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Original Article

The contribution of livestock business and utilization of biogas on the income of farmer's family in Boyolali Regency

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Abstrak

Tujuan: Usaha peternakan menghasilkan output berupa daging, telur, susu dan kotoran ternak yang dapat dimanfaatkan sebagai biogas untuk mencapai efisiensi dan optimalisasi usaha. Oleh karena itu, penelitian ini bertujuan untuk mengetahui kontribusi usaha peternakan sapi dengan pemanfaatan kotoran ternak menjadi biogas terhadap pendapatan keluarga peternak.
Metode: Penelitian dilaksanakan di Kabupaten Boyolali yaitu di Kecamatan Musuk, Ampel, Cepogo, dan Sambi, dengan teknik survei yang melibatkan 60 responden peternak sapi perah dan sapi potong yang telah memanfaatkan kotoran ternak menjadi biogas. Data dianalisis dengan menggunakan analisis deskriptif kuantitatif, analisis pendapatan, dan analisis kontribusi usaha.
Hasil: Hasil penelitian menunjukkan bahwa pendapatan usaha peternakan sapi potong dengan skala pemeliharaan rata-rata 3 ekor adalah Rp 458.083/bulan, sedangkan nilai pendapatan usaha peternakan sapi perah dengan skala 2 ekor sebesar Rp. 749,083 /bulan. Keluarga peternak sapi potong dan peternak sapi perah memperoleh pendapatan masing-masing Rp 5.497.000 dan Rp 8.989.000/bulan. Kontribusi usaha sapi potong dan sapi perah terhadap pendapatan keluarga sebesar 29,93% dan 36,88%.
Kesimpulan: Kontribusi usaha peternakan sapi dengan pemanfaatan kotoran ternak menjadi biogas masih rendah, di bawah 30%, sehingga masih dikategorikan sebagai usaha kecil. Pendapatan usaha peternakan dipengaruhi oleh pemanfaatan limbah menjadi biogas sebesar 7,1-8,0%.

Kata Kunci: Biogas; Kontribusi usaha; Pendapatan keluarga; Pendapatan usaha peternakan

Abstract

Objective: Farm businesses not only produce output in the form of meat, eggs, and milk, but also produce livestock manure, which can be used as biogas to achieve business efficiency and optimization. This study aims to determine the contribution of cattle farming by utilizing livestock manure into biogas on the income of the farmer's family.
Methods: The research was conducted in Boyolali Regency, namely in Musuk, Ampel, Cepogo, and Sambi Districts. Respondents of this study were dairy and beef cattle breeders who had processed livestock manure into biogas with a total of 60 respondents. The data analysis method used is descriptive quantitative analysis, income analysis, and business contribution analysis.
Results: The results of the study indicate that the income of beef cattle farming with an average maintenance scale of 3 animals is 458,083 IDR/month, while the value of dairy farming business

income with a scale of 2 animals is 749,083 IDR /month. Beef cattle farmer family income 5.497.000 IDR/month and 8.989.000 IDR/month for the family income of dairy farmers. The contribution of beef cattle business to family income is 29.93%, and 36.88% is for dairy cattle.

Conclusions: The conclusion is the contribution of beef cattle farming by using livestock manure into biogas is still low, which is below 30%, categorized as a small business. Livestock business income is not only influenced by the sale of cows and milk, but also from the utilization of waste into biogas (7.1-8.0%).

Keywords: Biogas; Business contribution; Farmer family income; Livestock business income

INTRODUCTION

Cattle farming can have a positive impact on development, in the form of increasing farmer income, expanding job opportunities, increasing food availability, especially meat and milk, as well as increasing local revenue. However, environmental and health issues related to cattle farming are sometimes overlooked. Livestock can pollute the environment through the disposal of livestock manure into the ground, surface water, and the emission of methane gas into the atmosphere. Therefore, sustainable animal husbandry not only needs to pay attention to the survival of livestock and their production but also the handling of waste that can pollute the environment [1], used as raw material for alternative energy sources biogas. Cow dung is methane gas and CO2 source, and cattle naturally produce it as exhaust from the digestive process [2]. Furthermore, methane gas and excess CO2 can cause pollution and trigger the greenhouse effect. Biogas technology with the concept of zero waste is expected to slow down the rate of global warming [1]. In Mixed Crop and livestock (MCL) farming systems, biogas technology can be assigned as a central component to treat the livestock manure and thereby reduce the environmental problems from nitrate contamination on soil, ammonia gas pollution and fecal pollution in the water [3,4].

Biogas on a household scale with 2-4 livestock or a supply of approximately 25 kg/day of manure can be used as a reactor tube with a capacity of 2500-5000 liters to produce biogas equivalent to 2 liters of kerosene/day. This gas should meet the cooking energy needs of a rural household with six family members [5]. Subsequently, the processing of livestock waste can provide additional income a part from livestock, such as biogas, solid and liquid organic fertilizers. Therefore, the processing of livestock waste can create employment opportunities in rural areas. Since biogas can be produced from locally available organic materials, it can be used to fulfill energy needs and to reduce the usage of fuel wood in rural areas [6]. In Indonesia, 69% of rural population is estimated using fuel wood for energy purposes thus facing potentially severe health impacts due to fuel wood use [7].

Economic feasibility analysis shows that biogas investment is feasible with a B/C ratio of 4.51 and returns in the 2.2 year with the digester's economic life of 20 years [8]. Furthermore, using this gas can reduce the cost of cooking fuel with community expenditures and biogas since monthly expenditures are more efficient. The cost of buying gas can be diverted for other household needs because livestock business using biogas contributes to the income of the farmer's family [9]. [10] reported that biogas is equivalent to 0.62 liters of kerosene or 0.46 kg of LPG, 0.52 liters of diesel, 0.80 liters of gasoline, and 3.50 kg of firewood. Literature shows that biogas technology offers benefits in many aspects. The adoption of biogas technology offers economic benefits in terms of reducing households' expenditure, increasing income generation and creating job opportunities [11,12]. When managing a business, it is clearly important to understand how profitable the business. Many business owners see an indicator of the profit of a business from the value of the profit margin. But if want to understand the contribution of a certain product to business profit, it is necessary to understand the kontribution margin. Based on the description above, this study aims to analyze the income and

contribution of livestock businesses using biogas to family income.

MATERIALS AND METHODS

The study was conducted in Boyolali Regency, Central Java Province, Indonesia, to determine the research location by purposive sampling. The consideration used is that the cattle population in this district is very high, including 86,363 dairy cows and 86,988 beef cattle to increase the potential for biogas raw materials [13]. Boyolali is also known as the "city of milk", because it is the district with the highest milk production in Central Java Province. The study used a survey method with a questionnaire as the main instrument to collect data. The data were obtained from beef cattle and dairy farmers who run their livestock business using biogas. Furthermore, the respondent breeders were 60 people, 30 beef cattle breeders in Sambi and Ampel sub-districts, and 30 dairy farmers in Musuk and Cepogo sub-districts. Respondents were taken from dairy and beef cattle breeders because these two types of livestock have different production commodities, so the source and amount of business revenue will also be different. Data were collected by direct observation of livestock business activities, documentation, and interviews with a questionnaire guide to obtain information related to the variables.

The data analyses used are descriptive quantitatif analysis, income analysis of cattle farming with biogas, analysis of family income, and analysis of the contribution of biogas cattle farming to family income. The total income of family members using biogas was obtained by the summation of the income from the cattle, the agricultural, and the non-agricultural businesses. The equation used is as follows [14]:

$$Y = X_1 + X_2$$

Information:

Y = Family income of biogas users (IDR/year)
X_1 = Livestock business income (IDR/year)
X_2 = Agricultural business income (IDR/year)

The contribution of the beef cattle farming business by utilizing feces into biogas to the income of the family of farmers was obtained from the income of beef cattle farming to the total income generated by biogas user families. The equation used is as follows [14]:

$$K = \frac{X_1}{Y} \times 100\%$$

Information:

K = Contribution of biogas beef cattle farming to farmer family income (%)
X_1= Livestock business income (IDR/year)
Y = Family income of biogas users (IDR/year)

The criterion for determining the contribution :

Income contribution < 30% : side business
Income contribution 30-70% : branch of business
Income contribution 30-70% : main business

RESULTS

Livestock is one of the leading business sectors in Indonesia; however, it is one of the producers of greenhouse gases (GHG). Therefore, the strategy of low external input sustainable agriculture (LEISA) and zero waste with integrated livestock crop systems is consistent with environmentally friendly sustainable development by increasing efficient use of natural resources and reducing GHG emissions. The utilization of alternative energy sources from livestock waste provides many advantages, such as quality fuel, odorless, producing compost, and more economical to recycle the process. Boyolali Regency is between 110°22' - 110°50' East Longitude and 7°7' - 7°36' South Latitude with an altitude of 75 to 1,500 m above sea level. Additionally, it has an area of 1,015.10 km2 divided into 19 sub-districts, 263 villages, and 7 sub-districts. Based on the geographical and astronomical location Boyolali Regency has a relatively large potential in cattle farming indicated by many breeders in the district. Around 256,560 residents, or almost a third of Boyolali's population of 1 million people, work as cattle breeders, and the farmer maintains about 86,363 dairy cows and 86,988 beef cattle. From the number of dairy cows, Boyolali the Regency can produce about 12 thousand liters of milk per day, and 80-90 cows are slaughtered daily to produce about 22.7 tons of meat. Also, cows raised in this Regency will produce solid waste in feces, which is a potential raw material for biogas.

The average feces produced is 25 kg/cow/day, and since 1 kg of dry manure = 0.3 m3 of biogas volume, one cow per day gets 7.5 m3 of biogas and 1 m3 of biogas is equivalent to 0.46 kg LPG [15].

Based on data, Boyolali has 1038 units of biogas digester, of which 925 are livestock biogas, and 24 are tofu industrial biogas [16]. The majority of biogas digesters in Boyolali Regency are fixed domes with varying sizes between 13 m^3-30 m^3. The cost of making a biogas digester is Rp. 1,000,000,- per m^3, hence, the procurement is usually through a program of assistance or grants from the government, coorporate social responsibility (CSR) from companies, universities, and other parties. However, several people construct it manually through self-help or with independent funds. The digester is not only used by one household, but can be used with several households or livestock groups, 1 unit of 13 m^3 biogas can supply biogas to 3-4 households [17].

Livestock business income using biogas

Net income is the difference between total livestock business revenues per year and the total annual production costs. The average value of income/respondent/year from beef cattle and dairy cattle business using biogas in Boyolali Regency can be seen in Table 1.

Contribution of livestock business with biogas utilization on farmer's family income

The contribution of smallholder beef cattle farming with the use of livestock

Table 1. Average income of cattle farming using biogas

Information		Beef cattle (IDR/head/year)	Dairy cows (IDR/head/year)
(A)	**Revenue**		
	1) Sale of cows/milk	23,570,000	22,082,500
	2) Calf sales	0	4,000,000
	3) *Slurry* sales	912,000	803,000
	4) Wood saving	435,000	420,000
	5) Gas saving	712,000	784,000
	Total (A)	**25,629,000**	**28,089,500**
(B)	**Variable cost**		
	1) Forage	2,150,500	2,792,000
	2) Concentrated feed	4,320,000	5,475,000
	3) Medicine	460,000	520,000
	4) Electricity and water tax	380,000	540,000
	5) Calf	6,300,000	0
	6) Family labour	4,320,500	7,300,000
	Total (B)	**17,930,500**	**16,627,000**
(C)	**Fixed cost**		
	1) Mandatory dues for members of the KTT	5,000	5,000
	2) Biogas depreciation	615,000	590,000
	3) Cage depreciation	416,000	648,000
	4) Equipment depreciation	165,000	480,000
	5) Parentstock depreciation	0	650,000
	Total (C)	**1,401,000**	**2,373,000**
(D)	**Income A-(B+C)**	**5,497,000**	**8,989,000**

Source: Processed primary data, 2021

manure into biogas to the income of farmers is the percentage of income earned from cattle farming using biogas to the total income of the farmer's family. The total income of farmers is obtained from cattle farming and income from other jobs other than beef cattle, such as farmers, traders, employees, the private sector and laborers. The amount of income received by the family of farmers from cattle farming and other businesses as well as the contribution of livestock business to family income can be seen in Table 2.

DISCUSSION

Through biogas technology, livestock manure can be converted into energy to meet different requirements, such as cooking, lighting, and other energy purposes. Therefore, biogas produced from livestock waste has a high economic value because it can be used as an alternative fuel in farmer households and an energy source for lighting [17]. Community expenditure can be reduced using biogas, and the purchase cost can be diverted for other household needs. Therefore, livestock business using biogas contributes to the income of the farmer's family.

The income of beef and dairy cattle with biogas utilization is obtained from livestock business revenues minus the fixed and variable costs. Table 1 shows the beef cattle business income of 5,497,000 IDR/year or 458,083 IDR/month, while for the dairy business, 8,989,000 IDR/year or 749,083 IDR/month. The number of livestock owners in the research location varied, consisting of an average of 3 heads per farmer. Therefore, the income obtained was multiplied by the number of livestock owned since the livestock is directly proportional to the income obtained. [18,19] states that the greater the productivity or the number of products produced, the higher the income obtained from the business. [20] who stated that the amount of income contribution to total household income depends on the size of the business

The income obtained by beef cattle farmers using biogas comes from selling cows and slurry, as well as saving wood and LPG. Meanwhile, the main revenue for dairy cow farmers is from selling milk, calf sale, and slurry, as well as saving wood and LPG. The total revenue for beef cattle and dairy cows is 25,629,000 IDR/year and 28,089,500 IDR/year. The revenue from biogas utilization to the total revenue is 8.03% for beef cattle and 7.1% for dairy cattle. Table 1 shows revenue from slurry sales for fertilizer is 912,000 IDR/year for beef cattle and dairy cows is 803,000 IDR/year. At the research site, slurry digestate is used as good compost for agricultural crops, for biogas users and also for the surrounding community. In fact, cow manure presents an important potential of renewable sources for energy and fertilizer [21]. This meant that slurry digestate produced from a biogas digester potentially contribute to economic benefits from fertilizer saving by 410,970 IDR/year or 31.61 USD/year at a currency of 13,000 IDR/USD [11]. Revenue from wood saving and LPG saving is 1,147,000 IDR/year for beef cattle and dairy cows is 1,204,000 IDR/year. According to [22], the economic efficiency of biogas use can be calculated by multiplying the digester size by the amount of gas produced per $1m^3$ digester (0.46 Kg). For example, the digester measures $13m^3$ x 0.46 = 5.98kg; therefore, each can produce 5.98 kg/day of gas and be used for eight households. The gain per household can be calculated by dividing the gas obtained by biogas users: 5.98: 8 = 0.74. These results show that each household gets 0.74 kg of gas every

Table 2. Farmer family income and business contribution

Family income	Family income and business contribution			
	Beef cattle (IDR/Month)	Contribution percentage (%)	Dairy cows (IDR/month)	Contribution percentage (%)
Livestock business biogas (3 head)	1,374,069	29.93	2,249,490	36.88
Other business	3,580,000	70.07	3,850,000	63.12
Total business	4,954,069	100	6,099,490	100

Source: Processed primary data, 2021

day. The price of 3kg LPG is 20,000 IDR therefore = 5,000 IDR/day. Despite this achievement the profit from biogas exploitation is relatively small, but it is actually the breeders who manages it biogas gets the main profit from the results of its livestock business, namely by the sale of cows and milk [23].

Table 1 shows a component of biogas depreciation costs in the fixed costs of a cattle farming business using biogas. This depreciation expense arises due to the reduced use of an asset (biogas installation). Depreciation value is calculated from the difference between the acquisition cost and the residual value, which is then divided by the economic life. Most of the biogas digesters in Boyolali Regency are fixed domes from concrete, with sizes ranging from 9m^3 to 20 m^3, and a construction cost of between 12,000,000 IDR to 25,000,000 IDR. According to [24], one of the advantages of the fixed dome biogas digester is the long technical life of use (up to 20 years), and the maintenance determines the installation. As a result, the average depreciation cost of biogas installation per year on beef cattle farms is 615,000 IDR and 590,000 IDR on dairy farms.

The contribution of smallholder beef cattle farming with the use of livestock manure is the percentage of income earned using biogas to the total income of the farmer's family. Referring to the formula for calculating the contribution of business income according to [14], Table 2 shows the contribution of income from beef and dairy cattle farming using livestock manure into biogas to the total family income by 29.93% and 36.88%. [25] states that breeders engaged in mixed farming with a 30-70% income from livestock are no longer a side but a semi-commercial business. The results showed that the contribution of income from beef cattle business with biogas was <30%, slightly higher than >30% for dairy cattle. This is consistent with [26] that farmers depend most on dairy farming. [14] states that when the income contribution of a business is small or <30%, then it can be concluded as a sideline business. Sideline business or side jobs are additional jobs owned by farmers because of the higher income obtained from the main job is not sufficient to meet basic daily needs or work the side is there because there is still time left after doing the main job [17]. According to [28], livestock business is low when its contribution to family income is below 30%. The criterion for determining the contribution range of cattle business income is a branch of business between 30-70%. In contrast, when the contribution is less than 30%, it is still a side business, but above 70%, it is the main business.

CONCLUSION

This study concludes through biogas technology, livestock waste has a high economic value since the manure can be converted into energy to meet the needs of cooking, lighting, and other purposes requiring energy. This will create a livestock business with high economic efficiency and is environmentally friendly. The income of beef cattle farming with an average maintenance scale of 3 animals is 458,083 IDR/head/month, while the value of dairy farming business income with a scale of 2 animals is 749,083 IDR /head/month. Beef cattle farmer family income 5.497.000 IDR/head/month and 8.989.000 IDR/head/month for the family income of dairy farmers. However, the contribution of beef cattle farming with the use of livestock manure into biogas is still low at 29.93% and 36.88% in dairy cattle; therefore, it is categorized as a small business. Livestock business income is not only influenced by the sale of cows and milk, but also from the utilization of waste into biogas (7.1-8.0%).

CONFLICT OF INTEREST

The authors declare no conflict of interest with any financial organization regarding personal, or other relationships with other people or organizations related to the material discussed in the manuscript.

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