Toward a Pesantren of Self-Sufficient in Energy by Improvement of Cow Cattle Results through a Balanced Ration and Utilizing Biogas of Cow Dung

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Abstract: The community outreach programs discussed in this paper is focused to the effort to realize a self-sufficient pesantren in energy and food needs, especially the needs of fuel for cooking and the needs of electricity for lighting by using cow dung to be processed into biogas. This program was implemented in the Entrepreneurial Pesantren of Sunan Kalijaga which is located in the hamlet of Jomblangan Bantul, Special Region of Yogyakarta who have bussines in the field of dairy farms and agriculture. Biogas produced from waste will also be utilized to provide an organic fertilizer that will be beneficial for farming. So a sustainable synergies between the boarding schools with its business will be realized. Strategies to improve cow cattle results refer to the research results of the National Academy of Science. That is the population of cows are divided into three groups: heifer, 3 – 4 parent for the first month after childbirth and the bull. Then for each group, balanced rations are formulated between rice straw, combines fine bran, coconut shell, elephant grass and cassavas. Whereas to carry out the road-map utilization of cow dung, the following things are done: 1) outreach to the citizens of the pesantren to socialize the utilization of cow dung as biogas and organic fertilizer as well as solid or liquid, 2) coordination with the pesantren for arrangement of cages and construction of biogas installations from cow dung, 3) construction system of biogas installations, and 4) carry out three kinds of outreach, namely the outreach of use and utilization of biogas for cooking and illumination, outreach of biogas installation system maintenance management, and outreach about the making and marketing of organic fertilizer and medicinal insect exterminator. The result of the above strategies are proven can reduce the pesantren spending in terms of cooking and electricity costs and increase the pesantren revenues of cows fattening.

Keywords: Pesantren of Self-Sufficient in Energy, Balanced Ration, Biogas.

Introduction

The community services program presented in this paper is addressed to the pesantren (*islamic boarding school*) who has an entrepreneurial in the field of dairy farms and agriculture. The purpose of this service program is to realize an independent pesantren in sufficing its energy and food needs, especially the needs of fuel for cooking and electricity for lighting by using cow dung to be processed into biogas. Biogas produced from the dung will also be utilized to provide an organic fertilizer that will be beneficial for farming. So, there is a sustainable synergies between the pesantren and its dairy farms and agriculture businesses.

The subject of this outreach program is The Entrepreneurial Pesantren of Sunan Kalijaga which is located in the hamlet of Jomblangan Banguntapan Bantul, Yogyakarta Special Region. According to the data on population of Bantul Regency, the pesantren is located at the area of under developed region with the majority of its citizens still belongs to a poor family (Widati, 2015). Here we describe the reason to select the Entrepreneurial Pesantren of Sunan Kalijaga as the subject of this program.

1. The pesantren has an adequate resources that consist of 32 cows and agricultural land.
2. The cow cage is located in the one complex with the pesantren. So, if the installation of biogas system is made in this place, then gas will be easily transmitted into all of pesantren area to be used as cooking fuel and lighting.
3. The pesantren has long been engaged in dairy farms and agriculture but they have some diviculties to develop their programs. This is because the human resources are still full of limitations.
4. The pesantren has had a business relationship to sell the cows and their agricultural products.
5. The availability of land for the installation of biogas which the land has blong to the pesantren. This wide land is very suitable to build biogas installation system, as well as fixed or floating system.
6. The layout of fields and orchards which is adjacent to the biogas installation system supporting the biogas waste processing results in the form of organic fertilizer is easily distributed.

Description of Pesantren's Condition

To get a description of the problems faced by The Entrepreneurial Pesantren of Sunan Kalijaga, some preliminary research were done. They

were survey to the location, interview with the chairman and members of the pesantren, and doing a comparative study to another pesantren in the Kweni hamlet that have successfully implemented a biogas installations system. Whitin these preliminary research and survey we found the following facts.

1. The growth of the cows are not optimal due to the given ration is still traditional (only the rice straw) and not pay attention to a balanced nutrient supplementation. As a result the weight of the cows is not ideal and imposes the decline of the selling value.
2. The pesantren needs a considerable cost to buy LPG for cooking the students food and to pay the electric bill to PLN. According to the obtained data, the pesantren must pay an average of Rp. 6,000,000.0 per month to buy LPG and Rp 1,550,000.0 per month to pay the electric bill. On the other hand, the pesantren income was minimal because only relying on funds from donors.
3. The occupants of the pesantren do not have any knowledge about the composition of a balanced ration for cows and cow manure utilization for biogas.
4. The agricultural production is less than they expected because of the difficulty in providing fertilizers. This condition will disrupt the growth process of the rice plant which will result a minimum grade in some agricultural products that is far from their expected target.
5. The environment and land are dirty because cow dung. Besides the unpleasant smell, the presence of cow dung also pollutes the soil, wastes the scene, and could be a disease factor.

Aims of the Program

According to the community problem mapping in The Entrepreneurial Pesantren of Sunan Kalijaga, this community outreach program is expected to improve the community pesantren social life with the following details:

1. Increasing the revenue sources for the pesantren by improving the productivity of cow reproduction and its weight through the granting of a balanced ration.
2. Embodying the pesantren of self-sufficient in energy by utilising cow dung to be processed into biogas as a source of cooking fuel. The biogas will replace LPG and electric generators (for lighting) and its waste will be processed into organic fertilizers for agricultural crops.

3. Increasing the capabilities and knowledge of the pesantren residents professionally and efficiently in utilization techniques of biogas and balanced rations.
4. Increasing the quality and quantity of community agricultural products through the utilization of organic fertilizer from cow dung
5. Increasing the quality of soil that has been contaminated by the manure.
6. Creating a clean, health and comfort environment that is free from pollution of cow dung.

Strategies

Based on some various problems found during the survey, then we formulated it in order to draw up solution steps according to the achievements of the expected conditions. We preseme that the Entrepreneurial Pesantren of Sunan Kalijaga problems are quite complex, so it need a phasing to solve. Another thing that is not less important and indispensable is the role of the community itself.

Therefore, we draft a roadmap to overcome the problems and its sustainability until the pesantren can reach its ability to solve the problems in their own environment (as shown in Figure 1).

According to the above road-map, basically there are two clusters of strategy to realize the pesantren self-suffivient in food and energy. The first cluster is a strategy for increasing the yield cow cattle through the granting of a balanced ration as nutrient supplementation and the second cluster is the utilization of cow dung as biogas and solid or liquid organic fertilizer.

To implement the strategy for increasing yield cow cattle, according to the research of the National Academy of Science (Hui and Sherkat 2005, Brus 2015) the population of cows in the pesantren are divided into three groups: heifer, lactation cow: 3 – 4 parent for the first month after childbirth and the bull. Following is the granting of a balanced ration strategies set out in the framework of the improvement of cow cattle results for each group.

The nutrient substances need of heifer of 300 kg body weight (BW) and with its expected gaining weight (EGW) 500 g per day are presented in Table 1 below (Reddy and Sivakumar, 2015).

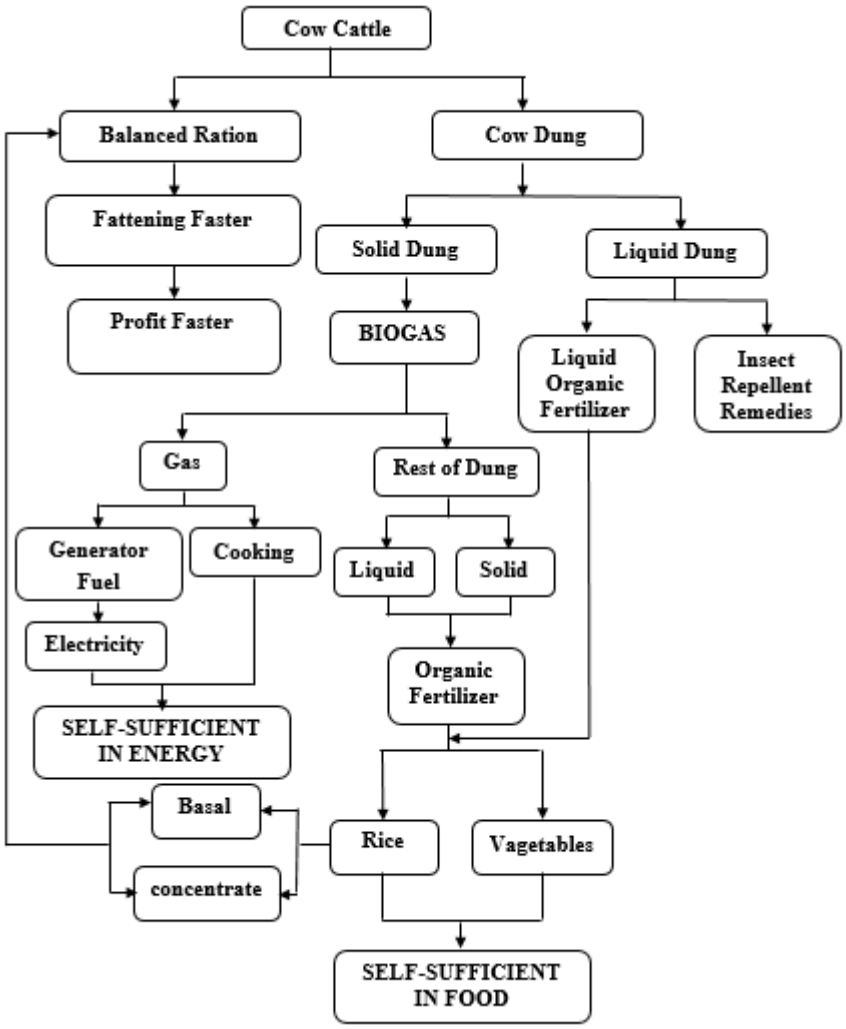

Figure 1. Optimization Road-Map of Cows Cattle

Table 1. Nutrient substances needs for heifer BW 300 kg EGW 500 g/day

Body Weight (kg)	EGW (kg/day)	BK (kg)	TDN (kg)	PK (g)	Ca (g)	P (g)
300	0.5	7.1	3.8	423	14	14

According to Table 1 and by assuming the consumption of rice straw is restricted to 1.33% body weight, using the method of Pearson squares (Bactawar, 2005) gained the nutrient substances needs that are presented in Table 2 below.

Table 2. Composition of the balanced nutrient substances for heifer

Items	**BK (kg)**	**TDN (kg)**	**DP (kg)**	**Ca**	**P**
Rice Straw	4.00	2.40	96	8	3
Fine Bran	2.06	1.25	130	14	31
Coconut Shell	1.05	0.82	209	3	7

Total	7.11	4.47	435	25	41
Needs	7.10	3.80	423	14	14

Next, a lactation cow requires a higher food substances because of lactation. The balanced ration needs for this group are presented in Table 3 below.

Table 3. Nutrient substances need for lactation cow

Items	**BK (kg)**	**TDN (kg)**	**PK (g)**	**Ca (g)**	**P (g)**
Nutrient need for lactation cow	8.1	4.5	505	24	24

According to Table 3 and using the method of Pearson squares (Bactawar, 2005), the nutrient substances needs for lactation cow are presented in Table 4 below.

Table 4. Composition of the balanced nutrient substances for lactation cow

Items	**BK (kg)**	**PK (kg)**	**TDN (kg)**	**Ca**	**P**
Elephant Grass	70	482	3.5	41.3	20.3
Coconut Shell	1.1	238	0.726	0.88	7.37
Total	8.1	720	4.23	42.2	27.7
Needs	8.1	721	4.5	24	24

For the bulls, according to the research of the National Academy of Science (Hui and Sherkat 2005, Brus 2015), its balanced ration needs are obtained in Table 5 below.

Table 5. Nutrient substance needs for bull

Items	**BK (kg)**	**TDN (kg)**	**PK (g)**	**Ca (g)**	**P (g)**
Nutrient needs	7.6	5.2	535	21	18

According to Table 5 and by the assumptions that the consumption of rice straw are restricted to 1.33% of the body weight, using the method of squares Pearson gained nutrient substances needs that are presented in Table 6 below.

Table 6. Composition of the balanced nutrient substances for bull

Items	**BK (kg)**	**TDN (kg)**	**DP (g)**	**Ca**	**P**
Rice Straw	1.80	1.06	40	3.78	1.44
Fine Bran	3.14	1.90	200	20	50
Coconut Shell	1.44	0.95	310	4.32	9.65
Cassavas	1.22	0.84	20	1.22	0.49
Total	7.60	4.75	570	29.32	61.58
Needs	7.60	5.20	535	21	18

To carry out the road-map utilization of cow dung, the first thing to do is to educate the pesantren residents to promote the use of cow dung as biogas and organic fertilizer either solid or liquid. The second step is the coordination with pesantren residents for cage arrangement and construction of the biogas installation. As it goes, the third step is to prepare tools and materials for the construction of biogas installations that directly followed by the fourth step that is the construction of a biogas installation system. The fifth step of this service program is doing some counselings. There are three kinds of counselings related to biogas given to the community and especially the residents of pesantren, they are (Putro, 2007):

1. technical education about the use and utilization of biogas for cooking,
2. technical education about the care management of biogas installations system,
3. technical education about manufacturing and marketing of organic fertilizers and insecticides.

Counseling to pesantren residents on the use of cow dung as biogas is expected to open the community horizons about the alternative sources of fuel besides oil (kerosene). Coordination with the residents is done in order to rise up a community participation to solve their fuel problem. The materials include things that need to be prepared to build the biogas installation systems. Some equipments and materials were prepared by the pesantren with the guidance of us. Similarly, the construction of a biogas installation system was carried out by them. After the installation is completed, some counselings were given by the experts from Faculty of Science and Technology UIN Sunan Kalijaga.

Here is a map-solving concept togather with the sustainability and autonomy of community to be able to solve problems in their own environment (as shown in Figure 2 and Figure 3).

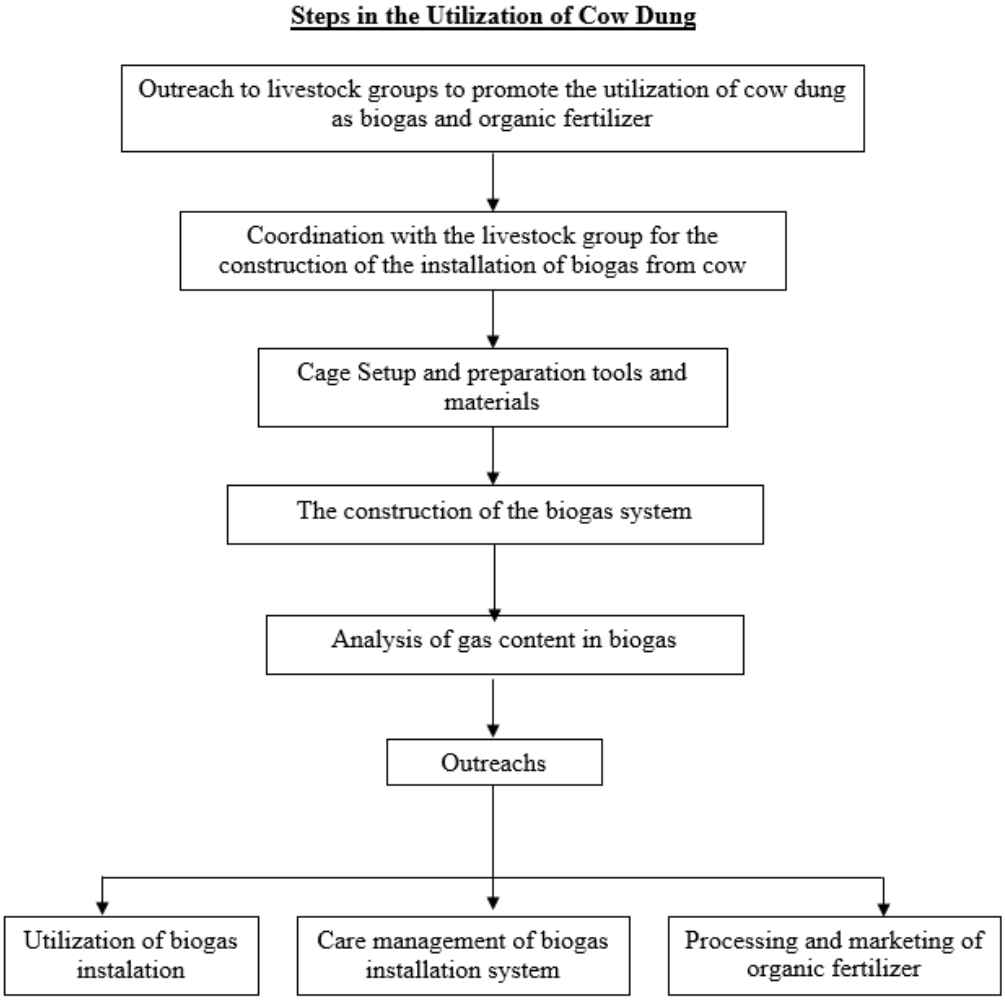

Figure 2. Map of-Concept Service Program

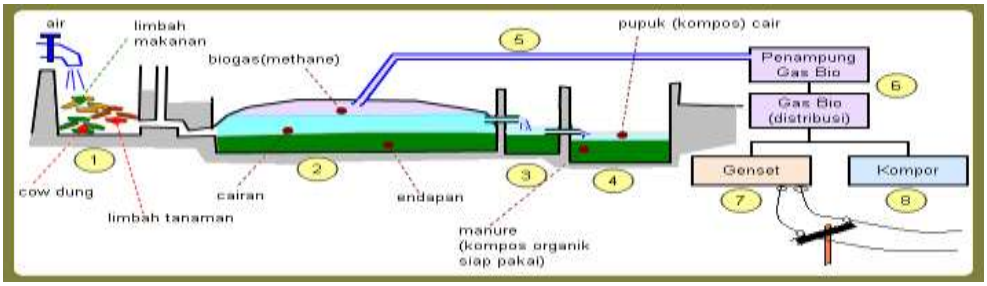

Figure 3. Sketch from the Installation Specifications and Biogas

Description:

1	Mixing tubs (Feed)	5	Biogas Pipes
2	Digester	6	Biogas Reservoir (Methane)
3	Control Tube	7	Genset (generator)
4	Typical analysis for digester effluent storage tubs containing ready-made organic compost	8	Gas Stove

Discussion of Needs Fulfillment Analysis

The analysis of energy fulfillment needs from biogas program for lighting and cooking fuel can be explained as follows.

Electrical supply energy from Biogas

The resulting energy from biogas

The combustion resulted from 1 cubic feet of biogas is equivalent to 0.028 m^3. Supplying this mass into the generator of electricity will be generated electrical power of 6 kWh/m^3. Furthermore, 1 kilogram of cow dung is equivalent to 0.031 m^3, where 1 m^3 of cow dung can produce 0.28 m^3 of gas. So, 0.031 m^3 of cow dung will produces

0.031 x 0036 m^3 gas = 0.00116 m^3 of gas.

It can be concluded that 1 kilogram of cow dung was able to produce 0.00116 m^3 of gas.

So the electrical energy produced by 1 kilogram of cow dung is

$$\frac{0.00116}{0.028} \times 6 \text{ kWh} = 0.239 \text{ kWh}.$$

According to the existing data, 1 cow produces 10-30 kilograms per day or around 20 kilograms per day. So from 1 cow, it will generated an electric power by 20 x 0239 kWh = 4.78 kWh. The ilustration of energy produced above is that from 1 cow, it could turn the lamp of 20 watts for 10 hours. Therefore the electrical power generated by

32 cows is 32 x 4.78 kWh = 153.28 kWh.

Needs of electricity per day in the pesantren

The Entrepreneurial Pesantren of Sunan Kalijaga has 25 rooms with size 10 x 5 m^2. Based on the survey, the average for each room there are:

- 2 lamps 20 watts to the inside of room,
- 2 lamps 10 watt for terrace,
- 1 10 watt power lights for the bathroom,
- 1 fan 20 watt,
- 1 television 14 inch 50 watts.

Thus, the total power required perroom is 140 watts. So if it is assumed the equipments are turned on for 12 hours per day, then in one day, the total electrical power needed by the pesantren is

25 x 140 watts x 2 hours = 49 000 watts or 49 kWh

(equivalent to the power generated by the 11 cows). Thus it can be concluded that the electrical energy required by the pesantren can be met by the biogas generated from cow dung.

Fuel supply for cooking

The resulting energy from biogas

Based on the data it is retrieved that 1 cow was able to produce 0.28 m^3 gas per day that equivalent to 1.90 kg of liquefied petroleum gas. This amounts is sufficient for 10 people cooking needs per day. So if the pesantren has 32 cows then it will generate
32 x 1.90 kg = 60.8 kilograms
of liquefied petroleum gas per day.

Needs of fuel for cooking per day

The Entrepreneurial Pesantren of Sunan Kalijaga had 100 students who became residents of psantren. Based on the above data were obtained that the need every 10 person is 2.4 kilograms of liquefied petroleum gas, so for 100 people it needed 38 kilograms of liquefied petroleum gas per day (the equivalent of gas produced by the 20 cows). Thus it can be concluded that the fuel for cooking required by the pesantren can be met by the biogas generated from cow dung.

Based on the above data, the pesantren needs of electricity and fuel to cook can be fullfilled by the 32 cows, with 11 cows to fullfill the needs of electrical energy and 20 cows to fullfill the needs of fuel for cooking.

Conclusion

This community service program has been successfully as expected. That is increasing the pesantren income resulted from fattening cattle and reducing the pesantren spending in terms of cooking fuel and electricity through the utilization of biogas. The knowledge and experience of the pesantren inhabitans also significantly increases. However, this program has not been loading utilization of biogas waste as organic fertilizer. So the program can still be followed by optimizing it.[]

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