, and farmers report that organic fertilizers alone are not sufficient to boost productivity as expected. Farmers are accustomed to resolving agricultural problems through the use of chemical input-based cultivation technology. On the other hand, farmers perceive their financial capacity to purchase chemical inputs to be limited, as they are sometimes difficult to obtain and quite expensive at the research site.

The factor that motivates farmers always to use nitrogen fertilizers on their farms is the immediate effect of nitrogen fertilizers on plant vegetative growth. Plants become fertile, and the amount of fresh green and fertile vegetative growth at the end of the production process determines crop yields. As a result, farmers apply nitrogen fertilizers in amounts that occasionally exceed the recommended guidelines. Only a few farmers are aware that plants' true needs include nitrogen and macronutrients in the form of phosphorus and potassium, which are required for flowering, fruiting, and plant strength during the generative growth phase of plants. As a result, despite the fact that this nutrient is required in less quantity than nitrogen, not all farmers use it. Along with the farmers' understanding, which still needs to be improved, this is also because phosphorus and potassium fertilizers are more expensive than nitrogen and are sometimes scarce.

The average amount of organic fertilizer used in paddy fields in integrated farming is 828.15 kg and 560.83 kg (MT I and II), respectively, with a value of Rp. 664.020.50. The cost of organic fertilizer in the form of manure and compost is an implicit cost component, that is, costs that farmers do not pay in cash but are calculated as part of the farming analysis. This organic fertilizer is made by farmers from cattle business waste. The total fertilizer cost for two planting seasons is Rp. 2,392,875, which means that organic fertilizer accounts for 27.75 percent of farmers' total fertilizer costs.

According to Huda and Wikanta's (2017) research, the amount of compost required for rice fields is quite substantial, reaching 8-10 tons per hectare. Additionally, according to Huda and Wikanta's (2017) research, an adult cow produces between 8-10 kg of manure per day, or 2.6-3.6 tons per year, or the equivalent of 1.5-2 tons of organic fertilizer. Thus, five cows are required to produce organic fertilizer for one hectare of rice fields.

The average farmer in the study area owns 4.9 cows, but only 60% of farmers process cow dung into organic fertilizer. To supply rice plants with the nutrients they require, all farmers continue to use inorganic chemical fertilizers such as urea, ponska, and Kalium.

Many farmers continue to use chemical pesticides manufactured in factories, and only a few use organic pesticides derived from animal and vegetable urine. Regent and Prevathon insecticides were used at an average rate of 5.42 liters and 4.26 liters, respectively. Meanwhile, the first and second planting seasons saw 37.7 liters and 35.5 liters of biourine organic pesticides, respectively. Pesticide use costs Rp. 672,875 for two growing seasons.

Farmers generally raise local beef cattle, which mean they raise more bulls than female cattle. Farmers keep beef cattle because they can be sold in a short period of time, between 8 and 12 months. Typically, on Eid al-Adha, cows are sold for sacrifice. However, some farmers in Semidang District, Alas Maras continue to raise cows for the purpose of selling their calves, which results in farmers raising more female cows. Cattle farmers utilize inputs such as feed, medicine, tillers, and labor.

In cattle farming, the depreciation cost of equipment is Rp. 432,490 per production period. Along with fattening cattle, tools such as shovels, buckets, broomsticks, compost houses, tubs, and tarpaulins are used for compost and biourine processing. Meanwhile, the average cost of a cage covering an area of 6 M^2 is IDR 1,381,795 per cage. Cattle farming has a total fixed cost (FC) of Rp. 1,814,285 per production period.

Beef cattle production is more semi-intensive, with cows kept in permanent cages and fed regularly. This is done to increase the cow's weight rapidly. In comparison to cows used for breeding or the sale of their calves, the rearing system is typically less intensive, with the cows being allowed to roam freely in the field or at the edge of the garden and forage for food on their own.

Cattle feed consumption varies significantly by study site, and the average cattle owner owns 4.9 heads. The total cost of animal feed for a 12-month production period is Rp. 3,246,450. Cows are fed grass in quantities up to 3,045.6 kg at a cost of Rp 1,218,275 and rice straw in quantities up to 1,623.5 kg at a cost of Rp 649,400. They were then supplemented with bran and concentrate at the cost of Rp. 389,575 and Rp. 956,850 per 324.65 kg and 277.35 kg, respectively. At the research site in South Seluma Subdistrict, some farmers use palm oil waste, referred to as solid, as an animal feed additive. The amount of solid used is minimal, at approximately 161.75 kg per production period at a cost of Rp 32,350.

Grass, rice straw, bran, and solids from the remaining oil palm bunches can be used to feed cattle. Farmers in the Seluma district, which is densely forested with oil palms, typically use the remaining palm fruit bunches, dubbed solid, as additional feed for cattle. However, farmers in the Rejang Lebong Regency do not use solid fertilizer due to the absence of oil palm plantations. Some farmers in Rejang Lebong supplement their cattle feed with bran.

Farmers frequently feed their cows a mixture of straw, solid (palm waste), grass, and bran. However, farmers do not always provide this combination, as feeding is determined by the availability of feed owned by farmers. According to Diwyanto (2000), one hectare of rice fields can produce approximately 10 – 20 tons of straw (fresh weight at harvest and season dependent) and is used to feed up to 1-2 adult cows throughout the year. Meanwhile, Haryanto et al. (2002) report that up to 5-8 tons of rice straw per hectare per harvest can be fed to adult cattle at a rate of 2-3 heads per year. If rice is cropped twice a year, it can meet the feed requirements of 4-6 cows throughout the year. Additionally, farmers can overcome the issue of feed availability by utilizing plant waste such as rice straw, which can provide up to 33.3 percent of the total grass required (Kariyasa, 2003).

The results showed that the average non-integrated farm income was Rp. 30,213,253.52/hectare/year, while the income of the integrated system was Rp. 35,296,162.79/hectare/year. The results of this study indicate that there is an increase in income of 16.83 percent in the integrated system. Revenues, production costs and revenues are presented in table 3.

Table 3 – Integrated and Non-Integrated Farming Revenue (Rp/Ha/Year)

No.	Types	Integrated UT	Non-integrated UT
1.	Paddy Agricultural Business		
•	Money Received	32.157.275,40	33.177.276,25
•	Cost	13.895.712,07	12.157.235,75
•	Income	18.261.563,33	21.020.040,50
2.	Cattle Agricultural Business		
•	Money Received	42.561.150.50	45.026357,53
•	Cost	30.609.460,20	30.750.235,30
•	Income	11.951.690,30	14.276.122,29
Total Revenue		30.213.253,52	35.296.162,79

Source: Primary Data Processed, 2021.

According to Table 3, non-integrated rice farming generates more revenue. This is because the use of chemical fertilizers is relatively high in non-integrated farming, which results in increased production. However, integrated farming has lower production costs than non-integrated farming. This is because farmers use a lot of organic compost and biourine from cow dung in their paddy fields, which reduces their reliance on chemical fertilizers and pesticides. Fertilizer costs were reduced by 27.75 percent in integrated farming, resulting in a higher income from rice farming in integrated systems than in non-integrated systems.

The cattle industry demonstrates a greater acceptance of the integrated system, as it sells additional products such as manure, compost, and biourine in addition to cattle products. Meanwhile, the integrated system's production costs are comparable to those of the non-integrated system, resulting in a higher income in the integrated system.

Farmers have not utilized waste in a non-integrated system, where rice and cattle farming are conducted separately. Straw from rice harvests is discarded or burned, not fed to cows. Meanwhile, farmers have been unable to process cow waste due to a lack of skills, labor, and collection difficulties. Farmers in the Semidang Alas Maras area keep cows that are only released to search for food, which makes collecting feces and urine difficult. Additionally, a small number of farmers lack the manpower necessary to process waste, as all labor is dedicated to the farming production process.

Farmers who raise cattle in a detached system generally do not implement an integrated system, in which rice and cattle waste are not mutually used. This is because farmers struggle to collect cow waste when cows are allowed to roam freely in the field or garden. On the other hand, farmers have avoided using rice straw as cattle feed, believing that cows can eat enough weeds in the field or garden.

Farmers in non-integrated research locations have not used compost or biourine made from cow urine. This is because it takes a long time, approximately one planting period, to see the effects of new organic fertilizers on the land. Additionally, because the production of organic fertilizer from cow dung takes approximately one month, farmers in need of fertilizer quickly will purchase chemical fertilizers directly from the fertilizer kiosk, rather than having to make compost first.

Meanwhile, integrated farming systems earn more than non-integrated farming systems. This is because, in addition to rice and cattle production, additional revenue is generated through the sale of compost and biourine. Additionally, there is a savings of up to 27.75 percent in fertilizer costs when chemical fertilizers are replaced with compost and biourine. These findings corroborate Howara's (2011) research in Majalengka, West Java, and Priyanti et al(2008).'s findings that integrated farming can reduce inorganic fertilizer use by 25–35 percent.

According to Howara's (2011) research, beef rice integration farming can boost farmers' income. Rice farmers who use organic fertilizer made from fermented cow dung earn Rp. 1.45 million per growing season, which is more than rice farmers who do not use organic fertilizer. This is because the use of organic fertilizers results in a reduction in the use of inorganic fertilizers, which results in lower production costs.

According to Priyanti et al. (2008), farmers earned Rp. 3.3 million per hectare by using organic fertilizers up to 2 tons/hectare in combination with urea, ZA, and KCl fertilizers in lowland rice farming. Priyanti added that because inorganic fertilizers are becoming more expensive, farmers should balance their use of organic and inorganic fertilizers.

Cattle integration with rice crops is a common practice among farmers in Bengkulu. Cattle excrete feces and urine, with the feces being used as an organic fertilizer for rice plants. Urine is another component of cow waste. Urine can be processed to create liquid fertilizer and organic pesticides for rice plants. Rice plants, on the other hand, generate agricultural waste such as straw, husks, groats, and bran. Straw and rice bran are both suitable for cattle feed (Wibawa, 2015).

For caged beef cattle, some farmers construct cages in their yards to keep them separate from rice fields. Farmers, on the other hand, continue to practice an integrated system in which rice waste in the form of straw is used as cattle feed, cow waste in the form of feces is composted, and cow urine is converted into biourine and then reused for rice farming. For farmers with large plots of land, the cage is constructed adjacent to rice fields. If the cowshed and rice fields are located in the same stretch, the integration system will be easier to implement.

According to Al Mamun et al., (2012; and Manjunatha et al., (2014), the livestock crop integration system has several advantages in addition to the primary yields of rice and cattle, including the following: (1) livestock can be used as labor, (2) continuous planting with compost derived from livestock waste helps improve soil fertility, and (3) crop waste from harvested crops can be used as animal feed. This is demonstrated by (Howara, 2011) in Majalengka, West Java and (Priyanti et al., 2001) in integrated farming, which showed an increase in rice production of 20-29 percent and was able to reduce the use of inorganic fertilizers by 25-35 percent, 0.7 kg / head / day. In addition, adult cows can produce 4-5 tons of wet manure/year. Manure is processed into compost as much as 2 – 2.5 tons of compost/cow/year. The compost produced is reused in the rice fields, where 1 hectare of rice fields requires 1.5 – 2 tons of compost. The use of compost will improve the physical properties of the soil and, at the same time, will reduce the use of chemical fertilizers, which are relatively expensive.

The results show that the income of integrated rice and cattle farming was higher than that of non-integrated farming. To find out the difference in average income in the two systems, the analysis of the average difference test (t-test) is used, which is presented in table 4.

Table 4 – Test of Average Income Difference between Integrated and Non-Integrated Farming

Description	Integrated UT	Non-Integrated UT
Total Sample Income	129	71
(Rp/Ha)	35.296.162,79	30.213.253,52
t count	-2,035 *	
Sig (2-tailed)	0,043	

Source: Primary Data Processed, 2021.

According to the average difference test results, the t-count value is -2.035 with a Sig (2-tailed) value of 0.043 0.05, indicating that there is a statistically significant difference in the income of an integrated rice and cattle system and a non-integrated system, where the integrated system's income is higher than the non-integrated system's income or integrated systems are more profitable than non-integrated systems.

The advantage of integrated agriculture is that it can significantly reduce the use of chemical inputs, thereby lowering production costs. Additionally, there will be no waste because other components will reuse the material. Apart from cost savings, another advantage of integrated farming is that farmers will have multiple revenue streams. Rice can be grown and a farmer can raise cattle. Livestock manure can be used as fertilizer, allowing farmers to reduce their reliance on chemical fertilizers. If the rice harvest fails, farmers can still earn money by selling cattle.

Farmers overcome the issue of feed availability in the rice and cattle integration model by utilizing plant waste such as rice straw and bran. The advantage of utilizing waste is that it not only increases feed security, particularly during the dry season but also reduces labor costs associated with grazing activities, allowing farmers to expand their livestock raising scales.

The utilization of cow dung as organic fertilizer in addition to being able to save the use of chemical fertilizers is also able to improve the structure and availability of soil nutrients. This impact can be seen in the increase in land productivity. Study results of Kurniati et al. (2020) show that the rice and cattle integration model developed by farmers in Bengkulu can reduce the use of inorganic fertilizers by 25-30 percent.

Seluma Regency, Bengkulu Province, is a rice and cattle development center with 14,845 hectares of paddy fields, including 7,786 hectares of irrigated paddy fields, 6,286 hectares of rainfed rice fields, 225 hectares of tidal swamps, and 548 hectares of lebak swamps, as well as 19,122 cows (BPS, 2019). Study results in Seluma Regency has an abundant supply of straw for natural animal feed. Rice straw production can range between 12 and 15 tons per hectare per harvest, depending on the location and variety of rice plants used (Kurniati et al., 2019)). Rice straw produced can be used as feed for up to 2-3 heads of adult cattle throughout the year, and in locations capable of harvesting twice a year, can meet the demand for fibrous feed for 4-6 heads per hectare of rice fields. One adult cow can produce up to 2 tons of solid organic fertilizer per year.

Lowland rice farming technology enables the use of processed cow dung from beef cattle fattening operations as an organic fertilizer. Additionally, the use of straw and bran as alternate feed sources for beef cattle demonstrates that production costs can be reduced. Rice straw, which is available throughout the year in large quantities at low prices, can be used in place of cattle feed.

Along with rice and live cattle sold for the festival of sacrifice, integrated farming generates revenue from the sale of manure, compost, and biourine. There are 129 farmers who sell manure and compost, or 64.5 percent, while those who process urine into biourine are still few in number, at around 31 people, or 15.5 percent. The low number of farmers processing biourine is due to the difficulty farmers face when collecting urine from cage-free cattle. Additionally, urine processing requires technology and additional labor, requiring farmers to incur labor costs in addition to those associated with cattle raising.

Revenues from manure and compost processing, as well as biourine processing, remain relatively small at Rp. 1,347,400 and Rp. 1,412,500 per year, respectively, representing only 3.1 percent and 3.2 percent of total revenue from livestock business.

According to Howara's (2004) research, farmers' incomes can be increased through rice-beef integration farming. Rice farmers who use organic fertilizer made from fermented cow dung earn Rp. 1.45 million per growing season, which is more than rice farmers who do not use organic fertilizer. This is because the use of organic fertilizers results in a reduction in the use of inorganic fertilizers, which results in lower production costs.

Additionally, cow dung as a source of manure can be a valuable by-product. Manure can be used as an organic fertilizer for rice plants, allowing the fertilizer to be used to fertilize and improve agricultural land. Utilizing livestock manure as an organic fertilizer can improve soil fertility, which has a beneficial effect on crop yields, thereby enabling competitive and environmentally friendly agribusiness efforts toward a more sustainable ecological system.

Farm technology and management can help farmers reduce production costs if they are used effectively. However, there are some technologies that do not result in cost savings if farmers use them inefficiently (Bayramoglu & Gundogmus, 2008).

According to the study of Jafrizal et al., (2018) in Selupu Rejang Subdistrict, Bengkulu Province, beef cattle and dairy cattle can produce an average of 11.4 and 13.4 kg/head/day of feces, respectively. 4-6 kg of organic fertilizer per day can be produced from this cow dung. To achieve high productivity with organic cultivation technology, an organic fertilizer rate of approximately 3.6 t/ha/season is required, which can be met by four cows. Along with feces, another type of livestock waste that can be used as fertilizer or biopesticide is urine. On average, a cow excretes 5 liters of urine per day. Additionally, this urine has economic value when processed into liquid fertilizer or biopesticide. Urine can serve a dual purpose, acting as a fertilizer for rice plants and a pesticide for nuisance organisms.

Yesmawati et al. (2019) indicates that feces and urine are used in conjunction for rice cultivation. Prior to integration, farmers applied phonska fertilizer at rates of up to 300 kg/ha and urea at rates of up to 200 kg/ha, along with synthetic pesticides. Once integrated, farmers use up to 150 kg/ha of phonska and 100 kg/ha of urea (semi-organic cultivation technology) and no inorganic fertilizers (organic cultivation technology). The remainder compensated for the use of livestock manure as fertilizer at rates of up to 3,600 kg/ha (semi-organic) and 7,200 kg/ha (organic), as well as the use of biopesticides derived from cow urine. Utilization of livestock waste has the potential to significantly increase revenue for organic rice and cattle farming. From the perspective of rice plants, the requirement for organic fertilizer/compost, which ranges between 3.6 and 7.2 tons/ha at a high cost, can be met through the livestock kept. Similarly, rice bran and straw are used as cattle feed after they are integrated. Additional feed is fermented from concentrate bran and hay.

Rice-cow integration is theoretically advantageous from both an economic and environmental standpoint. Economically, it can increase profits by meeting some or all of the fertilizer requirements for rice plants with livestock waste. Environmentally and qualitatively, the use of manure or organic materials means that they have conserved land by maintaining the biological, chemical, and even physical fertility of the soil (Ansar & Fathurrahman, 2018; Mukhlis, Melinda Noer, Nofialdi, 2018).

From a product standpoint, high-quality products can be produced that are safe for consumers' health due to their low toxic residues. According to Priyanti et al. (2011), small-scale livestock-plant farming in an agro-ecosystem of irrigated rice fields covering an area of 0.30-0.64 ha with an average of two cows per household increases household income and the livestock business's contribution to total household income reached 40%.

In the research location, there are still farmers who have not implemented the integration system. Several obstacles cause farmers not to implement the integration system, including:

- Limited knowledge of farmers regarding rice and cattle integration systems;
- The availability of labor is limited and still depends on labor in the family;
- The use of chemical inputs, both fertilizers and pesticides, is still high, because it is easy to obtain and the effect can be seen more quickly for farming;
- The cattle rearing system is not yet intensive, making it difficult to process cow waste into organic fertilizer.

Cattle development is not optimal in the research location. Farmers limited knowledge and skills, a lack of utilization (processing and supply) of agricultural waste-based feed, and a lack of cattle breeding businesses are all common problems in cattle development. Cattle breeders in Bengkulu generally keep cows for two purposes: fattening and breeding. There is a fundamental distinction between fattening and breeding, most notably in the purpose and maintenance management, particularly in rations/feeds provision.

Numerous studies document the shortcomings or constraints of livestock crop integration systems. According to results study in China, the reliance on imported feed was more significant than the use of internally processed feed. This demonstrates that farmers are resource-constrained and cannot generally convert crop waste to animal feed (Goswami et al., 2016). Meanwhile, Kumara et al. (2017) state in Kumara et al., (2017) that there are four primary impediments to adopting the livestock crop integration system are as follows: (1) The lengthy transition period of between 3-10 years required to implement the system, during which farmers experience a decline in production and income. (2) A lack of human resources, particularly in small families, impedes the implementation of integration techniques. (3) The absence of land security rights. (4) The disincentives to implementing an integrated system such as a lack of government subsidies, credit for fertilizer and herbicide use. Munandar et al., (2015) add to this weakness by stating that crops and livestock frequently require different land types and climates, increasing management costs. Additionally, the effect of organic fertilizer on plants is quite long, lasting up to three to four times the growing season (Muliarta, 2016), posing a barrier to farmers adopting an integrated system (Yuliani, 2014).

CONCLUSION

In Bengkulu Province, integrated farming systems based on rice and cattle generate a higher income than non-integrated farming systems. Additionally, there is a significant income disparity between integrated and non-integrated farming. According to the study's findings, farmers should practice integrated farming in addition to increasing income and achieving sustainable agriculture.

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