The Effect of Community's Perception of the Advantages and Disadvantages of Biogas Utilization for Cooking Towards Community's Interests of using Biogas in Pacet Sub-District of Cianjur Regency

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Abstract— The purpose of this study was to determine the factors affecting community's interest in using biogas as an alternative energy for cooking in Pacet Sub-district, Cianjur Regency. The analyzing tool used in this research was regression analysis. The result indicated that people's perception of the advantages and disadvantages of biogas utilization as cooking energy gave significant effect on community's interest to use biogas. Thus one way to increase community's interest in utilizing biogas as cooking energy was by educating the people about the advantages of biogas as well as providing a solution to the weakness of using biogas, especially in relation to the guarantee of biogas sufficiency for all residents' cooking needs.

Index Terms— Biogas, Regression, Community's Interest, Cooking Alternative Energy

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1 INTRODUCTION

Human needs for energy availability are continuously increasing while the supply of primary energy is still dominated by energy derived from fossil energy. Until this day, Indonesia is still highly depending on the supply of fossil energy (petroleum, natural gas and coal) as the main energy source. National energy needs keep on rising from year to year, while on the other hand, the condition of oil reserves / deposits tend to shrink. The limited availability of fossil energy sources because of its nature that cannot be renewable; as well as the rising demands of supply of energy; led to the immediate accomplishment of providing an alternative source of rejuvenate energy.

One of the government's appeals in reducing the use of fossil fuels is to use alternative energy which is renewable and can be further developed. The government has also conducted a kerosene based usage to LPG conversion program to reduce oil based fuel dependency.

The biomass energy becomes one of the developing alternative energy options. However, there are many obstacles during the process of biomass energy development. For example, the technology is not readily applicable. Besides, there are also other problems such as land requirement, food needs and economical needs competition.

There are several alternative energies that we can develop in our country, such as biodiesel, bioethanol, biogas and others. The principle of the development is sustainable development, in which the undertaken development has no negative effects on other areas of society. From the previous examples of alternative energy, biogas can be used as an affordable energy source for community, especially for the villagers, since the raw materials for biogas are easily found in the countryside. Moreover, biogas production requires simple steps.

Based on the foregoing description, the development of biogas from organic waste is one of the recommended ways of energy fulfillment. Biogas development program provides a variety of advantages. First, it supplies gas as an energy source. Second, it also produces solid and liquid wastes that can be used as organic fertilizer. Thus, biogas can be considered as a way to solve environmental pollution caused by organic waste in the area of cattle farms.

Cianjur is one of the regencies in West Java Province. In 2015, the population of Cianjur Regency is estimated to be 2,243,904 people, and the energy which is used for cooking is still dominated by LPG 3 kg (Table 1). The most interesting fact is that the inhabitants of Cianjur Regency have not used biogas as energy for cooking.

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TABLE 1
USE OF FUEL FOR COOKING IN CIANJUR

No.	Main Fuel for Cooking	Percentage (%)
1	Not cooking at home	0.79
2	Electricity	0.00
3	LPG 5.5 kg / bluegaz	0.21
4	LPG 12 kg	0.91
5	LPG 3 kg	61.77
6	Biogas	0.00
7	Kerosene	0.00
8	Charcoal	0.00
9	Firewood	36.08
10	Others	0.24
	Total	100.00

Source: [1]

On the other hand, Cianjur Regency is considered to be a potential development area of the livestock sector, such as beef cattle with the unification concept as both; center of education and practice site. This assumption arises due to the extensive area of Cianjur Regency and unoptimized lands use. In Cianjur Regency, there are large livestock populations consisting of 35,763 beef cattle; 2,397 dairy cows; and 8,571 buffaloes. With the large number of animal population, it will be useless if the waste is not altered into biogas which can be used as an alternative energy for cooking.

To build a biogas development project as an alternative energy for cooking, a feasibility study is required. The project should consider several aspects to be studied, such as legal aspect, social aspect, economical aspect as well as the study aspect of people's interest in using biogas. This research focused on the study of community's interest in utilizing biogas as an alternative cooking energy. This study examined further about community's opinion towards biogas utilization for cooking beyond interest perspective solely. Next, this research also observed on how big community's interest is to use biogas for cooking. It will be uselessly produced if the result is less desirable for community's taste.

2 LITERATURE REVIEW

2.1 Biogas

Biogas is a clean renewable energy. It is produced by anaerobic fermentation of organic material biologically, with the help of microbes [2]. The gas product resulting from this fermentation is a gas mixture with the main substance consisting of methane (CH4) and carbon dioxide (CO2), where methane is considered to be flammable gases and is a major component in natural gas fuel. This particular biogas can actually also take place under natural condition, but to accelerate and accommodate this gas, adequate tools that qualify the formation of this gas are needed [3].

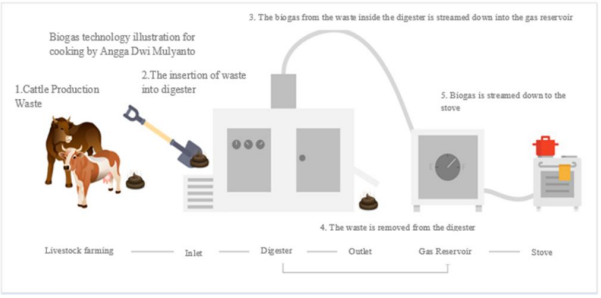

Fig. 1. Illustration of Biogas Technology for Cooking

Biogas can be made from a variety of sources organic waste: forest waste, plantation waste, agricultural waste, livestock waste, domestic waste and household waste. The utilization of biogas will also serve various purposes; it is either used as direct combustion (stove) or as an energy to turn on the machine (generator) by converting the gas produced into electricity. Biogas has a huge potential to be developed, in addition to an effort to save the environment. Thus, biogas utilization as prospective energy source should be considered carefully. Germany as one of European countries, in 2011, has developed more than 4,000 digesters to create power plants with a total capacity of about 2,559 MW [4].

2.2 Community's Interest of Using Biogas

The development of biogas development projects can be said to be successful if biogas products are demanded and used by the community. There are also other biogas development projects that have been done in other areas, such as in the Jetak Village, Getasan District of Semarang Regency. Unfortunately, biogas is less desirable by residents of the area [5]. Community interest in biogas production thrives as an important factor in a project development of biogas [6]. Many factors influence people's interest in using biogas, especially their perceptions of the advantages and disadvantages of using biogas, see Figure 2.

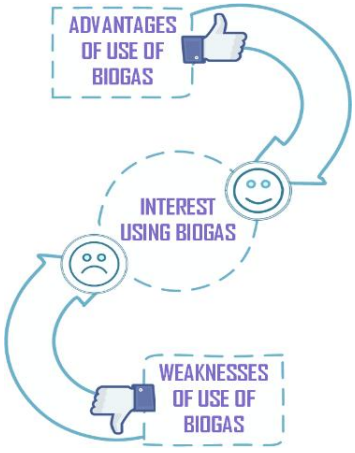

Fig 2. The Relationship of the Advantages and Disadvantages of Biogas Utilization Towards The Interest of Using Biogas

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3 RESEARCH METHOD

This study used a survey method to collect data from respondents. The questionnaire's subject matter examined several things, as follows:

a. The perceptions of each respondent about the advantages and disadvantages of biogas utilization for cooking

b. Respondents' perception scores measurement about the comparison of the advantages and disadvantages of biogas utilization for cooking.

c. The measurement of respondent's interest of using biogas for cooking

To measure the score of the following things: (1) advantages and disadvantages; and (2) interest in using biogas, the researcher applied Visual Analog Scale (VAS). The VAS concept that was applied could be seen in Figure 3.

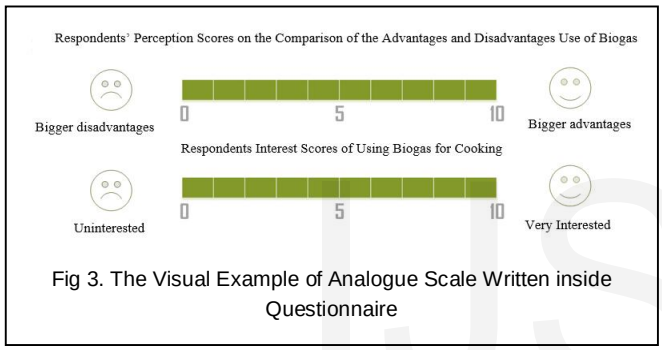

Fig 3. The Visual Example of Analogue Scale Written inside Questionnaire

In the Visual Analog Scale (VAS), the respondent was expected to provide an assessment on the comparison of biogas utilization advantages and disadvantages. The score started from 0 (it represented big disadvantages) to 10 (it depicted advantages). For the assessment of interest, the score was also started from 0 (no interest at all) to 10 (very interested).

From the survey data, descriptive analysis could be assessed through the comparison score of the advantages and disadvantages, and also the interest score. The analysis also covered additional qualitative information about the advantages and disadvantages use of biogas for cooking according to respondents' opinion. Thus, by employing the data, regression analysis could be executed to identify the comparison effect of the advantages and disadvantages of biogas utilization toward the interest of using biogas for cooking. This study was a simple regression analysis. Thus the research framework can be seen in Figure 4.

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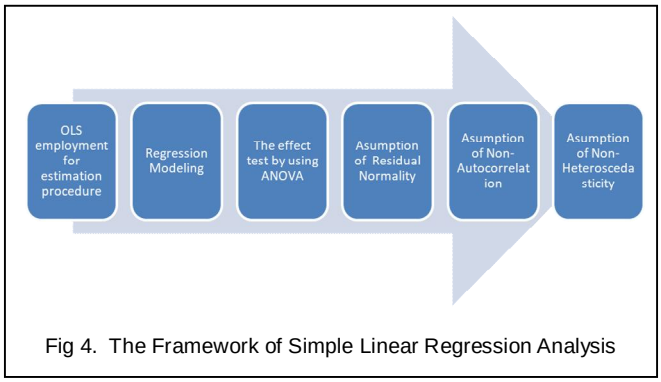

Fig 4. The Framework of Simple Linear Regression Analysis

The estimation of regression coefficient (β) using ordinary least square method (OLS) was formulated as follow:

$$\beta=(X'X)^{-1}X'Y$$

The results of the simple linear regression coefficient estimation above could be used as a guide for making simple linear regression equation as follows:

$$y=\beta 0+\beta 1\, x$$

Simple linear regression analysis was not completed through linear regression equation only, but it was also continued by following the test of influence using ANOVA. The testing of simple linear regression assumption consisted of the assumption of residual normality, non-autocorrelation, and non-heterogeneity. In testing the effect by using ANOVA if p-value value $<\alpha$ (where in this study, the researcher employed α = 0.05), it meant that the influence on the variable y was significant. The residuals were expected to spread normally in residual regression analysis. There were 3 kinds of data normality tests in Minitab: the Anderson Darling, Ryan Joiner, and Kolmogorov Smirnov [7]. In the residual normality test if p-value> α (where in this study the researcher applied α = 0.05), the residual spread normally. One way of non-heteroskedasticity testing was by applying Glejser Method [8]. If the p-value of the independent variable toward the absolute residual was less than 0.05 then there was heteroskedasticity. Thus, the regression model was not good enough to be used. One of the non-autocorrelation testing methods was the Durbin-Watson test. If D> Du then there was no correlation. If D <Dl then there was a positive correlation, but if Dl <D <Du then the correlation was inexplicable [9].

4 RESULTS AND DISCUSSION

Based on the community's survey, the gained results were as follows:

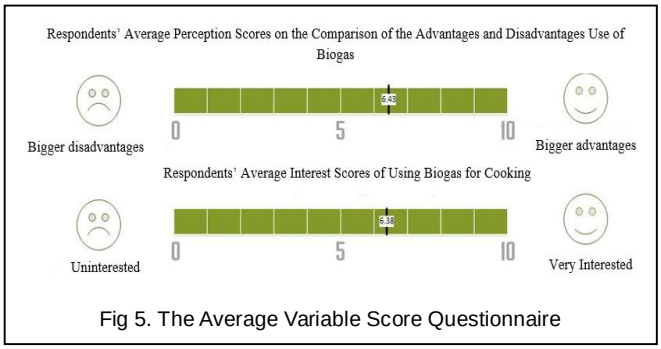

Fig 5. The Average Variable Score Questionnaire

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Based on the results in Figure 5, it could be concluded that the average score of respondents' perceptions about the comparison of the advantages and disadvantages use of biogas as an alternative fuel was 6.43. The value exceeded 5 so that it could be interpreted that the average respondent felt bigger advantages to disadvantages use of biogas for cooking. Some of the advantages according to the respondents including raw materials that were readily available in the surrounding environment. Therefore, it was more likely be cheaper at cost than today's cooking fuel (LPG). In addition, it also provided new benefits toward community waste. However, there were some weaknesses in the use of biogas based on respondents' opinions, such as lengthy production and the availability of biogas production to meet the needs of the residents. The average score of respondents' interest of biogas utilization for cooking was 6.38, which implied that the average respondents had an interest in using biogas as fuel for cooking.

The result of simple regression equation on people's perception influences to the advantages and disadvantages of biogas utilization for cooking (x) toward residents' interest of using it (y) was as follows:

$$y=-0.517+1.0727x$$

While ANOVA test results showed the following results:

TABLE 2
ANOVA RESULT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	1	509.2	509,146	167.2	< 0.01
X	1	509.2	509,146	167.2	< 0.01
Error	98	298.4	3,045		
Lack-of-Fit	7	25.28	3,612	1.2	0.309
Pure Error	91	273.1	3,001		
Total	99	807.6			

Based on the test results in Tabel 2 and the regression equation, therefore it could be obtained that the influence of community perception regarding to the advantages and disadvantages use of biogas for cooking (x) was significantly affected the community interest to use it (y) for x p-value of <0.05. The bigger people's assumption that biogas had many advantages rather than weaknesses, the higher community interest would be in using biogas as an alternative fuel for cooking. R 2 in the regression results (Appendix 1) showed the value of 63.05%, which meant the variability that could explain community's interest to use biogas by using the model was 63.05%. The rest was explained by other variables.

The regression analysis did not end once the regression model was appropriate. The regression assumption should be checked thoroughly whether it had met the criteria or not. If the test results of regression assumptions were not qualifying the criteria, it could be assumed that the results of regression analysis would not represent your data correctly (Minitab Inc., 2014). The following tests resulted from simple linear regression assumption:

a. Residual Normality Test

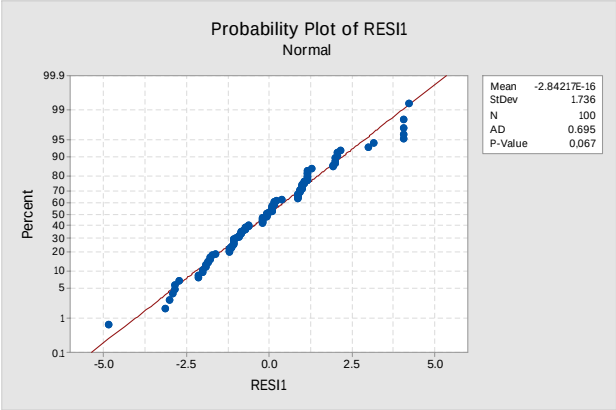

Fig 6. Residual Normality Test Using Anderson Darling Method

Based on Figure 6, residual normality test results using Anderson darling method could be obtained p-value> 0.05 which meant that residual spread normally, so residual normality assumption was fulfilled.

b. Non-Heteroscedasticity Test

TABLE 1
NON-HETEROSCEDASTICITY TESTING USING THE GLEJSER METHOD

Term	Coef	SE Coef	T-Value	P-Value
Constant	1.856	0.348	5.33	0
X	-0.0797	0.0515	-1.55	0.125

Based on results in Table 3, it could be acquired that p-value term X (0.125)> α (0.05) which could be further explained that meaning that there was no heteroskedasticity so that the assumption of non-heteroskedasticity was fulfilled.

c. Non-Autocorrelation Test

Durbin Watson Statistics (D) at Appendix 1 showed the value of 1.99015, while in the Durbin Watson table at Appendix 2, we got Dl = 1.352 and Du = 1.489. Because D> Du there was no autocorrelation existed, therefore the non-autocorrelation assumption was fulfilled.

Based on the result of three assumption tests, there was no violation on the regression assumption, thus the regression analysis result was already appropriate and therefore, it could be applied as the intended purpose.

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5 CONCLUSION

Community's perceptions on the advantages and disadvantages of biogas utilization as cooking fuel had a significant effect on the community's interest to use biogas as an alternative energy. One way to increase community interest in using biogas as an alternative energy for cooking was by educating people about the advantages of using biogas as well as offering a solution related to the disadvantages of using biogas. Especially, when it is regarding to the sufficiency of biogas production for fulfilling all residents' cooking needs.

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