Perception of the community on the use of biogas as alternative energy (Case study: Jetak Village, Getasan sub district)

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Abstract. The purpose of this research is to know public perception of biogas users in Jetak Village, Semarang Regency viewed from technological aspect, technical (biogas installation), biogas benefit, economy and environment. The method used qualitative descriptive with qualitative descriptive approach. The technique of determining key informants was done by purposive sampling. Data were obtained from cattle ranchers who lived in the study sites through interviews, observation and documentation. The result of this research is overall the perception about biogas energy get a positive response from user society. However, there are some things that should be considered for the government and others in providing assistance that is necessary to consider the evaluation and monitoring periodically so that the constraints experienced by the user community can be known early and can be found right solutions. In addition, the sustainability of the use of biogas energy can be done from generation to generation not just the aid which in the end becomes only useless materials.

Keywords: Biogas, dung, village, cattle, perception

1. Introduction

The need for energy use increases with the increase of population and the increase of energy consumption by the society due to the use various electronic equipment to support the comfort in life. The energy sources that have been used mostly come from fossil fuels such as coal, petroleum, natural gas and others. Fossil fuels are the source of energy that the process takes millions of years and can be said to be non-renewable energy [1].

As an agricultural country, Indonesia has a majority of the population who are farmers. Besides as farmers, people usually have other livelihoods is as a breeder of both chicken farmers, goats and cattle. In general, farmers who have agricultural land with the cattle of 1-10 livestocks [2].

Livestock activities is one of the greenhouse gas producers, where methane gas produced has a higher global warming potential than carbon dioxide. Therefore, it takes effort to process the waste so it is more
useful and reduce environmental pollution, including through biogas technology with the concept of zero waste [3].

Jetak village is one of the villages where the community has a dairy farm. With the dairy farm, the people of Jetak Village utilizes their feces for biogas energy. Currently, the people of Jetak Village has received some assistance from both local government and foreign assistant to develop biogas. However, in its development there are some installations that are no longer working even though most are still functioning. In relation to that matter, the researcher is interested to study the society perception on the utilization of cow dung into biogas energy in Jetak Village, so it is expected to be a reference in the development of biogas and can minimize the constraints that occur in the user community.

2. Method
This research was carried out on farmer communities in Jetak Village, Getasan Subdistrict (figure 1), with the consideration that Jetak Village was one of the regions that had implemented the biogas energy program from "HIVOS" assistance. The time of the research was carried out for 1 month, namely in May-June 2017. The research method used was qualitative descriptive with a qualitative descriptive approach. The technique of determining key informants was done by the purposive sampling, which is deliberately selecting all biogas users in Jetak Village, both those who currently use biogas and those who have no longer used were 45 respondents. In addition, in this study there were other key informants, namely community leaders of total 3 respondents.

Primary data was obtained from cattle farmers who live in the research location and use energy biogas through depth interviews, observation and documentation. Qualitative data analysis was carried out in three stages: data collection, data reduction and data presentation. Data analysis techniques used horizontalization, namely developing meaning groups into various themes of textural and structural descriptions and essential invariant structural stages, namely writing a composite description that presents the "essence" of a phenomenon that focuses on the similarity of the participants' experiences [4].

3. Results and discussion
Jetak Village is one of the villages in Getasan Subdistrict, precisely in a highland or mountainous area with cold temperatures. With such geographical conditions, Jetak Village is one of the villages suitable for dairy cattle breeding (figure 2). Most people in the village of Jetak have livelihoods as farmers, especially dairy cows. The people of Jetak village depends largely on raising dairy cattle for their milk. By looking at these conditions, the Andini Luhur Cooperative was formed which aims to prosper the members, the community and especially dairy farmers in the village of Jetak.

Topographically, the village of Jetak has a plain with latitude coordinates 7.3915 and longitude 110.4814. Jetak village has an area of 2.94 km² with a percentage of the area of 4.47 %. At present the village of Jetak has 12 hamlets, 12 RW and 33 RT. Geographically, Desa Jetak is ± 35 km from the Capital of the Regency, above sea level ± 850 m with an air scale between 18–26 °C.

The potential of dairy cattle in Jetak village can be used as renewable energy. The dairy cattle manure produced every day can be processed by farmers into biogas energy to help the community to meet energy needs independently. In 2009 the community of Jetak Village received an assistance from a biogas installation from the Netherlands with the "BIRU" program. This assistance is given to farmers who have small-scale livestock 3–5 cows / kk. The installed installation capacity is around 6 m³ which can produce 4 m³ of gas so that it can meet the daily energy requirements for cooking and lighting.

In the implementation of the community, biogas users experienced several problems where the existing installation was damaged. Damage can occur by several factors, both technical and non-technical. Therefore, to analyze the existing source of the problem, it should be analyzed in advance about the perception of the community using biogas in several aspects, namely aspects of new
technology, technical aspects related to installation, aspects of biogas utilization, economic aspects and environmental aspects.

3.1. Perception in new technology aspect
Biogas is a form of new technology offered to the public by the Government in anticipation of an energy crisis caused by a reduction in world oil reserves and minimizing the environmental damage such as greenhouse gases. For this reason, the Government should see the readiness of the community to accept the technology. The introduction of new technologies in community groups requires the transition of people’s perceptions and behaviors to create awareness in utilizing these technologies. Therefore, the development of biogas technology should be through a long-term planning starting with identification of the potential of natural resources to the application of biogas technology.

Figure 1. Map of research location of Getasan subdistrict.

Figure 2. Dairy cattle on Jetak Village.
This is in line with the research that has been conducted where the factors that influence the technology adoption process are socio-economic characteristics of farmers, institutional factors, technological characteristics, use of production facilities, costs of technology, technical implementation of production technology, risk, communication networks, agents counseling, and technical efficiency. The influence of each of these factors varies in size and is the direction of determining the decision of a technology adoption [5]. Thus, the introduction of new technology to community groups requires a long process before the technology can be accepted by one community group.

Currently, the socialization and training are one way used to introduce new technology to the community. The community will gain new knowledge and understanding so that the community is expected to be able to implement the technology. However, this method has not been fully effective in the introduction of new technologies to community groups. The intensity of socializing and training should be carried out continuously. This is intended to make the community to understand the intent and purpose of using the technology better.

The user community in Jetak Village actually gives a fairly good appreciation for energy biogas. This can be seen from how they explained in detail about biogas energy starting from the operation of the biogas plant, the stage of the manufacturing process, the operation of household necessities that can be used from biogas energy to the utilization of byproducts which are reused for agricultural land.

A biogas user named Mr. Yusmin revealed that biogas is the right solution to deal with the problems of waste generated from his farm. Before the presence of biogas the waste of cow manure produced is only stacked just near the cow pen. However, after the biogas energy produced can be used for daily needs such as cooking, lighting and turning on the generator. He said “This biogas is very helpful in meeting daily energy needs. In addition, the dirt that had accumulated near the cage can now be used for daily needs”.

A technology will be well adopted by the user community if the technology provides higher benefits or relative value added if a technology is adopted [6]. Some aspects that contributed to the acceleration of adoption were indicated by [7], namely the gap factor between technology introduced with technology needed by community groups and the ineffective way of disseminating information technology, and the lack of involvement of extension workers in the field.

Perceptions of the user community in Jetak Village in the context of new technology, in general they provide enthusiasm and high appreciation for the energy of this biogas. Most people realizes that using biogas waste problems from livestock can be resolved properly and provide benefits for daily energy needs. In the introduction of new technologies there are things that need to be considered where there are differences in attitudes in community groups in the face of technological innovation depending on the characteristics of the community group itself which is usually indicated by factors of age, education, number of family members and experience. Community groups will reject the existence of new technologies if they are not relevant to what they need, there is no compatibility with their work environment and are considered to interfere with their more important activities. Adopting perceptions of technology will be demonstrated by the adoption behavior of innovation attributes. The characteristics of adopters in the context of accelerating adoption of agricultural technological innovations have important meanings as a basis for explaining adoption behavior [8].

3.2. Perception in technical aspect (installation)

Adequate installation is one of the most important factors in producing the perfect biogas energy. The installation size used must be adjusted to the amount of daily raw material available. The selection of the biogas installation model must also be adapted to the culture of the biogas user community. For people in rural areas the model used must be simpler in terms of building construction and operations and maintenance. The durability of a biogas installation is one of the considerations that must be considered. Construction of biogas installations usually require special skills in the manufacturing process so that they will last longer in use.

The biogas installation in Jetak Village is 6 m³. This dimension is enough to meet the daily energy needs of a household scale. The chosen design is slightly different from other installations where before
entering the inlet there is a mixing and stirring place (figure 3). Thus more energy is needed to sort dirt, mix dirt and water with a certain ratio and stir.

There are several advantages of using this system, namely minimizing the presence of foreign objects that enter the main digester so that it affects the chemical processes in it (figure 4). In addition, this system can also minimize the damage such as blockages in the gas flow in the digester. There are weaknesses in this system, namely the lack of time efficiency and effectiveness in making it.

Mr. Yusmin said that "Actually, the process of stirring first takes longer. In addition, the energy spent doubled. But what else can we do, we just follow the design from there. If possible, the installation is made practical".

Overcoming some technical constraints, it is necessary to evaluate and monitor to see how far the difficulties experienced by the user community in the operation and maintenance of the installation. This aims to minimize installation damage both small and large scale. In the operation of the installation, especially in rural areas requires more effective and efficient time, it aims to increase public confidence in using biogas energy in a sustainable manner.

Figure 3. Mixing place cow manure with water.

Figure 4. Biogas digester
This is in line with the research conducted by [9] saying that several reasons for the large number of biogas that no longer operate are lack of socialization, applied technology that is less practical, needs careful maintenance, and lack of public knowledge about digester maintenance. The construction design that is made should be simple, easy to operate and maintain and has a high economic value so that people are more interested and have strong motivation in using it. At present, biogas installations have been widely introduced to the community, especially in the countryside, but the manufacture of a good biogas unit has not been widely known so that many pilots cannot run, then are closed and are not sustainable [10].

3.3. Perception in aspects of benefits

Biogas energy is an alternative energy that is expected to provide benefits to the user community. Some of the benefits obtained include saving expenses to buy fuel oil or LPG to meet daily cooking needs. In addition, reducing electricity costs because some of the lighting at home uses biogas. Even some users use biogas energy to help their work run engine power such as lathes and engine generators that are engineered to be used for biogas energy. This is in line with the opinion [11] that with the presence of biogas technology, manure can be converted into energy that can be used to meet energy needs for various needs such as cooking, lighting, transportation to other needs that require energy. If biogas has been widely applied, the problem of lack of supply or energy crisis can be avoided, and the problem of environmental pollution by livestock manure can be overcome.

The results showed that the community using biogas in Jetak village had felt many benefits both directly and indirectly after applying biogas technology. This can be seen from Mr. Sarman's statement revealing that "In addition to alleviating the burden of purchasing LPG and energy costs, biogas energy also helps in reducing the buildup of cow manure which has only accumulated near the cage, thus reducing unpleasant odors. Another benefit that I feel is that local residents who have not used it are interested in using this biogas".

The social value that can be felt directly in the implementation of biogas is that it can strengthen kinship between family members. Collaboration in the form of mutual cooperation between family members is felt by the user community. This can be seen from the statement of Mr. Yusmin who said that "In operating the biogas I was helped by my son. He mixed every morning and stirred between cow dung and water. In addition, my son modified the generator engine (figure 5) and grass lathe (figure 6) so that it can be operated with energy biogas. And now many from other regions come here to follow the modification of the machine (figure 7). "The main benefits and advantages of using biogas are viewed from the social side of the institution, namely the intertwining of the social nature of togetherness and tolerance between biogas users. The nature of togetherness, a sense of belonging, sharing, and caring for each other so that the biogas resources continue to function well [12].

In principle, biogas provides benefits not only to the user community but to the surrounding community. Indirectly processing of cow dung into biogas energy can reduce pollution of unpleasant odors that can cause social conflicts between people. In addition, cow dung that is left alone can cause contamination of ground water and river water pollution because the e-coli bacteria found in the dirt come in late in the water when cleaning the cage. If this is allowed to continue, it will disrupt human health and the environment. The same thing also expressed by [13] said that biogas technology can reduce environmental pollution so that environmental hygiene is better maintained. In addition, the biogas produced is expected to reduce people's dependence on the use of kerosene and fuel wood as fuel.

3.4. Perception in the economic aspect

The application of biogas technology to the user community provides various benefits including economical factor. Biogas technology can affect the user community in reducing the cost of daily needs, especially in energy use. This was felt by the people who uses biogas in Jetak Village.
One user community Mr. Yusron said that “Since using biogas I can save expenses per month. Usually I buy 3 kg / week LPG gas for cooking. If calculated, I can save my money of IDR 50 thousand-60 thousand / month. Can I make other needs”.

For people using biogas, especially in rural areas, savings of IDR 50–60 thousand / month are very valuable for them because it can be used to meet other needs. Indirectly, this savings can help the user community in managing their finances. The same thing was also expressed by [14] saying that the use of biogas can reduce household fuel needs by IDR 42 thousand / month.

Biogas also provides other benefits in the economic sector. Besides being able to provide savings, biogas is also able to increase revenue for the user community if biogas by-products can be used optimally. Biogas byproducts in the form of sludge can be processed into liquid fertilizer and solid fertilizer. These processed products are usually used alone for agricultural land or resold to third parties so that the user community benefits financially. There are three benefits obtained by biogas users, namely household expenditure efficiency, efficiency of crop farming input costs, household income from the sale of organic fertilizer and an increase in the value of livestock business productivity [15].
For the user community in the village of Jetak the biogas by products in the form of sludge is still not used optimally. These byproducts are only left in the reservoir after drying only used for fertilizer on their own land. This was conveyed by Mr. Yusmin said that “I use the biogas output optimally. After leaving I left it in the shelter, after that I used it for my own land”.

If biogas byproducts can be used optimally, then the user community can benefit from the sale of solid fertilizers and liquid fertilizers that can be used to increase family income to meet their daily needs or to reserve funding for damage to biogas installations. The same thing was also revealed by [14] saying that the by-products in the form of organic solid and liquid fertilizers obtained also had a high selling value. On average per month with a source of livestock manure from 3–4 cows, 50 liters of organic liquid fertilizer and 140 kg of solid organic fertilizer are obtained with a selling value of IDR190 thousand / month.

For this reason, there is a need for a continuous assistance for the user community in utilizing biogas by-products. This is very necessary so that the user community feels significant benefits in the economic sector.

3.5. Perception in environmental aspects
Jetak village is one of the villages where most of the people have dairy cattle that are managed individually. Before the existence of biogas technology, waste generated from livestock was only stacked near the cage. The more the day the waste volume is increasing and there is no handling from the breeders’ community. The unpleasant odor caused disturbs the surrounding community when carrying out activities. According to [16], waste from livestock manure that is directly discharged into the environment without being treated will contaminate air, water and soil, causing pollution. Some of the gases produced from livestock waste include ammonium, hydrogen sulfide, CO2, and CH4. These gases besides greenhouse gas also cause unpleasant odors and disrupt human health. On land, livestock waste can weaken the carrying capacity of the soil, causing soil pollution. While in water, pathogenic microorganisms (disease causes) originating from livestock waste will pollute the aquatic environment and often found Salmonella sp.

This was stated by Mr. Imron. “I just left cattle dung near the cage, because I don’t know how to process like cow dung. Sometimes neighbors also like to complain because the smell is not good. The presence of biogas is very helpful in processing dirt. The environment around the enclosure is cleaner because the sewage coming out is immediately installed. The sludge from the process also turns out not to smell at all and can be used as fertilizer.” The study by [17] also argued that processing cow dung into an environmentally friendly biogas alternative energy is a very beneficial way to be able to utilize nature without damaging it so that the ecological cycle stay awake.

Biogas users provide a positive response to the use of biogas for environmental cleanliness, especially around the cage. Biogas technology indirectly has a positive impact on the health of the environment and the health of humans and livestock. The process through biogas technology uses natural processes without the addition of chemicals so that the sludge produced at the end of the process is safe for environmental health and can even be used as fertilizer.

By using biogas technology indirectly the volume of livestock waste decreases. In principle, livestock waste that is left alone without the processing process contributes greatly to the effects of greenhouse gases. This is because the methane gas (CH4) produced naturally by livestock manure is more than carbon dioxide (CO2) gas. According to research in 2006 it was found that 51 % of GHG emissions came from the livestock industry. CH4 emissions from the livestock industry come from 2 (two) activities, namely enteric fermentation and manure management [18]. Slaughterhouses are one of the industry sectors that produce GHG emissions in the form of CO2 gas from energy use such as electricity and CH4 gas from livestock.

In addition, the user community in Jetak Village has not implemented a zero waste system or better known as a livestock planting system. This system is an integration between agriculture and livestock where people use biogas technology to process livestock manure, then the biogas output in the form of sludge can be used for agricultural land, so that agricultural products can be reused for cattle feed.
Organic fertilizers produced from biogas output devices can be used and are of high quality. The high content of the ingredients can increase soil fertility by improving the physical, chemical and biological properties of the soil. The process of making organic fertilizer by utilizing biogas output is more efficient than composting which requires a wider area and a longer process. In addition, the airtight designed digester also reduces the failure rate of the decomposition process so that the organic fertilizer produced is of the highest quality [19].

One user community, Mr. Yusmin explained that "I have not used biogas products for agricultural land. It is only used for land around the house. Actually, it can but because our energy is limited to being just sober”.

In principle, by applying the livestock planting system, the user can overcome the availability of animal feed by utilizing agricultural products such as rice straw, corn straw and other crops.

According to [20] said that a system of integrating livestock planting can be useful for resource optimization and for reducing business risks.

4. Conclusion
Overall the perception of energy biogas has received a positive response from the user community, especially in the aspect of new technology and the benefits of biogas. However, in some other aspects the user community is still experiencing problems so that the sustainability of the use of biogas by the user community has not wholly reached.

a. In the new technology aspect
   Perceptions of the user community in Jetak Village in the context of new technology, in general they provide enthusiasm and high appreciation for the energy of this biogas. Most people realize that using biogas waste problems from livestock can be resolved properly and provide benefits for daily energy needs. In the introduction of new technologies there are things that need to be considered where there are differences in attitudes in community groups in the face of technological innovation depending on the characteristics of the community groups themselves.

b. In the technical aspect
   The biodigester design in Jetak Village is slightly different from the biodigester that has been available so far. Some users experience difficulties in operating the digester due to lack of efficiency and effectiveness in processing. In addition, extra energy is needed to sort, mix and stir before entering the main installation.

c. In the benefit aspect
   In principle, biogas provides benefits not only to the user community but to the surrounding community. Indirectly processing cow dung into biogas energy can reduce pollution of unpleasant odors that can cause social conflicts between people.

d. In the economic aspect
   Using energy biogas, the user community in Jetak village can save 50 thousand to 60 thousand per month. Indirectly this savings can help the user community in managing their finances.
   For the user community in the village of Jetak the biogas byproducts in the form of sludge is still not used optimally. These byproducts are only left in the reservoir after drying only used for fertilizer on their own land.

e. In the environmental aspect
   Biogas users provide a positive response to the use of biogas for environmental cleanliness, especially around the cage. Biogas technology indirectly has a positive impact on the health of the environment and the health of humans and livestock. Overall the user community in Jetak Village has not implemented a zero waste system.
Judging from the technical aspects, it is necessary to evaluate and monitor to see how far the difficulties are experienced by the user community in the operation and maintenance of the installation. Installation selection must be adjusted to the culture of the user community to minimize installation damage. In addition, installation selection must also consider the effectiveness and efficiency of installation work to conserve user community power and foster the interest of the user community to continue using biogas.

Judging from the environmental aspects, assistance must be made by the relevant agencies regarding the zero waste system so that the user community can utilize the system optimally.

In terms of economic aspects, assistance from related institutions is also needed in relation to the utilization of biogas / sludge waste products into solid or liquid fertilizers so that the overall economic benefits can be felt by the user community.

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