

Economic Value of Utilizing Manure in Yogyakarta Goat and Sheep Farmers Association: A Partial Budgeting Approach

Trisnanda Fredinabila Ramadhani¹, Tian Jihadhan Wankar², Tri Anggraeni Kusumastuti^{2*}

¹Graduate School of Animal Science, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia

²Department of Livestock Socio-economics, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia

*Correspondence Email: trianggraeni@ugm.ac.id

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ABSTRACT

The utilization of livestock manure from goat and sheep farming presents significant opportunities for farmers to increase the value of their production. This study aimed to identify the various uses of manure by-products, assess their economic impact, and examine factors influencing the sale of these by-products. The sample included 53 respondents, selected through convenience sampling from active members of the Yogyakarta Goat and Sheep Farmers Association (PPKDY). These farmers, engaged in both household and smallholder farming systems, had at least one year of experience and participated in interviews. Data were analyzed using a descriptive quantitative approach, with partial budgeting used to assess the economic impact. Additional income was generated through the sale of both fermented and non-fermented compost, with costs covering raw materials, processing, packaging, and labor. Multiple linear regression analysis was conducted to determine factors influencing manure sales. Results showed that respondents were of productive age (20-64 years), had high education levels, and 5-7 years of farming experience. The most common use of manure was as compost fertilizer and applied to agricultural land, as farmers also grew feed crops and other plants. Economic analysis revealed that non-fermented compost earned IDR 11,050 per sack, while fermented compost earned IDR 14,550 per sack. The study found that factors such as sale type and livestock numbers significantly affected manure sales ($P < 0.01$), with education also influencing sales ($P < 0.05$). This research highlights the importance of recognizing manure as an income source and encourages increased collaboration and technical support through PPKDY.

Keywords: *by-product, compost, livestock manure, partial budgeting, sales*

BACKGROUND

Goat and sheep farm is a promising sector to be developed in Indonesia. As the country with a majority of Muslim population, Indonesia use goats and sheep as sacrificial animals during Ei dal-Adha. Additionally, goat and sheep meat is a popular culinary choice among the community. Therefore, goat and sheep farm should be optimized not only in terms of primary products such as meat, milk, and livestock, but also in terms of secondary products (by-products). One of the issues faced by farmers in Special Region of Yogyakarta is the underutilization of manure by-products. According to Khoshnevisan et al. (2021) it remains as an issue to upgrade manure's organic matter because of the high investment costs, operating parameters, manure collection, and digestate management have hindered its developments in rural areas in developing countries.

For example, many farmers discard livestock manure into local rivers, which causes environmental issue (Hu et al. 2017). This issue can be mitigated through principles of circular economy, which advocates for minimizing waste, reusing resource, and recycling materials to create economic value. By integrating circular economy practices, livestock manure can be transformed into valuable products, contributing to both environmental sustainability and economic growth. Circular economy defined as an economic system that shifts away from the 'end-of-life' model by focusing on reducing, reusing, recycling, and recovering materials throughout production, distribution, and consumption to achieve sustainable development, promoting environmental quality, economic prosperity, and social equity for both current and future generations (Kirchheerr et al., 2017).

In support of SDGs 13 on climate action, the utilization of livestock manure can help minimize waste, reduce carbon emissions, and close the loop in agricultural systems. Based on the population of goats in D.I Yogyakarta, assuming that each goat produces 4 kg of manure per day (Ibrahim et al., 2022), the total manure generated by 466,759 goats would amount to 1,867,036 kg per day. Meanwhile, the manure from sheep would be 561,592 kg per day. If projected monthly, the total manure from goats and sheep in D.I. Yogyakarta would be 72,858,840 kg per month, or 72,858.84 tons per month. This figure is then linked to complaints from the local community in D.I. Yogyakarta regarding livestock waste, including the residents of Kampung Wisata Kali Gajah Wong, who have raised concerns about the large amount of manure from goats. This has become a significant issue that disrupts daily activities, highlighting the need for better waste management that is also economically viable (Rubiyatno et al., 2023).

Manure by-products can be used for various products with market value. Livestock urine can be processed into liquid organic fertilizer that positively impacts plant growth complementing each other with solid organic fertilizer (Dwiyanti et al. 2025). Goat and sheep feces can be converted into biogas due to its carbon-to-nitrogen (C/N) ratio of 20-25% (Junaidi et al., 2020). In addition to being used as biogas, manure can be processed into organic fertilizer. Goat manure, for example, contains 2.43% nitrogen, 1.35% potassium, 0.73% phosphorus, 0.56% magnesium, 1.95% calcium, 291 ppm zinc, 42 ppm copper, 468 ppm manganese, and 2,891 ppm iron (Safuad et al., 2022). Other references show that goat feces contain 0.95% nitrogen, 0.35% P_2O_5 , and 1.00% K_2O , while goat urine contains 1.35% nitrogen, 0.05% phosphorus, 2.10% potassium, and 85% water (Kusumastuti et al., 2022). Shivakumara & Kiran (2019) compared the economic aspects of goat and sheep farming using extensive, semi-intensive, and intensive systems. They found that manure by-products generated the highest income in the intensive system, followed by the semi-intensive and extensive systems, with the smallest income from manure in the latter. Kusumastuti et al. (2022) analyzed the potential and additional income from processing goat manure into compost using partial budget analysis. A similar study by Ponnusamy & Devi (2017) applied partial budget analysis to assess additional income from utilizing feces and urine from cattle, buffalo, sheep, goats, pigs, and chickens. Other studies have linked such research to the Sustainable Development Goals (SDGs), a global commitment to improve welfare through 17 goals set for 2030. Washaya & Washaya (2023) found the production of biomethane effectively eliminates pathogens and odors, while the resulting digestate has high fertilizer value, helping to mitigate the environmental impacts associated with goat manure. On the other hand, if manure is properly utilized, it can serve as a source of additional income for farmers.

Selling manure can generate additional income for farmers, with manure being sold at around IDR 3,000 per sack (50 kg capacity) (Zulfiah, 2015). If processed into compost, the price increase to IDR 5,000 per sack (Khandari & Jahroh, 2015). Furthermore, liquid organic fertilizer produced from livestock manure can be sold from IDR 5,000 per bottle (Azzahra & Sufriadi, 2023). Research by Hida et al. (2023) states that livestock group in North Sumatra generated an additional income of IDR 5.600.000 per year from selling goat manure and fertilizer.

Many farmers in the Special Region of Yogyakarta are members of Yogyakarta Goat and Sheep Farmers Association (PPKDY), an organization that serves as a platform for farmers to exchange information, ideas, and experiences, as well as engage in discussions. PPKDY continues to develop the potential of its members through training programs and even the establishment of the PPKDY cooperative. On November 24-25, 2021, PPKDY representatives visited training facilities, including a compost production site and biogas installation. This initiative was further followed up by PPKDY Chairman, Mr. Sufyan Tsauri, who prepared 37 member-owned farms as Independent Rural Agriculture Training Center (P4S). However, despite these initiatives, there has been no commercial trade of manure by-products by PPKDY to date. Therefore, the aim of this research are to identifies the types of by-product utilization implemented by farmers, analyzes the additional income generated from utilizing goat and sheep manure by-products, and examines the factors that influence the sale of these by-products. The novelty of this research lies in examining the actions taken by goat and sheep farmers, particularly those involved in a livestock association, in utilizing manure by-products. Unlike previous studies that focus solely on the utilization of manure, this research explores how being part of an association may influence farming practices. Specifically, it will investigate whether members of the association adopt similar manure management practices compared to independent farmers. This distinction is significant, as association membership could provide additional resources, training, and shared knowledge that may lead to different approaches in manure utilization, setting this study apart from others that have not considered the role of collective farming groups.

RESEARCH METHODS

The research was conducted in goat and sheep farms located in the Special Region of Yogyakarta (DIY). The location was selected using a convenience sampling method, based on the criteria of farms that are members of Yogyakarta Goat and Sheep Farmers Asssocation (PPKDY) in the Special Region of Yogyakarta. The selected farms were active in farming, registered as members of PPKDY, utilized either household or small-scale farming systems, had at least one year of farming experience, and were willing to participate in interviews. The research was carried out from August 2024 to September 2024.

The research instruments used were interviews and questionnaires. The questionnaires consisted of structured questions with predefined answer options. The interviews were conducted through face-to-face verbal interactions, aimed at obtaining high response rates and gaining a more detailed understanding of the conditions at the farms. Interviews were conducted with 53 goat and sheep farmers who were members of PPKDY, consisting of 7 goat farmers, 29 sheep farmers, and 17 farmers raising both goats and sheep. The sampling method used was convenience sampling.

The data collected for identifying the utilization of livestock manure by-products includes activities related to the use of manure by-products and the extent to which these by-products are utilized to increase income. In this study, partial budgeting analysis of livestock manure by-product utilization was conducted in goat and sheep farms of PPKDY members in Special Region of Yogyakarta. Data were gathered on the daily production of manure by-products, production costs associated with the utilization of these by-products, income, expenses, and revenue from their use, as well as the additional or net income generated. The framework for partial budgeting analysis of livestock manure by-product utilization is as follows:

Table 1. Framework for Partial Budget Analysis of Livestock Manure By-Product Utilization

No.	Added returns (A)	Added costs (B)
1.	Compost Fertilizer	Raw material
2.	Liquid Organic Fertilize	Labor cost
3.		Processing cost
4.		Transportation cost
5.	Total additional income:	Total additional costs:
Change in income:		
Conclusion/Recommendations:		

Source: Digiacomo *et al.*, 2021

To analyze the factors influencing the amount of sales generated from the utilization of goat and sheep manure by-products, statistical methods were employed. Regression analysis is a technique used for forecasting as well as examining the relationships between variables (Ningsih & Dukalang, 2019). Multiple linear regression analysis is used when more than one independent variable is applied to the dependent variable (Kurniawan, 2016). In this study, multiple linear regression analysis was used to determine the factors that influence the amount of sales generated from the utilization of goat and sheep manure by-products. The data was analyzed using SPSS 30.0 version, which included multiple linear regression analysis along with classical assumption tests such as normality test, heteroscedasticity test, and multicollinearity test, as well as hypothesis testing. The multiple linear regression model utilized in this study is as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + D_1 + D_2 + e$$

(Lena, 2025)

Information:

- Y : Sales of fertilizer (unit of 25 kg sack per month)
- a : Constant
- b_1 - b_3 : Regression coefficients
- X_1 : Livestock population
- X_2 : Formal education
- X_3 : Farmer's knowledge of livestock manure by-product
- D_1 : Dummy for type of sale
- D_2 : Dummy for agriculture land ownership
- e : Standard error

Table 2. Variable Operational Definitions

	Variable	Scale	Operational Definitions
X ₁	Livestock population	Interval	The total number of sheep and goat owned or managed by the respondent is quantified by converting it into Animal Units (AU). Animal units are used to standardize and express stocking rates among different kinds and classes of livestock.
X ₂	Formal education	Ordinal	The education level of respondents was categorized into four levels: 1 for those who had completed primary school, 2 for those who had completed junior high school, 3 for those who had completed high school, and 4 for those who had completed a university degree or equivalent education.
X ₃	Farmer's knowledge of livestock manure by-product	Ordinal	The knowledge of farmers refers to how they understand livestock manure by-products, from general concepts to their specific utilization. This knowledge is divided into three categories: low (0-3 correct answers), medium (4-7 correct answers), and high (8-10 correct answers).
D ₁	Dummy for type of sale	Nominal	1: Owns land; 0: Does not own land
D ₂	Dummy for agriculture land ownership	Nominal	1: Fermented fertilizer; 0: Non-fermented fertilizer

Operational Boundaries

1. Goat farmers include dairy goat farmers, breeding goat farmers, and meat goat farmers, while sheep farmers include breeding sheep farmers and fattening sheep farmers.
2. According to Sleman Regional Regulation No. 1 of 2017, household farming systems involve livestock operations with fewer than 15 animals, while smallholder farming systems involve operations with 15 to 299 animals.
3. Livestock waste refers to the waste produced in the form of manure and urine from animals.
4. The number of livestock includes the total number of goats and/or sheep owned by the PPKDY farmers.
5. Formal education refers to the structured, hierarchical, and officially recognized education pathway undertaken by farmers, which includes primary school, junior high school, senior high school, and higher education.
6. Farmer knowledge includes general knowledge related to livestock by-products, methods of processing and utilizing animal waste, characteristics of processed animal waste products, and the impacts of utilizing livestock waste.
7. Land ownership refers to the land owned by farmers for cultivating food crops, horticultural plants, or forage plants.
8. Fermented fertilizer is made from animal waste that undergoes a fermentation process, while non-fermented fertilizer is made from animal waste that only undergoes drying without any additional materials.
9. Prices during the study period are considered fixed.

RESULT AND DISCUSSION

Farmer's Characteristic of Yogyakarta Goat and Sheep Farmers Association Members

The data on farmer's characteristic as presented in Table 3 reveals that all farmers were within the productive age range of 20-64 years, in line with Vereswati et al. (2024), who defined productive age as 20-64 years, with those over 65 considered non-productive. Ukkas (2017) and Rosyida et al. (2021) also noted that age affects productivity and the adoption of innovations in manure by-product utilization. However, some farmers believe that anyone who wishes to take the manure is welcome to do so, even offering to clean the barns in exchange. Others view giving livestock manure to friends, fellow farmers, or local communities as a form of social relationship.

The farmers' education level plays an important role in their productivity. Of the 53 farmers, 10 household farmers and 27 smallholder farmers had higher education degrees. Studies by Fitria & Vega (2018) indicate that education influences farmers' mindset, knowledge, and entrepreneurial ability, including the use of livestock manure by-products. Respondents with higher education believe that utilizing manure can serve as a continuity in their business, providing additional income or being used for feed crops and personal agricultural land.

Table 3. Farmer's Characteristic of Yogyakarta Goat and Sheep Farmers Association Members

Characteristic	Household Farmers		Smallholder Farmers	
	Freq. (n=18)	%	Freq. (n=35)	%
Age (years)				
20-64	18	100,00	35	100,00
>64	0	0	0	0
Education				
No formal education	0	0	0	0
Primary school	1	5,56	0	0
Junior High School	2	11,11	0	0
High School	5	27,78	8	22,86
Higher education	10	55,56	27	77,14
Household size (Persons)				
1-2	0	0	5	14,29
3-4	13	72,22	19	54,29
5-6	5	27,78	8	22,86
7-8	0	0	3	8,57
Farming experience (years)				
2-4	2	11,11	9	25,71
5-7	8	44,44	14	40,00
8-10	7	38,89	7	20,00
11-13	0	0	2	5,71
14-16	1	5,56	2	5,71
17-19	0	0	1	2,86

Source: Primary Data, 2024

Regarding household size, 13 household farmers and 19 smallholder farmers had 3-4 family members. Ijatuyi et al. (2017) states that household size is frequently viewed as a key factor affecting productivity. Although the majority of PPKDY farmers have 3 to 4 family members, only one or two

people, typically the husband and/or wife, manage the farming business. Their children are either still in school, married, or employed elsewhere. As a result, it is usually the farm owner or the barn workers who handle the manure processing. According to Aziz et al. (2019), it is stated that farmers run their farming businesses by involving only immediate family members, and it is believed that additional labor is required to process manure.

In terms of farming experience, 8 household farmers and 14 smallholder farmers had 5-7 years of experience. According to Muharastri et al. (2015), this experience influences farmers' decision-making, including in utilizing manure by-products. Overall, PPKDY farmers are in their productive age, have higher education, a household size of 3-4 members, and 5-7 years of farming experience. Respondents tend to utilize the potential of livestock manure by-products as a way to optimize business income and apply the knowledge gained through training, socialization, and the experiences of other PPKDY farmers in utilizing manure by-products.

Non-formal education, represented by the farmers' knowledge of goat and sheep manure by-products as presented in Table 4 was assessed through 10 statements in a questionnaire. Respondents indicated whether the statements were true or false, and the answers were categorized based on the number of correct responses: high (8-10 correct answers), medium (4-7 correct answers), and low (0-3 correct answers).

Table 4. Knowledge Category of PPKDY Farmers

Category	Household Farmers		Smallholder Farmers	
	Freq.	%	Freq.	%
High	15	83,33	23	65,71
Medium	3	16,67	12	34,29
Low	0	0,00	0	0,00

Source: Primary Data, 2024

According to the results, the knowledge of manure by-products of PPKDY farmers in DIY showed relatively high levels, 83.33% of household farmers and 65.71% of smallholder farmers demonstrated good knowledge. This suggests that farmers have a solid understanding of manure by-products. As stated by Abeykoon et al. (2025) farmers with a high education more likely have a higher knowledge. Overall, PPKDY farmers in DIY are well-informed about goat and sheep manure by-products and their potential uses. Based on the data obtained, PPKDY farmers are technically aware of the production process. However, they still lack knowledge about the characteristics of the compost fertilizer and liquid organic fertilizer, as well as the use of liquid organic fertilizer on crops. According to Mangalisu & Arma (2019), farmers find it more practical to use solid fertilizer for their agricultural land.

Utilization of Goat and Sheep Manure By-Product

The data on the utilization of goat and sheep manure by-product as presented in Table 5 reveals that the most commonly utilized livestock manure by-products among PPKDY farmers with a household farming system are used on their own land, with 50% (9 farmers) of the respondents reporting this practice. In contrast, smallholder farmers primarily utilize manure by-products in the form of compost fertilizer sales (28.57%) and pure manure sales (28.57%). There are two farmers in Economic Value of Utilizing Manure (Ramadhani et al., 2025)

each category who do not utilize these by-products. Some farmers produce various manure by-product products based on market demand and consumer needs. The use of goat and sheep manure as Liquid Organic Fertilizer (LOF) has the advantage of containing nitrogen (N) and potassium (K) in quantities twice as high as cow manure (Warintan et al., 2021). Goat manure contains 2.27% N, 1.35% P, 3.34% K, 10.36% Organic Carbon, a C/N ratio of 27.04%, and 27.04% moisture (Adhitya, 2017).

Table 5. Utilization of Goat and Sheep Manure By-Product

Utilization Type	Household Farmers		Smallholder Farmers	
	Freq.	%	Freq.	%
Not utilized	2	11,11	2	5,71
Sales				
a. Raw livestock manure	3	16,67	10	28,57
b. Compost fertilizer	2	11,11	10	28,57
c. Liquid Organic Fertilizer	1	5,56	2	5,71
d. Planting media	1	5,56	2	5,71
Used on own agricultural land	9	50,00	9	25,71

Source: Primary Data, 2024

Manure by-products used as planting media are categorized as organic planting media. According to Dakiyo et al. (2022), planting media made from a mixture of soil, rice husk charcoal, and goat manure in a 1:1:1 ratio yields the best results compared to other planting media. This is because rice husk charcoal improves soil porosity, and goat manure enhances nutrient content, thus increasing plant productivity. Most farmers use livestock manure as fertilizer for feed crop, agricultural, and personal plantation lands to save on fertilizer costs and due to the difficulty in obtaining subsidized fertilizers. On the other hand, Busthanul et al. (2023) states that 46,46% of the fertilizer subsidy policy's effectiveness is ineffective. This aligns an opportunity for livestock farmers to develop manure fertilizer processing as an alternative with the concept of sustainable agriculture, which integrates farming and livestock practices. According to Velten et al. (2015), sustainable agriculture is defined as a system that integrates plant and animal production practices. The long-term goal of this system is to meet food security needs while improving environmental quality. Sustainable agriculture also aims to use non-renewable resources and local resources efficiently by integrating the cycles of livestock and farming. Additionally, sustainable farming focuses on maintaining the economic viability of agriculture and improving the quality of life for farmers and the broader community. Jiang et al. (2022) state that organic fertilizers, such as compost, can improve soil fertility, agricultural product quality, and plant productivity, making them an ideal alternative to chemical fertilizers. Beyond enhancing land and crop productivity, according to Ratriyanto et al. (2019), organic fertilizers also help reduce the costs associated with land maintenance.

Economic Value of Utilizing Goat and Sheep Manure By-Product

Based on the results as presented in Table 6, Table 7, Table 8, and Table 9 two tons of livestock manure are produced over a period of 3 months from a herd of 8 animals, yielding 2.52 kg of manure per animal per day. According to Mujiyo & Suryono (2017), a goat can produce 50 kg of

manure per day, or 1.5 tons per month. For compost production, 1 ton of goat and sheep manure is mixed with 2 liters of EM4 or M21, and 1.5 liters of molasses are added. Probiotic starter (1 kg) and dolomite (10 kg) are then used to initiate fermentation. Afterward, the mixture is ground and packaged in 50 kg sack, which are then sewn shut. Typically, PPKDY farmers use recycled feed or flour bags due to their lower cost. However, one of the PPKDY members operates as a compost producer, selling it at the PPKDY cooperative for Rp 25,000 per 20 kg sack.

Table 6. Partial Budget for Processing Non-Fermented Compost for 25 kg Sack in Household Farmers

No.	Added returns (A)	Price (IDR/sack)	Added costs (B)	Price (IDR/sack)
1.	Compost Fertilizer	15.000	Manure non-fermented	0
2.			Labor cost (per person)	2.000
3.			Grinding cost	200
4.			Used sack (sack)	1.500
			Sewing cost (per sack)	250
5.	Total additional income:	15.000	Total additional costs:	3.950
Change in income:		IDR 11.050/sack		
Conclusion/ Recommendations:		The utilization of livestock manure has the potential to serve as an additional source of income for farmers on a monthly basis. If it is assumed that 22 sacks can be produced per month, the additional income would be: IDR 11,050 x 22 = IDR 243,100 per month.		

Source: Primary Data, 2024

Table 7. Partial Budget for Processing Fermented Compost for 25 kg Sack in Household Farmers

No.	Added returns (A)	Price (IDR/sack)	Added costs (B)	Price (IDR/sack)
1.	Compost Fertilizer	25.000	Manure	0
2.			EM4 (0,05 L)	30.000/L = 1.500
3.			Molasses (0,375 L)	10.000/L = 3.750
4.			Dolomit (2,5 kg)	5.000/10 kg = 1.250
5.			Labor cost (per person)	2.000
6.			Grinding cost	200
7.			Used sack (sack)	1.500
			Sewing cost (per sack)	250
8.	Total additional income:	25.000	Total additional costs:	10.450
Change in income:		IDR 14.550/sack		
Conclusion/ Recommendations:		The utilization of livestock manure has the potential to serve as an additional source of income for farmers on a monthly basis. If it is assumed that 337 sacks can be produced per month, the additional income would be: IDR 14,550 x 22= IDR 320,100 per month.		

Source: Primary Data, 2024

Table 8. Partial Budget for Processing Non-Fermented Compost for 25 kg Sack in Smallholder Farmers

No.	Added returns (A)	Price (IDR/sack)	Added costs (B)	Price (IDR/sack)
1.	Compost Fertilizer	15.000	Manure non-fermented	0
2.			Labor cost (per person)	2.000
3.			Grinding cost	200
4.			Used sack (sack)	1.500
			Sewing cost (per sack)	250
5.	Total additional income:	15.000	Total additional costs:	3.950
Change in income:		IDR 11.050/sack		
Conclusion/ Recommendations:		The utilization of livestock manure has the potential to serve as an additional source of income for farmers on a monthly basis. If it is assumed that 337 sacks can be produced per month, the additional income would be: IDR 11,050 x 337 = IDR 3,723,850 per month.		

Source: Primary Data, 2024

Table 9. Partial Budget for Processing Fermented Compost for 25 kg Sack in Smallholder Farmers

No.	Added returns (A)	Price (IDR/sack)	Added costs (B)	Price (IDR/sack)
1.	Compost Fertilizer	25.000	Manure	0
2.			EM4 (0,05 L)	30.000/L = 1.500
3.			Molasses (0,375 L)	10.000/L = 3.750
4.			Dolomit (2,5 kg)	5.000/10 kg = 1.250
5.			Labor cost (per person)	2.000
6.			Grinding cost	200
7.			Used sack (sack)	1.500
			Sewing cost (per sack)	250
8.	Total additional income:	25.000	Total additional costs:	10.450
Change in income:		IDR 14.550/sack		
Conclusion/ Recommendations:		The utilization of livestock manure has the potential to serve as an additional source of income for farmers on a monthly basis. If it is assumed that 337 sacks can be produced per month, the additional income would be: IDR 14,550 x 337= IDR 4,903,350 per month.		

Source: Primary Data, 2024

The assumption for monthly fertilizer sack production is based on a daily manure output of 2.52 kg per animal, the monthly manure production per animal is 75.6 kg, which equates to 236.62 kg per Animal Unit (AU). Therefore, the additional income from fermented compost fertilizer in household farming is IDR 320,100 per month, while non-fermented compost fertilizer yields IDR 243,100 per month. In smallholder farming, the additional income from fermented compost fertilizer is IDR 4,903,350 per month, and from non-fermented fertilizer, it is IDR 3,723,850 per month.

According to Washaya & Washaya (2023) and Kusumastuti et al. (2022), goat and sheep manure can provide additional income through sales. When considering the advantages and disadvantages, the benefits of fermented compost include the fermentation process, which helps prevent spoilage and increases nutrient content. This is supported by Wijaksono et al. (2016), who found that fermentation reduces the C/N ratio compared to fresh manure while boosting phosphorus (P) and potassium (K) content. Due to the lower C/N ratio, fermented compost can be used as fertilizer that will not burn plants. Additionally, the fermentation process reduces the number of pathogenic bacteria on plants (Holaj-Krzak et al., 2024). The use of dolomite in fermented compost also improves soil productivity by neutralizing soil acidity. According to Armaini & Purba (2018), dolomite adds calcium (Ca) and magnesium (Mg) and displaces H⁺ ions at the colloidal surface, thus neutralizing soil pH. However, one drawback of fermentation is that it increases methane (CH₄) levels, contributing to greenhouse gas emissions. This was noted by Puastuti et al. (2021), who reported that the fermentation process in compost raises CH₄ concentrations. Despite this, the fermentation process enhances product quality, increases shelf life, and improves plant yields compared to non-fermented compost.

In the context of Circular Economy (CE), the use of livestock manure for composting aligns with key CE principles by promoting resource recovery, reducing waste, and supporting sustainable agricultural practices. CE encourages a shift from a linear "take, make, dispose" model to a more circular approach where materials and products are kept in use for as long as possible, extracting maximum value from them while in use and then recovering and regenerating products and materials at the end of each service life. In this case, utilizing livestock manure as a resource for composting directly supports the CE framework by converting what would otherwise be considered waste into valuable, nutrient-rich fertilizer. This process reduces the environmental burden associated with chemical fertilizers and promotes sustainable farming practices. Furthermore, by creating additional income opportunities from the sale of compost, CE principles contribute to the economic prosperity of farmers, particularly in smallholder and household farming systems, while simultaneously supporting environmental sustainability.

However, for a more effective transition to a circular economy, improving the labeling and marketing of compost products becomes essential. As mentioned by Aprilia et al. (2021), proper labeling can enhance consumer awareness and increase purchasing decisions, which can, in turn, expand the market for these circular products. Jumawan et al. (2021) and Sitio & Rochdiani (2022) further emphasize that labeling plays a critical role in product identity and helps distinguish products in a competitive marketplace, thus supporting the broader goal of fostering a more sustainable and circular agricultural sector.

Determinant Factors That Affecting The Sales of Goat and Sheep Manure By-Product

This section presents the result of the multiple linear regression and summarized in Table 10. The results suggest that the variable of livestock population has a positive and significant effect on the amount of manure sold. The more livestock a farmer has, the greater the amount of manure they will produce and sell. This aligns with Dananjaya (2020) statement that as the amount of goat manure produced increases, the processing into organic fertilizer also increases, thus providing additional income for farmers.

The variable of formal education has a positive and significant effect on manure sales. This means that the higher the farmer's formal education level, the more likely they are to sell the manure

byproducts. Saputra et al. (2024) explain that higher levels of formal education lead to more mature thinking, behavior changes, improved business management skills, and better decision-making, all of which make farmers more inclined to optimize the utilization of goat and sheep manure by selling the fertilizer.

The variable of knowledge has no significant impact on manure sales. This suggests that although farmers may have knowledge of manure byproducts and their utilization, they do not always implement it. According to Sari and Al-Hafiz (2024), knowledge alone is not enough; awareness and practical implementation are necessary to optimize the use of manure. Another reason could be the high labor costs associated with manure processing, which may hinder farmers even those with higher education from fully implementing manure utilization.

Table 10. Demographic Determinants Affecting The Sales of Goat and Sheep Manure By-Product

Variable	Unstandardized Coefficients		Standardized Coefficients Beta	T	Sig.
	B	S.E			
(Constant)	27.862	16.881		1.651	0.106
Dummy variable for type of sale	-12.342	3.638	-0.366	-3.392	0.001***
Knowledge	-6.577	3.776	-0.185	-1.742	0.088
Livestock population	0.191	0.71	0.307	2.714	0.009***
Dummy variable of land ownership	-8.496	7.694	-0.123	-1.104	0.275
Formal education	6.353	2.575	0.259	2.467	0.017**

Information:

*** = highly significant (P<0.01)

** = significant (P<0.05)

Source: Porcessed Data, 2024

The equation for the multiple regression model is generally written as follows:

$$Y = 27,862 + 0,191X_1 + 6,353X_2 - 6,577X_3 - 12,342D_1 - 8,496D_2 + e$$

Information:

Y : Sales of fertilizer (unit of 25 kg sack per month)

a : Constant

b₁-b₃ : Regression coefficients

X₁ : Livestock population

X₂ : Formal education

X₃ : Farmer's knowledge of livestock manure by-product

D₁ : Dummy for type of sale

D₂ : Dummy for agriculture land ownership

e : Standard error

The dummy variable for the type of manure sold whether fermented or non-fermented shows a significant negative effect. This indicates that the sale of non-fermented manure is 12.342 units Economic Value of Utilizing Manure (Ramadhani et al., 2025)

higher than fermented manure. Non-fermented manure is easier to process, quicker, does not require large spaces, and has lower costs compared to fermented manure. Additionally, farmers may have limited labor and space for processing, as most only involve one or two family members in the farming operation, while others may still be in school, married, or employed elsewhere. Therefore, the manure processing is typically handled by the farm owner or a farm worker. Aziz et al. (2019) note that farmers typically run livestock operations with only close family members involved, and manure processing often requires extra labor. Thus, to improve the efficiency of manure processing, PPKDY could set up a dedicated facility for processing goat and sheep manure collectively from its member farms, as suggested by Soadikin et al. (2019), who argue that livestock groups help promote collective manure processing.

The dummy variable for land ownership whether or not the farmer owns land shows that farmers with land have lower manure sales (8.496 units) than those without land. This is because some farmers prefer to practice “livestock farming without harvesting” (not producing their own forage), relying more on concentrated feed or purchasing silage instead of using fresh forage. Farmers believe that fresh forage is more costly in terms of maintenance, labor, and weather dependence, compared to concentrated feed. Kuswoyo (2017) explains that sourcing forage by hand is labor-intensive and weather-dependent, making it less efficient than using concentrated feed. In conclusion, the number of livestock and formal education positively influence the sale of goat and sheep manure byproducts, while the farmer's knowledge negatively impacts sales. Farmers tend to sell non-fermented manure more frequently and, in general, those with land are less likely to sell manure products.

CONCLUSION AND SUGGESTION

The utilization of goat and sheep manure by-products is primarily used to increase plant productivity, sold in its raw form, and processed into compost. The economic analysis of production planning using the partial budget method for processing manure into non-fermented compost results in an additional income of IDR 12,100 per sack or IDR 689,700 per month, while fermented compost generates IDR 14,550 per sack or IDR 829,350 per month. The dummy variable for the type of sale and the number of livestock has a positive and highly significant effect ($P < 0.01$), while formal education has a positive and significant effect ($P < 0.05$) on the sales of goat and sheep manure by-products. Furthermore, to increase the income of goat and sheep farmers in PPKDY, in addition to periodic socialization on the benefits and added value of manure by-products, technical guidance should be provided on product processing technology, post-production packaging, labeling, and product certification through coordination with educational institutions, government agencies, and the private sector. To address the limitation of labor, PPKDY could provide a processing facility for the manure by-products from its member farmers, allowing for more efficient and collective processing.

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