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# Research Article
# Tangible Benefits of Etawah Crossbred Goat Manure Utilization in Yogyakarta Indonesia

[1]Tri Anggraeni Kusumastuti, [2]Rochijan, [3]Nanung Agus Fitriyanto and [1]Rini Widiati

[1]Department of Livestock Social Economics, Faculty of Animal Sciences,
Universitas Gadjah Mada, Jl. Fauna No. 3, Bulaksumur, Yogyakarta 55281, Indonesia
[2]Department of Animal Production, Faculty of Animal Sciences,
Universitas Gadjah Mada, Jl. Fauna No. 3, Bulaksumur, Yogyakarta 55281, Indonesia
[3]Department of Animal Products Technology, Faculty of Animal Sciences,
Universitas Gadjah Mada, Jl. Fauna No. 3, Bulaksumur, Yogyakarta 55281, Indonesia

## Abstract

**Background and Objective:** Local farmers in Indonesia predominantly raise these goats to support their income, earn savings and improve their livelihoods, this can come from the sale of goats, kids, meat, milk and solid and liquid fertilizers. This study aimed to quantify the tangible benefits of solid and liquid fertilizers from Etawah crossbred goat manure and determine the influencing factors at the village-breeding centre of Etawah crossbred goat in Samigaluh District, Kulon Progo Regency, Yogyakarta, Indonesia. **Materials and Methods:** A total of 100 respondents were purposively selected from the two major livestock groups of Akursari and Agung Menoreh in Ngargosari Village and Pagerharjo Village, respectively and directly interviewed using questionnaires. Tangible benefits were studied using descriptive quantitative analysis and influencing factors were examined using multiple linear regression (MLR). **Results:** The average goat ownership of 12.81±7.58 heads (1.40±0.83 Animal Unit) produced 4.375 kg/day of faeces and 8.75 L/day of urine. Waste utilization generated an income of IDR 1,122,088/month including IDR 278,608 (24.83%) from solid fertilizer and IDR 843,480 (75.17%) from liquid fertilizer. A significant difference was observed between goat ownership and household members ($p<0.01$). Tangible benefits were significantly affected ($p<0.05$) by dummy non-formal education and dummy job. **Conclusion:** In summary, goat manure utilization is an opportunity to improve farmers' income.

Key words: Etawah crossbred goat, farmers' income, goat farmers, manure, solid and liquid fertilizers, tangible benefit, waste utilization

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Corresponding Author: Tri Anggraeni Kusumastuti, Department of Livestock Social Economics, Faculty of Animal Sciences, Universitas Gadjah Mada, Jl. Fauna No. 3, Bulaksumur, Yogyakarta 55281, Indonesia



Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Etawah crossbred goats (Peranakan Etawah) are Indonesian local goats crossbred from Kacang goat and Jamnapari goat that are widely distributed nationwide[1]. Local farmers predominantly raise these goats to support their income, earn savings and improve their livelihoods[2]. Even under harsh environments, Etawah crossbred goats can still maintain their growth and reproductive performances to produce meat and milk[3]. In Indonesia, this breed is preferred for meat production to supply protein products nationwide[4]. Female goats are reared for milking and reproduction and selected male goats are signed up for animal contests[5].

Manure is collected by farmers as fertilizer for their crops[6]. Goat faeces and urine contain higher potassium than other livestock wastes[7]. Manure compost through land application is beneficial to increasing maize productivity. Renewable fertilizer increases plant growth and reduces the cost for farmers[8]. Compared with cattle manure, goat manure used in vegetable gardens has relatively shorter exposure to weather elements such as gaseous losses and rain leaching. This finding explains why goat manure is better than cattle manure[9].

Manure composting is an optimal technique for solid biomass waste management that can reduce the risk to the environment and human health[10]. According to their chemical arrangement, fertilizers are classified as either inorganic/chemical or organic. The former is composed of one or a combination of several components or chemicals processed through a manufactured plant and the latter is known as compost or the final/intermediate by-product from plant or livestock materials.

The continuous use of inorganic fertilizers will disrupt the physical properties of the soil. One way to maintain a balance between the physical and chemical properties of the soil and prevent land damage is conservation by using organic fertilizers or compost[11].

Goats are one of the most potent livestock for organic fertilizer procurement at the village level where they are easy to buy and raise on backyard farms. The quality of manure indicates its ability to supply nutrients to the soil or plant for yield improvement[9]. Goat faeces contain 40-50% dry matter and 1.20-2.10% nitrogen. Goat manure consists of 67% solid and 33% liquid and has the following elemental composition: 0.95% nitrogen (N), 0.35% $P_2O_5$ and 1.00% $K_2O$[12]. Goat urine waste contains 1.35% nitrogen (N), 0.05% phosphorus (P), 2.10% potassium (K) and 85% water[13]. Thus, both types of fertilizers provide profitable responses to farmers[14].

Samigaluh District, Kulon Progo Regency, Yogyakarta, Indonesia is located in the upland area (>250-1,000 m asl) nearby Menoreh Hills with a land slope rate of >15-40%. Samigaluh District, which is a highland area, has a relatively low average daily temperature and thus is not suitable for the cultivation of Etawah crossbred goats[15]. Given that the majority of goats are kept in confinement, farmers cannot collect their manure in large quantities that provide tangible benefits. Only a few breeders are familiar with the technology of correctly processing faeces and urine into fertilizer. Hence, they sell compost and liquid organic fertilizer for PE goats at IDR 10,000/sack for compost and IDR 18,000/bottle of liquid fertilizer. Compost can be used in many potential crops to increase the value of integrated agriculture-livestock waste utilization through innovation and multiply the income of farmers. Examples include legumes, such as *Calliandra haematocephala* and *Gliricidia sepium* and non-legumes, namely, cassava and weeds (nature grass). This study aimed to quantify the tangible benefits of solid and liquid fertilizers from Etawah crossbred goat manure and determine the influencing factors. Research on the importance of intangible benefits, namely, the added value of sewage, is expected to bring additional value to the household economy.

## MATERIALS AND METHODS

**Location:** This study was conducted at the village-breeding centre of Etawah crossbred goats in Samigaluh District, Kulon Progo Regency, Yogyakarta, Indonesia. This district has the largest population of goats comprising 4,422 males and 10,692 females, which is equivalent to one-quarter of the total goat population in Kulon Progo (60,211 heads)[15].

**Data collection:** Samples of solid and liquid fertilizers were collected and then analyzed at the Laboratory of Waste and Environment Technology, Faculty of Animal Sciences and Laboratory of Analytical Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada, Indonesia from May to August, 2017.

Two villages of Ngargosari and Pagerharjo breeding Etawah crossbred goats were selected as the sample population. Respondents consisted of two livestock groups with the largest number of members, namely, the Akursari and Agung Menoreh groups from Ngargosari and Pagerharjo villages, respectively. A total of 100 farmers were purposively selected according to their activities of utilizing goat manure in solid and liquid fertilizers. Primary data were collected through interviews using questionnaires.

**Data analysis:** Descriptive method was used to identify farmer profile, livestock ownership and tangible benefits of compost and liquid fertilizer. Multiple linear regression (MLR) analysis was adopted to determine the tangible benefits of waste treatment by applying the following equation[16]:

$$Y = \alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+D_1+\beta_4X_4+D_2+D_3+\beta_5X_5+\mu$$

Where:

Y = Tangible benefit waste treatment (IDR/month)
α = Intercept
$\beta_1,...\beta_4$ = Regression coefficient
$X_1$ = Age (year)
$X_2$ = Formal education (score)
$X_3$ = Experience (year)
$D_1$ = Dummy of non-formal education
1 = Participate in the extension program of waste treatment
0 = Other
$X_4$ = Number of family (person)
$D_2$ = Dummy of job
1 = On farm
0 = Other
$D_3$ = Dummy of location
1 = Pagerharjo village
0 = Ngargosari village
$X_5$ = Goat ownership (head)
μ = Stochastic disturbance term

Regression coefficient was estimated with ordinary least squares and then tested using R-square, F-test and t-test[17,18].

## RESULTS AND DISCUSSION

**Demographic characteristics of Etawah crossbred goat farmers:** The farm household characteristics of Etawah Crossbred goat farmers were shown in Table 1. The farmers were aged between 47 and 52 years and had experience in raising goats for more than 20 years. Tauer[19] studied farmer productivity life cycle in the US and found that productivity first increases and then decreases with age. At the age of 55 years, they may fail to adopt new technology and replenish their capital stock. Therefore, farmer regeneration and persuasion targeted to the youth to participate in goat farming are crucial in sustaining the family farming business.

The average number of farm household members was 3-4. Men contribute to farming activities and women are responsible for the majority of household work and often participate in farming. Thus, the majority of labour is provided by family members, although hired labourers are also used. This finding was similar to the study of Fanelli[20], who reported that women are considered substantial labourers on rural farms.

The majority of the farmers are elementary school graduates, thereby implying their relatively low education level. Several farmers have achieved higher education and a few are illiterate. According to Nzabakenga *et al.*[21], the low education level of farmers affect their income. However, the respondents in the present study are actively participating in training, seminar, or counselling to improve their farming skills. Similarly, Eric *et al.*[22] reported that extension service aids rural farmers in receiving information and adopting technology to improve their competency.

Formal education, number of families, type of work and livestock ownership are the factors that influence waste utilization. The level of formal education affects the use of waste, that is, a high education level allows farmers to easily adopt new innovative technology for waste utilization[23]. Meanwhile, a low level of education leads to the lack of knowledge of farmers about the benefits derived from waste treatment and technology for waste treatment[24]. The number of livestock ownership also influences the use of waste, that is, having a large number of livestock forces farmers to perform practical actions compared to spending time and energy utilizing waste. The number of family members has a positive effect on waste utilization. If the number of family members increases, then the utilization of waste also increases. The number of family members is correlated to the potential labour for farming carried out by farmers[25]. The type of work affects the farmer's time in the use of waste. Farmers who have a non-agricultural main job will devote much of their working time to their main job[26].

Table 1: Socio-economic profiles of goat farmers in two villages of Ngargosari and Pagerharjo, Kulon Progo, Yogyakarta, Indonesia

| Variables | Ngargosari | Pagerharjo |
|---|---|---|
| Number of farmers (n) | 50 | 50 |
| Farmer's age (year) | 47.88±10.20 | 52.28±11.04 |
| Experience in raising goats (year) | 22.54±14.22 | 28.66±14.42 |
| Household members (n) | 3.58±1.43 | 4.14±1.03 |
| **Farmer's formal education (%)** | | |
| Illiteracy | 2.0 | 4.0 |
| Elementary school | 46.0 | 66.0 |
| Junior high school | 22.0 | 20.0 |
| Senior high school | 26.0 | 8.0 |
| College | 4.0 | 2.0 |
| **Farmers non-formal education (%)** | | |
| Yes | 80.0 | 46.0 |
| No | 20.0 | 54.0 |
| **Primary occupation (%)** | | |
| Government employee | 4.0 | 0.0 |
| Private sector worker | 0.0 | 2.0 |
| Casual laborer | 8.0 | 0.0 |
| Farmer | 88.0 | 98.0 |

Table 2: Data ownership of Etawah crossbred goats in two villages of Ngargosari and Pagerharjo, Kulon Progo, Yogyakarta, Indonesia

| | Ngargosari | | Pagerharjo | | Average | |
|---|---|---|---|---|---|---|
| Animal status | Head | AU | Head | AU | Head | AU |
| Buck | 1.48±1.05 | 0.24±0.17 | 1.52±0.91 | 0.24±0.15 | 1.50±0.97 | 0.24±0.16 |
| Pregnant | 1.86±0.83 | 0.30±0.13 | 2.53±1.48 | 0.40±0.24 | 2.27±1.30 | 0.36±0.21 |
| Lactation | 1.72±1.02 | 0.28±0.16 | 1.65±1.09 | 0.26±0.17 | 1.67±1.06 | 0.27±0.17 |
| Dry doe | 1.60±0.63 | 0.26±0.10 | 2.06±1.14 | 0.33±0.18 | 1.84±0.95 | 0.30±0.15 |
| Young doe | 1.25±0.62 | 0.10±0.05 | 1.91±1.23 | 0.15±0.10 | 1.68±1.09 | 0.13±0.09 |
| Male kid | 1.70±0.82 | 0.04±0.02 | 1.90±0.91 | 0.05±0.02 | 1.81±0.87 | 0.05±0.02 |
| Female kid | 1.85±0.97 | 0.05±0.02 | 2.21±1.59 | 0.06±0.04 | 2.04±1.33 | 0.05±0.03 |
| Total | 11.46±5.95 | 1.26±0.66 | 13.77±8.35 | 1.50±0.90 | 12.81±7.58 | 1.40±0.83 |

AU: Animal unit

The majority of the farmers are raising goats. They preferably keep small animals that are convenient to buy and maintain and yield manure to be used as fertilizer. The farmers also implement crop-livestock systems wherein animals are fed with crop by-products or other plant materials. According to Bhatti *et al.*[27], income from crop and livestock are insufficient to support farmer livelihoods. Therefore, the farmers in the present study utilize manure in solid and liquid fertilizers, which boost crop production and serve as an additional source of income.

The superior crops in Kulon Progo plantations include cash crops, namely, coffee (*Coffea* sp.), tea (*Camellia sinensis*) and coconut (*Cocos nucifera*), food crops, namely, rice (*Oryza sativa*), corn (*Zea mays*) and cassava (Manihot esculenta), medicinal plants and ornamental chrysanthemum (*Chrysanthemum* sp.). These crops are a good opportunity for farmers to market fertilizers. The plants commonly fed to goats are calliandra (*Calliandra calothyrsus*), gamal (*Gliricidia sepium*) and rubber cassava (Kendal: Javanese). Feed is usually given in the afternoon around 16.00-17.00 WIB. Leftover feed is then used to mix fertilizer. The livestock group is a permanent supplier of PT. Pagilaran cultivates tea and chrysanthemum commodities. Owing to their lack of certification, problems in the commercialization of solid and liquid fertilizers have aroused. Therefore, information must be provided on the packaging and labelling that contains nutritional content. The selling price of liquid fertilizer in 1L/bottle packaging is IDR 22,000 and that of solid fertilizer is IDR 15,000/sack with a capacity of 20 kg. Therefore, the production of liquid fertilizer must be increased because it has benefits and a high selling price that will increase farmers' income.

**Tangible benefits of raising Etawah crossbred goats and utilizing their manure:** Data on Etawah crossbred goat ownership were shown in Table 2. The average number of goat ownership was used to determine the availability of manure as the main material for making solid and liquid fertilizers. The average goat ownership was 12.81±7.58 head or 1.40±0.83 AU. The largest average ownership was attributed to doe, which is projected to replace non-productive doe. However, doe cannot be sold for the replacement and financial needs of farmers. Breeders prefer to sell male goats due to their higher market demand and price compared with a doe. According to Msalya *et al.*[28], the number of dairy goats was 311.8 and 218 g/day for mature and grower goats, respectively.

Sewage waste utilization is important to support land conservation efforts and simultaneously increase farmers' income. This finding is following the study of Said[29], who stated that livestock waste as the result of livestock business has the potential to be managed into organic fertilizers, such as compost, to increase environmental carrying capacity, enhance crop production and reduce the impact of pollution on the environment. Soyer and Yilmaz[30] stated that if storage and handling are carried out properly, then the livestock manure waste management system can minimize risks to the environment. Stevens *et al.*[31] stated that the use of livestock manure could increase farmers' income.

According to Maghfoer *et al.*[32], goat manure contains an adequate amount of nutrients for optimal plant growth. Faeces and urine are the main components of solid and liquid fertilizers, respectively. Both fertilizers are added with effective microorganism 4 (EM4) and molasses solutions to expedite the degradation of organic materials. Hence, sacks and bottles are needed for packaging. Table 3 shows the tangible benefits of utilizing goat manure as fertilizer.

Only 30% of 6 kg of faeces are needed to produce solid fertilizer and the remaining will be discarded as agricultural waste. The components are mixed in a small pit. In 1 month, 22 sacks of compost can be produced with a retail price of IDR 15,000/sack (at 20 kg/sack). For liquid fertilizer, only 25% of 8.75 L/AU/day can be used because the animals are kept in confinement. In a month, farmers can produce 66 bottles of liquid fertilizer with a retail price of IDR 20,000/bottle. Therefore, goat manure produces tangible benefits for farmers.

Table 3: Tangible benefits of utilizing manure in solid and liquid fertilizers

| Components | Amount | Price (IDR) | Total (IDR) |
|---|---|---|---|
| Solid (compost) fertilizer (per sack) | - | - | 15,000 |
| Liquid fertilizer (per bottle) | - | - | 22,000 |
| **Costs of solid fertilizer** | | | |
| Faeces (kg) | - | - | - |
| $EM_4$ (L) | 0.013 | 22,000 | 286 |
| Molasses (L) | 0.067 | 10,000 | 670 |
| Yarn and needle (n) | 1 | 250 | 250 |
| Sack (n) | 1 | 1,000 | 1,000 |
| Gasoline (L) | 0.021 | 6,500 | 130 |
| **Costs of liquid fertilizer** | | | |
| Urine | - | - | - |
| $EM_4$ (L) | 0.011 | 22,000 | 220 |
| Molasses (L) | 0.05 | 10,000 | 500 |
| Bottle (n) | 1 | 3,300 | 3,300 |
| Label (n) | 1 | 1,200 | 1,200 |
| **Total cost** | | | |
| Solid fertilizer | - | - | 2,336 |
| Liquid fertilizer | - | - | 5,220 |
| **Income** | | | |
| Solid fertilizer (per sack) | - | - | 12,644 |
| Liquid fertilizer (per bottle) | - | - | 12,780 |

EM4: Effective microorganism

Table 4: Regression analysis of factors influencing the tangible benefits

| Variables | Coefficient | Std. Error | t–value | Probability |
|---|---|---|---|---|
| (Constants) | 11.89 | 0.64 | 18.59 | 0.00*** |
| Farmers age ($X_1$) | –0.23 | 0.18 | –1.30 | 0.20 |
| Formal education ($X_2$) | –0.05 | 0.10 | –0.52 | 0.60 |
| Dummy non-formal education ($D_1$) | 0.17 | 0.08 | 2.03 | 0.05** |
| Experience ($X_3$) | 0.04 | 0.05 | 0.85 | 0.40 |
| Number of family ($X_4$) | 0.45 | 0.11 | 4.16 | 0.00*** |
| Dummy job ($D_2$) | 0.24 | 0.10 | 2.46 | 0.02** |
| Dummy location ($D_3$) | 0.05 | 0.08 | 0.61 | 0.54 |
| Goat ownership ($X_5$) | 0.69 | 0.10 | 7.00 | 0.00*** |
| R-squared | 0.80 | | | |
| Adjusted R-squared | 0.78 | | | |
| F–statistic | 45.19 | | | |
| Prob (F–statistic) | 0.00*** | | | |

***, ** and * denote significance at the 1, 5 and 10% levels, respectively

Based on the above findings, the farmers' income from selling 22 sacks of compost and 66 bottles of liquid fertilizer in a month was IDR 278,608 (at sack IDR 12,664) and IDR 843,480 (at bottle IDR 12,780), respectively. The total tangible benefit is IDR 1,122,088/month (24.83% of solid and 75.17% of liquid fertilizers). Therefore, liquid fertilizers generate a higher revenue than solid fertilizers due to the high retail price of each bottle of liquid fertilizer and easy distribution to buyers in the upland area. Meanwhile, carrying huge sacks is the main problem of farmers or buyers regarding solid fertilizers.

**Factors affecting the tangible benefits of raising Etawah crossbred goats:** The factors affecting the tangible benefits from waste utilization. The MLR analysis showed that the R-squared value was 0.80 and F-test was significant ($p<0.01$) (Table 4). Household members and goat ownership ($p<0.01$) and dummy non-formal education and dummy job ($p<0.05$) significantly affected the tangible benefits of waste utilization.

The quality of solid and liquid fertilizers was shown in Table 5. The moisture content of solid fertilizer was almost similar to the SNI standard of 46.80% and that of liquid fertilizer was 98.30%. Both fertilizers had a similar K concentration of 3.20%, which was higher than the standard minimum. The nitrogen content of solid fertilizer was 2.56%, which was higher than the standard minimum. Meanwhile, liquid fertilizer had a similar N concentration to the standard. The solid and liquid fertilizers had C contents of 4.93 and 1.61%, respectively, which were lower than the standard. A high P concentration of 0.41% was found in the solid fertilizer, whereas a low P concentration of 0.0012% was observed in the liquid fertilizer.

Table 5: Quality of goats' fertilizer in two villages of Ngargosari and Pagerharjo, Kulon Progo, Yogyakarta, Indonesia

| | | Fertilizers | |
|---|---|---|---|
| Parameter (%) | SNI | Solid | Liquid |
| Moisture | Max 50.0% | 46.80 | 98.30 |
| Potassium (K) | Min 0.20% | 3.20 | 3.20 |
| Nitrogen (N) | Min 0.40% | 2.56 | 0.40 |
| Carbon (C) | Min 9.80% | 4.93 | 1.61 |
| Phosphorus (P) | Min 0.10% | 0.4100 | 0.0012 |
| Carbon:Nitrogen (C/N) | 10-20 | 2.10 | 4.03 |

Based on the above findings, the quality of goat fertilizer in Samigaluh was relatively similar to the SNI standard (SNI): 19-7030-2004. Nevertheless, improving moisture content in solid fertilizer, the carbon content in solid and liquid fertilizers and phosphorus content in liquid fertilizer can enhance the quality of fertilizers. In addition, farmers must incorporate product labelling because it provides basic information for the product and allows the buyers to know about the item, the instructions and the uses. This practice would increase the selling price per unit and thus expand the product into a broad market.

The management of manure into compost and liquid fertilizer carried out by farmers is following Indonesian National Standards. Nevertheless, the knowledge of farmers regarding correct fertilizer content and waste management must be enhanced by coordinating with educational institutions and the Livestock Service Office.

Efforts to increase farmers' knowledge regarding waste management are expressed through counselling and training activities on organic fertilizer production technology. Extension activities can be carried out with assistance from related institutions such as extension workers, including educational institutions. One example is universities, which play a role in socializing and transferring technology, especially those related to waste treatment. Various information technologies and the latest innovations that have been developed in universities should be fully and sustainably applied to partners (farmers and breeders)[33,34].

Packaging and labelling must be improved to improve the value of waste management. The information contained in the packaging of a product is a component of marketing information that influences consumer opinions about this product. Packaging design is also a part of a marketing strategy to increase the competitiveness and interest of buyers. Packaging is a well-designed set of symbols that create the image of a product, influence consumer perceptions and attitudes toward this product and present its characteristics and attributes. Another function of packaging is to protect the product from damage during storage and transportation[35]. The packaging of a product consists of a design (colour, image, font, shape and size), information (packaging materials and product information) and instructions for use. Colours and pictures on the packaging can increase product identification and spur consumers' memories of the product. The font style on the packaging is a means of communication between producers and consumers. Small and dense font styles can lead to misunderstandings and unclear information to consumers. Product information on the packaging can also help consumers compare the quality and value of a product with those of other similar goods[36].

Packaging is part of a product and labelling is part of the packaging that provides information about product composition, product quality, taste and colour of the product, date of manufacture and product expiration date, service contact numbers for consumers and company profiles of producers. Therefore, labelling is the main source of product information for consumers[37]. Consumers can easily compare products through their labels. Product packaging and labelling are the last opportunities for marketers to convey a brand image of offering the best choice among other competing products[38]. The existence of a certified label can improve product quality and selling value.

Liquid organic fertilizer is widely circulating in the market and is mostly applied through the leaves or referred to as foliar liquid fertilizers that contain essential macro and micro nutrients[39]. Liquid fertilizer is beneficial for plants during growth and development, improves the soil quality and contains microorganisms that cause diseases in plants. Plants can utilize nutrients from fertilizers by minimizing leaching and evaporation. An example of fertilizer use is reported on corn plants. In corn plants, liquid fertilizer does not affect plants at 2 and 3 weeks after planting because of their young age and few leaves. Hence, the liquid fertilizer is not fully absorbed. From the 4th week onwards, the plant grows sufficient roots and leaves, which allow the absorption of liquid organic fertilizer and increase the availability of nutrients for plant growth[40].

Compost application can increase the content of a large number of nutritional compounds in crops (such as chlorophylls, carotenoids, sinapic acids and phenols). Benefits in the long-term were only reported for nutrient supply, carbon sequestration, soil biodiversity and soil workability[41]. This effect can be attributed to the function of compost to increase the population and diversity of soil biota and positively affect the soil conditions. The activity and metabolism of soil biota (micro, meso and macrobiota) increase soil and plant productivity by enhancing the availability of soil nutrients, such as taking up N from the air,

dissolving previously unavailable P, forming substances that can stimulate plant growth, generating substances that can suppress the growth of disease-causing microorganisms and reducing toxic elements (anti-toxic) for plants and soil biota. The chemical properties of the soil are improved due to the presence of complete essential nutrients (macro and micro) and the nutrient uptake from chemical fertilizer fertilization has become efficient. An example of compost usage has been reported in rice plants. Compost application can reduce soil bulk density and increase water content and field capacity. Compost application improves total porosity and increases fast drainage pores of the soil. Compost addition can increase the numbers of panicles and grains[42].

## CONCLUSION

The utilization of Etawah crossbred goat manure produced tangible benefits of IDR 278,608 (24.83%) and IDR 843,480 (75.17%) for solid and liquid fertilizers, respectively, for a total of IDR 1,122,088 per month. Goat ownership and household members are the factors influencing the tangible benefits of waste utilization. Dummy non-formal education and job also exert a significant effect. The percentage of farmers who apply technology to utilize waste manure in fertilizer has only reached 20%. Therefore, the importance of utilizing waste must be further socialized. For increased fertilizer production and commercialization, collaboration must be conducted with the Department of Animal Husbandry, universities and ornamental plant and plantation industries. For product certification, including information on packaging and labelling, programs involving the Department of Trade must be developed to manufacture products of high quality and increase their selling value to reach a wide market segment. The novelty of the research is the measurement of the green economy of the use of waste which has an added value. The benefit of research is that it helps farmers to increase their income through the introduction of technology for making liquid fertilizer and compost and supports environmentally friendly programs.

## SIGNIFICANCE STATEMENT

The novelty of the research is the measurement of the green economy of the use of waste which has an added value. The benefit of research is that it helps farmers to increase their income through the introduction of technology for making liquid fertilizer and compost and supports environmentally friendly programs.

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