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ANALYSIS OF BIOGAS UTILIZATION AS ENVIRONMENTALLY FRIENDLY ELECTRICAL ENERGY IN TANA TORAJA

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ABSTRACT

Biogas produced from livestock and agricultural waste is used by the community as a substitute for natural gas energy and as a substitute for electrical energy to provide gas needs for gas stoves and household electrical energy needs in Tana Toraja Regency. This study aims to analyze the level of community involvement in Tana Toraja Regency in utilizing biogas as an alternative energy source and a solution for livestock and agricultural waste. Furthermore, by using a quantitative approach, this research also aims to identify the impact of using biogas as an alternative energy for the community from an economic, social and environmental perspective. Biogas is one solution to the scarcity of posil energy sources and is an environmentally friendly alternative energy source. This advantage makes Biogas an energy source that has good prospects as an alternative energy substitute for non-renewable energy in Indonesia, which is currently experiencing an energy crisis, which is characterized by increasingly scarce and high fuel prices which have an impact on the higher production costs of power plants. The existence of renewable energy is something that is very important to meet energy needs in Indonesia.

Keywords: Biogas, Electrical energy, Renewable Energy

1) INTRODUCTION

The environment is often referred to as the environment. is a term that can cover all-natural living and non-living things that exist on earth or parts of the earth, which function naturally without excessive human intervention. Opposite of the artificial environment, which includes areas and components that are heavily influenced by humans. Understanding the environment is usually said to be everything around humans or living things that have reciprocal and complex relationships and influence each other between one component and another. In an environment there are two important components that form it so as to create an ecosystem, namely biotic components and abiotic components. The biotic component of the living environment includes all living things in it, namely animals, humans, fungi, plants and other living things, while the abiotic components are inanimate objects that are beneficial for the survival of living things in an environment which

includes land, water, fire, rock, air and so on. A deeper understanding of the environment in accordance with Law No. 32 of 2009 is the unity of space with all objects, forces, conditions, and living things, including humans and their behavior, which affect nature itself, the continuity of life, and the welfare of humans and living creatures.

According to Law no. 32 of 2009 Waste is the remainder of a business from/or activity while livestock waste according to Government Regulation No. 18 of 1999 is residual waste from a livestock business activity such as livestock raising, slaughterhouses, processing livestock products, and so on. The waste includes solid waste and liquid waste such as faeces, urine, food waste, embryos, egg shells, fat, blood, nails, bones, horns and others. The first step that is very important to know in managing livestock waste is the exact amount and characteristics of the waste. Knowing the characteristics of livestock waste is a very important factor in designing a biological treatment system. The characteristics of livestock waste can be divided into three groups of properties, namely, physical properties, chemical properties, and biological properties. Physically, the characteristics of livestock waste can be identified based on the form (solid, semi-solid and liquid), texture (compactness) and the amount (kg per unit of livestock) produced. Chemically the nature of the waste is determined by the composition of the chemical substances contained and the level of acidity (pH). Biologically, waste is determined by the type and population of microflora-fauna contained in it which is usually reflected by the type and population contained in the digestive system of livestock that produces the waste.

Bioenergy is now one of the renewable energy sources that is being massively developed in Indonesia, not only because the energy sources are easy to find in Indonesia but also because of the various variants. One of the energies including bioenergy is biogass. Biogass can replace natural gas. This gas comes from various kinds of organic waste such as biomass waste, human waste an animal waste. Biogas is a gas produced by anaerobic methanogenic bacteria (methane-producing bacteria that can only live in oxygen-free conditions) from the process of overhauling organic materials. Due to the flammable nature of methane, biogas can be used as an alternative energy source for the community. The biogas produced is used by residents as an energy source to replace electricity and LPG. The purpose of using this simple technology is to anticipate the scarcity of fuel oil and as an action to control environmental pollution. The target for the distribution of biogas can be said to be uncertain because most biogas programs depend on the interest of residents and local governments in the use of biogas.

Today, technological advancements in all sectors have led to a significant increase in the demand for energy. This requires the availability of unlimited energy with conventional energy sources that have begun to be limited. New and renewable energy has become one of the most popular energy supply solutions lately. One of the New and Renewable Energy (EBT) is Biogas. Utilization of biogas which is part of renewable energy is in line with government programs in order to encourage the development and utilization of New and Renewable Energy (EBT), especially bioenergy in order to achieve the target of EBT utilization[1] This study focuses on the potential of New and Renewable Energy (EBT) from livestock waste, and the various uses of biogas as EBT in the North Toraja area.Substantially: The content of the introduction is supposed to clearly mention the aims of your writing. It states your research problems or the question(s) you intend to address in your paper. Your introduction would typically include some variation such as the statement of your topic, problem or gap in knowledge, your forecast, as well as relevant literature reviews.

2) METHODS

This research in terms of methodology is quantitative research through survey research and experimental research in the form of True Experimental Design Variant Pretest Posttest Control Group Design Broadly speaking, this research uses a Research and Development R&D approach. Borg & Gall (Adi, 1997) defines research and development as a process used to develop and

validate educational products, with an R & D cycle consisting of studying research findings related to the product to be developed, developing products based on the findings, conducting testing, and revises to correct deficiencies found in the testing phase. In more stringent programs, the cycle is repeated until field test data indicate that the product has met the defined behavioral goals.

This research was conducted by collecting secondary data from previous studies and primary data from a questionnaire on community involvement in the utilization of livestock waste into new and renewable energy.

This research was conducted in Palipu Village, Mengkendek District, Tana Toraja Regency. Palipu village was chosen as the research site because it has the potential of 252 breeders, each farmer owns about 10 to 20 livestock. The research site with a sample of the area was selected by purposive sampling method.

The data collection techniques used in this study included observation at the survey stage and structured interviews, at the experimental stage giving a test (pretest-posttest) about the knowledge of farmers in processing livestock waste or biogas, giving a questionnaire (questionnaire) in the scale of the attitude of farmers to processing biogas. biogas into renewable energy. The data needed in this study consists of primary data and secondary data. Primary data (questionnaire distribution to respondents) was obtained from direct interviews with respondents using a list of questions that had been prepared. In addition, this study also used secondary data (institutional visits) obtained from related institutions and agencies as well as other literature/publications related to the research topic. The data needed in this study consisted of primary and secondary data in the form of statistics, maps, attitudes, and knowledge. Each data used has benefits in the study, namely providing a narrative/descriptive picture of the physical, social, and economic conditions of the research area (map of the research area and its description), the basis for sampling calculations, and the benefits of data for analysis.

Analysis of Participation

Participation data from respondents were analyzed using Analysis of Participation Value (NP) according to Supriyanto (2007), as follows:

$$\mathbf{NP= \frac{n}{N} \ x \ 100\%}$$

where:

NP (%) = Perception and Participation Value ---

----NP (Negative or Positive)

n = score obtained

N = max score

Economic Benefit Analysis

LQ (Location Quotient) is a method used to analyze the superior production found in the Village LQ formula:

$$LQ = \frac{E \ /E}{E \ /E}$$

Description:

Eij = regional variable (example: commodity yield) sector in region j

Ej = regional variable in region j

Ein = regional variable in sector I in region n (Districts) En = regional variable n . region

Environmental Benefit Analysis

Emission calculation method

Intergovernmental of Climate Change Environmental calculations are carried out to determine whether a project, in this case the use of biogas, is environmentally beneficial or not. Calculation of environmental benefits is a tool for reducing emissions caused by the use of biogas. The formula used is:

Emission Factor x Livestock Population/ 106Kg/Gg

Social Benefit Analysis

Utilization of livestock biogas can generate social benefits for the people in palipu. Social benefits are generally qualitative. These benefits can be estimated experimentally by using respondents whose results can then be processed statistically.

3) RESULTS

The production of biogas from animal manure was developed using the anaerobic fermentation methodology. The first stage of the process with this method is the acidification process, namely the process of decomposition or decomposition of the components that make up organic matter into organic acids without oxygen. The second stage of the process is the methanation process, which is the process of converting organic acids into biogas. The anaerobic fermentation process is carried out in a biodigester. The biodigester used is a semi-permanent type in the form of a prism made of fiber. The volume of this biodigester is 9 m3. With this large volume, it is expected to be able to accommodate more raw materials for continuous biogas production. So that more and more biogas can be produced for generator fuel needs on a continuous basis. Construction of biogas facilities and infrastructure Biodigester is a reactor where the fermentation process of waste/cow dung into biogas takes place.

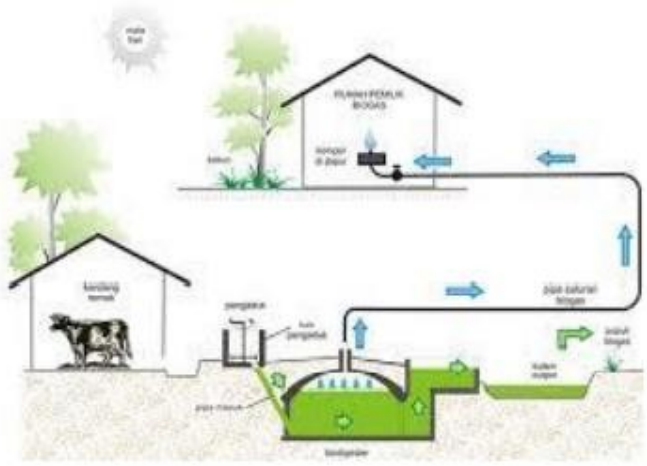

Figure 1. Biogas Installation Sketch (Source: Sujitno, et al 2010)

In this biodigester reactor there will be decomposition of organic materials contained in cow dung into organic acids. Furthermore, these organic acids will decompose anaerobically into biogas. This biodigester is made of fiber with a volume of 9 m3. This biodigester is composed of rectangular and triangular shaped plates. The plate-making material consists of a mixture of fiber and resin which is arranged in layers to reach a thickness of 0.8 - 1 cm. Furthermore, these plates are arranged into a prism/diamond-like shape and planted/placed in a 1 - 1.5 m high soil excavation. The most important thing about making this biodigester is that there should not be any leakage from the series of plates that make up the biodigester. Gas holder is a biogas storage reactor that functions as a place for biogas storage before it is flowed through a connection pipe to a generator or biogas stove. This gas holder is made of Polyethylene plastic material 150 to 200 microns in diameter 1.2 m long 2-3m. The biogas stored in the gas holder then flows through the connection pipe/hose to the houses and can then be used as fuel for generators and biogas stoves. Biodigester unit design planning and technical guidance Before making a biodigester and other equipment units, it is necessary to first plan the design for the biodigester unit. The planning sequence of the biodigester unit design begins with the calculation of the volume of the biodigester, the determination of the biodigester model. Performance Test of Power Plants/Gensets using Biogas Fuel After the work on planning the biodigester and biogas infrastructure has been completed, the next step is to test the performance of power plants/gensets using biogas fuel.

1. To produce a power of 450 - 1000 Watt, a generator requires biogas fuel of 0.6 - 1 m3 of biogas per hour.
2. The use of the generator is around 12 hours/day.
3. Consumption of biogas for generators per day is in the range of 7.2 - 12 m3/day.

Based on the concept of applying biogas production technology to fuel power plants in this activity, the following are obtained:

1. Biogas can be used as fuel for power plants/generators.
2. To produce a power of 450 - 1000 Watt a generator requires biogas fuel of 0.6 - 1 m3 of biogas per hour.
3. The biogas produced is accommodated in a gas holder and then channeled through a hose to be used as fuel for generators and stoves.
4. The biodigester used in the manufacture of biogas is a semi-permanent type biodigester with a volume of 9 m3. This biodigester is made from a mixture of fiber and resin which is made in layers. With the technology of making biogas from cow dung, the direct benefit that can be felt is the reduction of piles of cow dung that has the potential to pollute the air, soil and water.

The results of the analysis of the value of participation based on the data show that the community involved in the program biogas participated since the initial planning of the biogas program implementation (93.2%). The respondent community also participates at the time of determining the initial location for the biogas installation (99%) and in the provision of land (90.1%). In the process construction of biogas installations, the user community has direct involvement to contribute. The results of the participation data analysis for the F test have a significant level of 0.43 which is greater than = 0.08 or value 0.43 < 0.03, so it can be concluded that the independent variables in the study are age (X1), number of livestock (X2), education (X3), biogas management assistance (X4) and the duration of biogas utilization (X5) together did not significantly affect the the dependent variable is community participation.

4) DICUSSION

Community participation in the biogas utilization program in Palipu village was high/participated (81.13%) whilelow participation/less participation (18.87%). The F test shows that the variables of age, number of livestock, education, assistancebiogas management and duration of biogas utilization did not significantly affect community participation.

The results of the LQ analysis are the leading sectors or bases in Palipu Village. This leading sector is used to determine the production results that can be used as raw materials for processing in the home industry or biogas utilization. Farmers' expenditures to buy LPG can be used as initial capital for the development of home industries. The home industry to increase the benefits derived from the use of biogas is carried out by processing the superior products of Palipu Village as processing raw materials. In the process, alternative energy is used from biogas utilization so as to produce finished products with higher selling values.

Through the analysis of methane calculations, it was found that before the utilization of biogas, the methane gas emissions generated from livestock manure were 234 Gg CH4 while after the use of biogas it could reduce methane gas emissions to 102 Gg CH4. Social Benefit Analysis, the analysis used to determine the social benefits that exist after the use of biogas is the formal method of the experimental model. This method is carried out by giving a direct score (score) by the respondent on the social benefit parameters that have been determined. The highest value obtained by certain social benefit parameters according to public perception is the social benefit obtained from the use of biogas in Palipu Village, Tana Toraja Regency.

The use of biogas as an alternative energy creates a social impact on the community in Palipu Village. The highest value obtained by certain social benefit parameters according to public perception is the social benefit obtained from the use of biogas.

In relation to the level of community involvement in Palipu Village, Tana Toraja Regency in utilizing biogas as an alternative energy source and livestock and agricultural waste solutions, awareness of the benefits of biogas with the highest percentage so that the greater use of biogas in Palipu Village is expected to also support the development and improvement of the village economy. The greater the utilization, the greater the energy produced to meet energy needs.

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