Biogas development: Dissemination and barriers

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Abstract. Biogas as alternative energy has long been developed in Indonesia since 1970, however, the utilization of biogas as fuel has not been optimum even can be said is still low compared to the potential. Biogas can be produced from wastes (agriculture, household, farm, etc.), but from various studies and experiments, the best biogas is produced from livestock manure. Initially, the biogas produced from livestock manure was not approved by the community because of the public's perception that cow dung/manure is dirty and inappropriate to be used for lighting and cooking. Over time these perceptions have changed and biogas is more accepted, but the utilization of biogas is still not optimal, various obstacles arise. This paper provides an overview of the barriers in biogas dissemination in West Java-Indonesia, among others, the investment is expensive, the process is considered complicated, the reluctance to manage the digester like filling cow dung, etc. Knowledge of these barriers can be used for designing the method in disseminating also the pattern/model of biogas development and application in a community to be accepted and sustainable. Information was extracted by observation and survey, interview and learning from various studies and reports. In addition, action research was also conducted in Subang, Sumedang, Bandung of West Java. Results from the studies and action research, show that biogas is actually needed by society, especially in rural areas, if its price is affordable and its operation is easy or not complicated, and also supported by policy.

1. Introduction

Biogas as alternative energy has long been developed in Indonesia since the 1980s [1]. Biogas can be produced from wastes (agriculture, household, farm, agroindustry, etc.), but from various studies and experiments, the best biogas is produced from livestock manure. For instance, the research on cow dung/manure for biogas production by Abubakar and Ismail [2] and a report on biogas implementation [3] showed that cow dung is an effective feedstock for biogas production achieving high cumulative biogas yield with stable performance, with a continuous process. From experiences of Sriharti’s research on biogas from varieties of wastes (households, vegetables and fruits, and animal manures), vegetable waste gives a high yield of biogas, but vegetable wastes alone cannot produce biogas; it has to be mixed with manure in batch or semi-continuous anaerobic digestion [3]. Therefore animal manure, i.e. cow dung is more favorable in the biogas process. By using wastes, next to providing energy and organic fertilizer, it also maintaining environmental sustainability. However, the utilization of biogas as fuel has not been optimum, even can be said is still low compared to the potential [4]. Biogas technology was introduced in Indonesia in the 1980s [1]; however, until now the utilization of biogas in Indonesia is still low, while environmental aspects are still not becoming people’s concern, especially in rural area.

At the beginning of biogas development, especially biogas from animal wastes (cow dung for example) was facing high resistance from the people. Resistance was due to the perception that wastes were dirty and not proper to be used for cooking [5,6]. Nowadays people’s perception already changes
and they can accept the use of biogas for cooking, especially when other fuels (such as kerosene, LPG and firewood) were expensive and difficult to get or of limited availability.

Biogas development and dissemination in Indonesia were targeted for households, at the beginning for electricity, and now mostly for cooking. The targeted areas for biogas dissemination were areas where the community raise livestock, especially cattle, such as the case of biogas dissemination in West Java. Biogas development and dissemination in West Java were not only promoted by the government but also by private organizations (NGO), and there is also a demand from the people although in a very little amount. However, the utilization of biogas as fuel has not been optimum even can be said is still low compared to the potential. The study in West Java is an evaluation of biogas dissemination in the community and how they use it.

2. Methodology
The study was an evaluation study through observation and interview to collect data and information. Data and information gathered were then analyzed and interpreted with descriptive analyses by linking the program of biogas development and dissemination with the tested theory [7]. In this study, the theory referred to technology as the solution to problems in the community. Here the technology was biogas and the problems were wastes that become pollutant to the environment. In this matter, the program would operationalize the theoretical concept where biogas was expected to solve the waste problems. For testing the theoretical concept then specific goals were stated, namely (1) Increasing the use of wastes as source of energy, (2) Increasing the use of wastes as organic fertilizer, (3) Reducing the amount of wastes being dumped into the river, (4) Reducing the use of fuel oil or gas (un-renewable fuel), (5) Changing the habit of community in managing wastes (utilized the wastes rather than throwing it into the river).

In relation to theoretical linkages, it can be seen the goals are as follows:

- **Goal 1:** Increasing the use of wastes as sources of energy by producing biogas.
- **Goal 2:** Increasing the use of organic fertilizer by processing wastes and remaining biogas fermentation.

By accomplishing the first two goals, it would lead to **Goal 3:** Prevent river pollution by reducing the amount of waste thrown into the river and reducing air pollution by processing the waste, and **Goal 4:** Reducing the use of fuel oil or gas.

In the long run, it will also lead to **Goal 5**, which is changing the habit of the community in managing the wastes into more benefit activities or products. If these goals were accomplished, the program would be considered successful. If the program is not accomplishing the goals then analyses will also be conducted to factors that become the barriers in accomplishing the goals. The analyses then can be used to improve the program or for planning such programs in different areas.

3. The dissemination of biogas
In this study, three districts in West Java province, i.e. Subang District, West Bandung District and Sumedang District become the study areas where biogas was disseminated. In the first two districts, the biogas was disseminated among farmers which also have cattle, while in the last district (Sumedang), the biogas was developed for tofu small enterprise. The type of biogas digester was also different between the one disseminated among farmers and tofu entrepreneurs. Materials used for biogas production are different, namely cow dung for digester in farmers and tofu liquid waste for digester in tofu enterprise.

The biogas developed among farmers was targeted for household needs, i.e. cooking, as an alternative in reducing environmental pollution, because the habits of farmers are to throw cow waste into the river. Actually, the cow dung was already used as organic fertilizer, but the dung production was higher than the capacity to produce fertilizer. In addition, in West Bandung District there was a belief that chicken manure was much better for organic fertilizer. On the other hand, in Sumedang, the biogas was developed as an effort to solve the problem of liquid waste from tofu production that was polluting the river, which odor disturbed the community live surrounding the tofu enterprises. The
biogas developed and disseminated in the study areas was mostly promoted by government and NGOs (80%) and 20% were self-financed.

3.1. The dissemination of biogas in Subang District
In Subang District, the study was conducted in four areas for evaluating biogas that has been disseminated at different times, from 1994 to 2015. The study subjects were farmers who also had at least two cattle per household, referring to previous studies that show that to produce biogas that can be used to meet fuel needs for household daily activities, at least each household have to have two cattle.

3.1.1. Cigeurang Hamlet of Sagalaherang Sub-District. In Cigeurang Hamlet there were 15 biogas digesters with the capacity of 6 - 8 m³ from the program of the Energy Mining Office and private enterprises. Cigeurang Hamlet was a dairy farming area with the ownership of cows was between 5 to 19 per farmer. The biogas produced was used to boil water for the sterilization of cow's nipples, which was done twice a day in the morning and evening. Biogas needs for cooking 10 liters of water was 1,020 liters, twice in a day. Other used of biogas are for cooking rice and dishes three times a day for 3 hours per day for 1 family, the required biogas was 1,830 liters. The total biogas requirement was 2,850 liters per day. Digester capacity of 6 m³ was a digester standard for the needs of 1 family having 4 cows. The amount of cow dung available was around 125 to 380 kgs per day, the waste that was used for filling the digester was around 60 kgs, so there was still about 65 kgs of cow dung. Some of it was used for agricultural fertilizer for farmers who had dual professions as a cattle farmer and land farmer, and they dumped the rest of the waste into the river. Even though biogas production could be increased by increasing the amount of cow dung put into the digester, due to the biogas need was only 2,850 liters per day, therefore they also limited the amount of cow dung put into the digester.

The biogas produced here can replace LPG as a fuel, which average consumption is 4 tubes (of 3 kgs size LPG tube) per month. If the cost is IDR 25,000/tube, by using biogas, the farmers can save IDR 100,000 per month. The farmers actually feel fortunate with the use of biogas, especially when the availability of LPG is rare. In certain times, such as at Eid (Islamic holiday), LPG is difficult to get because the demand is quite large, while the availability is limited. At present, there is a government policy that will revoke the 3 kgs LPG subsidy, and replace it with a bright gas of 5.5 kgs at a price of IDR 65,000. Considering this condition, the use of biogas become more beneficial for the people.

3.1.2. Sukatengah Hamlet of Compreng Sub-District. In Sukatengah Hamlet, there was only one farmer with 8 cows who had a digester with a capacity of 5.5 m³. The digester came from the government program which implemented in 2014. The biogas produce was used for cooking drinking water, rice and dishes. In a family of 2 people, cooking time was 1.5 hours per day, the amount of biogas consumed was 915 liters per day. The amount of cow dung put into the digester was 3 buckets or 21 kgs per three days. Each cow produced 10 kgs of waste per day, in total the amount of cow waste was 80 kgs per day. The waste that was not used for biogas was dried, and once every two months was sold for fertilizer.

The benefit was already felt by the farmer, but it was not yet become a need. This was shown by the reluctance in continuing in using biogas. Recently, the digester was abandoned because the stove using biogas was broken, while on the other hand, the farmer could get LPG easily.

3.1.3. Cadasngampar Hamlet of Kasomalang Sub-District. In this location, there were two digesters with the capacity of 15 m³, utilized by 15 members of the dairy farmer group, each member had 5 to 15 cows. The digester was located in a farm area which had around 140 cows. Biogas was only used for cooking for 15 families. Biogas could not be used to sterilize milk, because the distance for distribution, around 35 meters, was too far and therefore it had low pressure which in effect the flame produced was low. Although Wanwewe stated that the distance from the digester to the gas consumption is insignificant [8], in this study area it was found that distance significantly affected the biogas produced for consumption. This condition was in accordance with Wahyuni’s research, which proposes the ideal distance of the digester to the kitchen or gas consumption is approximately 20 meters [9]. However, in
this area, not only the long distance but the biogas was also distributed to 15 households. In order to increase the biogas pressure so it can be used for cooking in small-scale businesses, a compressor must be added [10].

3.1.4. Tambakmekar Village of Jalancagak Sub-District. In this location, there were two digesters in different locations. One digester with the capacity of 1 m³ was located in a village and belonged to a farmer who built it by his own initiative. The other one was located in the Educational Foundation, it was built by support from students’ parents organization, the capacity was 50 m³ with the price of IDR 50 million, and it had to be repaid in three years.

The digester located in Educational Foundation had low production of biogas with a small pressure and therefore could not be used for daily cooking but only to boil water. The aim of biogas development in this area was for daily cooking for students, as it was a boarding school. The reason for the low production of biogas was because the one who managed the biogas program did not really understand the technology as the materials they put into the digesters were kitchen wastes that still had high water content.

The other digester in the community with low capacity also had low production of biogas. Here, the materials for producing biogas were also kitchen wastes with high water content. The digester did not produce enough biogas for daily cooking, which was the aim of developing biogas in this location. However, they still used it for daily cooking besides kerosene. In this case, it was only reducing the use of kerosene and was not replacing it.

3.2. West Bandung District
In West Bandung District biogas was disseminated in three (3) different areas and different times. But all targeted community were farmers who have cattle, at least two cattle per household.

3.2.1. Barunagri Hamlet. In Barunagri Hamlet, biogas was disseminated in 2004 by an NGO through Local Cooperative. The targeted people were farmers that also had cattle, and in this area, each household had 3 cattle on average. Here, the people were offered biogas technology by building a digester in each household, with the capacity varied from 2 m³ up to 6 m³. The NGO offered subsidy around 1/3 of the price of the digester, and the rest could be paid in instalments through the local cooperative. The instalments were paid by their production, which was milk of 20 liters twice a month. With this offer half of the farmers (around 30 households) who had cattle applied for the program, as they had problems in discarding the cattle dung except just throwing it in the sewers that flow directly into the river and causing environmental disturbances. The digester was built near the cattle shed, which was also near to their house. This condition was actually not healthy, but the first concern was how to discard their cattle waste without disturbing the environment.

In this area, most of the people (around 70%) still used the biogas they produced for their daily activities, which were cooking and cooking water for sterilizing cow’s nipples. The biogas here was managed to substitute LPG for cooking activities, except during several events such as on the feast of Eid where cooking activities increased and consequently also the need for energy. In this case, LPG was also needed. The other 30% of the people were not using biogas due to several reasons such as their cattle were already sold, the location of the digester was far from the cattle shed, they were reluctant to collect the cattle wastes to be put into the digester, and for some people, the activities in operating the digester was troublesome. In order to produce biogas, the digester must be fed with cow dung twice a day, in the morning and evening, which was to some people were disturbing their daily activities. Other than that, some farmers had only limited land so they prefer to use their limited land to extend their house by closing the digester.

3.2.2. Cikole Hamlet. There were eight digesters disseminated in this area supported by an NGO, with two different capacities; the 9 m³ capacity digester was built for 1 household, and the 15 m³ capacity digester was built for two households. On average each household had 6-10 cattle that produced as much
as 150-250 kgs waste per day. On the other hand, the digester only needed 60 kgs per day, therefore not all the wastes could be used.

Biogas was used to cook 10 liters of water for sterilizing cow’s nipples, which was done twice a day, in the morning and evening and consumed 1,020 liters of biogas. Next to cooking water, it was also used for cooking rice and dishes about 3 hours per day; these activities consumed 2,850 liters biogas per day. Before using biogas, they used kerosene for cooking, and for these activities, they needed 30 liters kerosene per month at a price of IDR 8,000 per liter, so they spent IDR 240,000 per month. By using biogas, they did not have to spend money on fuel.

The biogas was disseminated in 2015 but recently was not used anymore due to people reluctant to collect the cow dung for the digester that was located far from the cowshed. In turn, the production of biogas was low and was not enough for their daily needs, and therefore they abandoned the digester.

### 3.2.3. Cibodas Village
In Cibodas Village, there were 255 dairy farmers who had about 125 biogas digesters scattered in 5 hamlets. The digesters were obtained from Biogas Program supported by NGO in collaboration with the Ministry of Energy and Mineral Resources. The digesters were obtained by credit and subsidy of 20-40%, the funding was managed by Local Cooperative. Biogas was used as a fuel for household cooking which replaced LPG. Cooking time was around 3 hours per day, biogas consumption per day was 2,850 liters. Before using biogas, the people used LPG, 3 tubes per month; one tube equal to 3 kgs at the price of IDR 25,000 per tube. On average, people spent IDR 75,000 per month for LPG, and they did not have to spend it if using biogas.

The biogas was disseminated in 2010 but recently was not used anymore because they already sold their cattle. To get the cattle wastes, they had to collect it from other areas which were far from the location of their digester. They also abandoned their digester as it happened in Cikole Hamlet.

### 3.3. Sumedang District
The digester was located in West Conggeang Village with the capacity of 10m³. The digester was implemented as a solution for handling liquid waste from tofu production. In this area, the material for biogas production was the liquid waste from tofu production called whey. The whey caused bad smell and it disturbed the people lived surrounding the tofu enterprise. The capacity of tofu production was 100 kgs per day, and it produced 4,350 liters of whey which was dumped in the ditch and went to the river. With biogas program, the whey was then flowed to the digester. The first focus of the biogas program here was to use the biogas from whey for cooking in the tofu processing. Cooking 100 kgs soybeans to produce tofu requires 27.2 kgs of LPG [12], equivalent to 118 m³ biogas. Biogas produced by the digester was about 1.5 m³ per day, and according to Raliby et al [11], it was enough for daily cooking in one family consisting of 4-5 people. On the other hand, Sriharti et al [1] showed that biogas need for cooking activity in 1 family for 3 hours was 1.83 m³, therefore the biogas produced here was insufficient not only for tofu processing but also for cooking activity.

### 4. The barriers of biogas dissemination
From the evaluation of biogas dissemination in three districts in West Java, some has successfully accepted and used by the community, but some others were abandoned. Figure 1 shows the users of biogas development in the study areas, which mostly were farmers who also cattle breeders. The average the farmers had 3 to 4 cattle per households, where minimal requirement to produce biogas for the family were two cattle per household.

The evaluation shows that biogas was mostly accepted when disseminated among farmers and cattle breeders. However, not all biogas disseminated were used by the farmers due to several reasons. At the beginning of the implementation/dissemination, they all used the biogas for their daily needs as shown in Figure 2.

In general, the biogas was used for daily cooking, as shown in Figure 2. Most of them used it for daily cooking and boiling water to sterilized their cow’s nipples. By using biogas, they reduced the use of LPG or kerosene; these two types of energy source were used by all people and sometimes were very
difficult to find. Although it could be used to replace or reduce the use of LPG or kerosene, some people also abandoned it after some times (Figure 3) for several reasons (Table 1).

Figure 1. The user of biogas in the study areas.

Figure 2. The use of biogas at the beginning of dissemination.

Figure 3. The use of biogas after dissemination.

Figure 3 shows that many people still reluctant to use biogas as the source of energy in their cooking activity. The condition was caused by using biogas was not as easy as using LPG or kerosene; there was a procedure that they had to perform in order to get good biogas. One thing that had to be done was always maintaining the digester to produce good biogas, which for several people was troublesome. Therefore, they still preferred the conventional energy such as LPG and kerosene. There was actually a question from the farmer: ‘Is there a technology that can make biogas easy to use, as easy as using LPG and kerosene?’ This question marks the desire of the community to be able to use biogas energy as easily as using LPG or kerosene.
Table 1. The use of biogas and its barriers.

| Location                        | Duration (Years) | Still Use         | Abandon | Reasons                                                                 |
|--------------------------------|------------------|-------------------|---------|-------------------------------------------------------------------------|
| Sagalaherang-Subang            | 3                | 100 Daily cooking |         |                                                                         |
| Cicadas, Sagalaherang-Subang   | 3                | 100 Daily cooking |         |                                                                         |
| Educational Foundation, Cagak-Subang | 4          | 100 Boiling water |         |                                                                         |
| Cagak-Subang                   | 3                | 100 Daily cooking |         |                                                                         |
| Compreng-Subang                | 3                |                   | 100     | Biogas stove was damaged and it was easy to get LPG                     |
| Kasomalang-Subang              | 5                | 100 Daily cooking |         | Fired-gas was too low, could not be used to boil milk                   |
| Cikole-West Bandung            | 5                | 50 Boiling water  | 50      | Location of the waste collection was far from the digester, reluctance to collect the waste |
| Cibodas-West Bandung           | 7                | 100 Daily cooking |         |                                                                         |
| Barunagri-West Bandung         | 13               | 70 Daily cooking and boiling water for sterilization of cow’s nipples | 30 | The digester was too far from the cow-shed, small landholder, reluctance to take care of digester |
| Conggeang-Sumedang             | 19               |                   | 100     | Fired gas was too low, could not be used for tofu production           |

Table 1 shows that in general, people using the biogas have felt the benefit of biogas. But on some occasions, it is not used or abandoned because it was not meeting the people’s need. If we look at Table 2, all biogas use was for daily cooking. This is very good because it can reduce dependency on fuel. But in some locations, the development of biogas did not pay attention to surrounding hygiene. For instance, many digesters were built near cow sheds and houses, because the cow sheds are located next to the house. Referring to health, this condition does not support its surrounding hygiene, but referring to accessibility, this condition supports the production and utilization of biogas.

Next to biogas, biogas process also produced a mud-like material called slurry, which can be used as organic fertilizer. But not all people use slurry for fertilizer, as shown in Table 2. For organic fertilizer, there were other choices such as organic fertilizer from chicken and sheep manures, which according to them gave better results.

Table 2. The use of slurry.

| Activity                         | %  |
|----------------------------------|----|
| Used as organic fertilizer in farming | 42 |
| Rarely use                       | 14 |
| Not used, just left it           | 44 |
| Total                            | 100|

Table 1 also indicates that the barrier toward biogas development can be categorized into two aspects, namely technical and social barriers, which is further elaborated in Table 3.
Table 3. The barriers of biogas development.

| Location         | Technical barriers                                                                 | Social barriers                                      |
|------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------|
| Compreng-Subang  | Biogas stove as a supporting technology was needed in order to use biogas          | Easy to get other energy such as LPG                 |
| Cikole-West Bandung | Biogas production was too low, only enough for boiling water for cow’s nipples sterilization | The cowshed was too far, causing reluctance in collecting cow dung |
| Barunagri        | Biogas production was too low, only enough for boiling water for cow’s nipples sterilization | The cowshed was too far that caused reluctance in collecting cow dung, there was no land to build the digester, reluctance to take care of the digester, disturbing their daily activities especially in the morning |
| Conggeang-Sumedang | Biogas production was too low and the fired gas was too small                        |                                                     |

Table 1 and 2 describe that actually, people are beginning to accept biogas as an alternative for energy as long as it is easy and practical. It is showed when other energy sources such as LPG and kerosene is very easy to obtain, they will choose it rather than biogas. Because LPG and kerosene already establish with the availability of supporting technologies, such as the stove and easy to carry. While for biogas, it has to use a specific stove for biogas that has limited availability. When the stove is broken, it is difficult to replace and workshop that can repair it is still limited. Here was the indication that biogas development is still lack of supporting technology that makes biogas is easy to use.

The social barrier is often ignored in development activity such as biogas development [13]. In this study, the social barriers as shown in Table 3 generally referred to people’s habit such as reluctance to collect cow dungs, due to the distance from the plants to the user’s location was too far. They also felt that it was too troublesome to maintain the digester. In order to get high production of biogas, the digester should be filled with cow dungs twice a day in the morning and evening, or at minimal once in a day. The procedure in producing biogas are: cow dung is mixed with water in a ratio of 1:1, then stirred until homogeneous in a tank or container, then the mixture is put into the digester. The purpose of stirring is to accelerate the fermentation process, thus also accelerate biogas production. These activities to some people were considered as troublesome. Here, the people preferred to have energy that was easy to get and also practical to use such as LPG or kerosene; when the stove was broken, they could replace it easily. The barriers to the dissemination of biogas technology can be extracted as shown in Figure 4.

5. Discussion
Table 1 and 2 describe that biogas dissemination in the community was used but not optimal. They only use biogas according to their needs, not comparable with their potential. For example, on average the dung produced per one cow is 95 kgs per day, one family on average have 3-4 cows and produced around 380 kgs dung per day. For filling the digester, they only used 60 kgs, and therefore there were 225 kgs or about 79% cow dung left unused. In some areas, they processed it as fertilizer, but most of it just dump it into the ditch that directly goes to the river. This practice shows that they were not aware of the environmental aspects of biogas development. In 2017, the Government of Bandung Municipal has already complained that the people from West Bandung District have polluted the river that flows to the city by dumping the cow’s dung into the river. They already contaminated the water source for drinking water, therefore the government has asked the people not to dump the cow dungs into the river and offering a program to use the cow dung for worm breeding and fertilizer. But the people still dumped the cow dungs into the river, they do not want to process it as fertilizer as they believed that fertilizer from chicken and sheep wastes are better. For the people, it is just easier to just dumped it into the river.
Figure 4. The chart of barriers in biogas dissemination in the study area.

Technical barriers found in the study areas mostly deals with the material they put into the digester. Quality of the input material will affect the biogas produced, and people did not really concern with it. How they mix the cow dungs with water and the proportion is important, and some of the farmers and cattle breeders feel the reluctance to do the mixing. This condition happened because most of the people did not really understand biogas technology. Other than that, the supporting technology, i.e. biogas stove and the repairing service for biogas are rarely available.

Overall, the development and dissemination of biogas can be seen as successful as many of them still use biogas in their daily activities. However, the people still do not aware of the goal of biogas development which is related to environmental and energy alternative. Looking back at the goal of the biogas program, it can be said that it is not 100% successful because it does not meet all the goals. Goal 1 and 4 have been partially fulfilled: people use the biogas for daily cooking and boiling water, and some of them replace or reduce the use of fuel oil or gas. By producing biogas, the amount of waste dumped into the river was reduced. However, when faced with alternatives which energy source they will choose if all kind of energy is available and easy to get, they will choose the one that can be got easily and practical to be used and also cheap, such as LPG and kerosene. These two energy sources were already established with supporting technology such as the stove, compared to biogas which is still limited. In addition, when the biogas stove broke, they cannot replace it and therefore they abandon biogas.

Referring to Goal 2, not all people in the study area are willing to process the cow dung as fertilizer, as there are other alternatives that considered as giving better results. For this reason, they do not produce fertilizer from cow dungs and do not use the slurry for fertilizer either. With this condition, the biogas program cannot meet Goal 2. Even though the amount of cow dung thrown into the river decreases (Goal 3), but the habit of people does not change. The people still throw away the remaining cow dung into the river and therefore Goal 5 cannot be achieved. People are still not taking environmental aspect into their consideration.

6. Conclusions and recommendations

6.1. Conclusion

Barriers in biogas development from the study can be concluded as follows:
1. Technical barriers occur due to the lack of understanding of biogas technology, namely reluctance in maintaining the digester due to the lack of training, extension, and technical assistance.

2. Social barriers concern with people’s habit:
   a. Reluctance to fill the digester twice a day (morning and afternoon), especially in the morning because they have many activities thus fill in the digester with cow dung is considered as bothersome.
   b. Biogas is produced just enough for daily cooking, no motivation to expand although the potential is high.
   c. Preference for energy technology that is easy to use and get such as LPG and kerosene.
   d. Dump the dung into the river is still felt easier than process it for biogas. This is indicated by the lack of motivation to expand the digester.
   e. The community have not yet considered the environment in biogas development, therefore they still dump the dung into the river if not use for biogas production.

6.2. Recommendation
Theoretical concepts are not always in accordance with reality; adjustments always have to be made in accordance with the conditions of the location and the community. In this study, the concept of biogas development was conducted within the frame of saving the energy and maintaining the environment by using waste to produce alternative energy, which will reduce air and river pollution and also saving the use of fossil fuel (non-renewable energy). For the reasons, implementation of biogas needs more than just technology approach:

1. A policy that not only focuses on the financial aspect by providing a subsidy for biogas development, but also has to be equipped with other supporting facilities such as the availability of supporting technologies (e.g. stoves for biogas), workshops that can handle technical problems related to biogas technology, and personnel capable of handling biogas.

2. Policy related to the environment that forces people to always pay attention to their environment, such as not throwing cow manures into the river. At present, the community is free to throw cows manure into the river because there are no penalties for it, though there is an appeal for not throwing wastes to the river.

3. Intensive extensions and assistance for community concerning the concept of biogas technology and development.

Acknowledgement
Our gratitude to the Development Centre for Appropriate Technology LIPI (DCAT-LIPI) for providing funds and support in this study, also to the Head of DCAT-LIPI for the support during the research and writing of this paper. Our thanks also go to the researchers who have helped in this activity: Takiyah Salim, Rislima F. Sitompul, Edi Jaenudin, community and local government in the study area.

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