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Community empowerment based on utilization of livestock waste to become biogas in Bacukiki Energy Independent Village

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ABSTRACT

Watang Bacukiki Village has a farm that produces cow manure but is not utilized. Cow manure (solid waste) eventually accumulates and creates an unpleasant odor. Based on these problems, PT Pertamina Patra Niaga Fuel Terminal Parepare carried out a CSR program by empowering the community, namely the Bacukiki Berdikari Energy Village as a form of assistance around the company's operational locations by building reactors so that cow manure does not pollute the environment and can be used as new, environmentally friendly energy, namely biogas, and compost. This program involves the community in processing cow manure. The research was carried out in collaboration with research centers, while data collection used observation, interviews, and surveys. The results of the biogas are used for household gas needs with the aim that the people in Watang Bacukiki Village can be energy independent through environmentally friendly energy that is self-produced through locally owned potential.

Kata Kunci
Biogas
Gas Buang
Limbah padat
Watang Bacukiki

Pemberdayaan masyarakat berbasis pemanfaatan limbah ternak menjadi biogas di Desa Mandiri Energi Bacukiki. Kelurahan Watang Bacukiki mempunyai peternakan yang menghasilkan kotoran sapi namun tidak dimanfaatkan. Kotoran sapi akhirnya menumpuk dan menimbulkan bau yang tidak sedap. Berdasarkan permasalahan tersebut, PT Pertamina Patra Niaga Fuel Terminal Parepare melaksanakan program CSR dengan melakukan pemberdayaan masyarakat yaitu Kampung Energi Berdikari Bacukiki sebagai bentuk bantuan di sekitar lokasi operasional perusahaan dengan membangun reaktor agar kotoran sapi tidak mencemari lingkungan. dan dapat dimanfaatkan sebagai energi baru yang ramah lingkungan yaitu biogas, dan kompos. Program ini melibatkan masyarakat dalam pengolahan kotoran sapi. Penelitian dilakukan bekerjasama dengan pusat penelitian, sedangkan pengumpulan data menggunakan observasi, wawancara, dan survei. Hasil dari biogas tersebut dimanfaatkan untuk kebutuhan gas rumah tangga dengan tujuan agar masyarakat di Kelurahan Watang Bacukiki dapat mandiri energi melalui energi ramah lingkungan yang diproduksi sendiri melalui potensi yang dimiliki masyarakat setempat.

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INTRODUCTION

PT Pertamina Patra Niaga is a subholding of PT Pertamina (Persero) engaged in the downstream oil and gas industry, specifically running the distribution and marketing business of energy products, including Fuel Oil (BBM), Liquefied Petroleum Gas (LPG), lubricants, aviation fuel, as well as asphalt and petrochemical products to meet the needs of retail and corporate consumers. Parepare BBM Terminal is one of the BBM Terminals located in Parepare City, South Sulawesi Province which distributes BBM to several areas in South Sulawesi Province and West Sulawesi Province. As part of corporate social responsibility (Corporate Social Responsibility/CSR) around the operating site, PT Pertamina Patra Niaga Terminal BBM Parepare has a CSR program to develop quality energy together with the surrounding community with the concept of sustainable empowerment.

Watang Bacukiki Sub-District is one of the sub-districts located around the Operational Area of PT Pertamina Patra Niaga Fuel Terminal Pare-pare. Watang Bacukiki Village has the potential for Cattle Farming. Livestock business activities certainly produce waste. Cattle farm waste includes solid waste, organic waste, and gaseous waste. The solid waste generated from cattle farming includes feces/dung, leftover feed, and others. Liquid waste from the cattle breeding business includes urine, remaining drinking water for livestock, used water for bathing livestock, and used water for cleaning livestock equipment. Gas waste from cattle farming businesses includes NH_3, H_2S, CH_4, and others(Matos et al., 2017) . Most of the waste from cattle farms in Watang Bacukiki Village is still allowed to accumulate without being managed. One of the potentials that can be used to solve the problems faced by the people of the Bacukiki sub-district is livestock manure in the form of cow feces which is highly available and can further be converted into biogas (Yahya et al., 2018). Biomass waste in the form of plant and livestock residues such as crop leftovers and manures are some of the largest available bioenergy sources in both rural and agro-industrial areas (Avaci et al., 2013). Biogas is a flammable gas resulting from the fermentation of organic matter by anaerobic bacteria. The biogas obtained contains methane gas with a composition of 55-75% and several other gases such as CO_2 and hydrogen (Recebli et al., 2015). Biodigester utilization can be reduces methane gas emissions (CH4) produced during the decomposition of organic materials produced from the agricultural and livestock sectors, because cow dung is not left behind decomposed openly but fermented into biogas (Sulistiyanto, 2016).

In this program, the community is educated and assisted to manage waste from cattle farms into biogas which can be utilized for household gas needs so that the people in the Watang Bacukiki Village can be energy independent through environmentally friendly energy that is self-produced through the potential that exists in the area. In implementing Environmental Social Responsibility to answer SDGs points (5,7 & 8). The programs implemented are closely related to efforts to implement sustainable development. This sustainable development does not only focus on environmental issues but also includes two other aspects, namely economic development and community empowerment (people, profit, and planet).

The husbandry industry is an industry that produces large amounts of solid and liquid waste with carbon concentrations between 8000-10000 mg (Darwis, 2015), so the industry has the potential to pollute the environment if management is not carried out. The steps that have been taken by the industry in dealing with waste problems are generally by means of an open anaerobic solid and liquid waste management system, in which the system will break down the pollutant content of carbon and nitrogen into methane, carbon dioxide, and other compounds by anaerobic microorganisms, resulting in environmental pollution, and can act as agents of the global warming effect (Sanjaya & Haryanto, 2015). The two enormous problems that are increasingly threatening the good life of many nations include the task of waste management and inadequacy of energy supply (Onwuliri,2013) In the world, about 75% of the energy production is based on non-renewable sources, and this energy is obtained through the combustion of releasing gas emissions into the atmosphere (Korhonen, 2018)

While Indonesia's power generation still comes primarily from fossil fuel, the Indonesian government is targeting to achieve a total of 23% renewable energy in the energy mix by 2025 (Khalil, 2019). Biogas technology with a zero-waste concept is expected to be an alternative energy and can reduce environmental problems. Biogas technology with a zero-waste concept is expected to help slow down the rate of global warming. Besides being an alternative energy, biogas can also reduce environmental problems, such as air pollution, soil pollution, and global warming. Biogas can be produced from various types of widely available organic feedstock such as animal manure and slurries, wastewater and sewage sludge, municipal solid waste, organic waste from dairy production and food industry, agricultural biomass, lignocellulosic residues (stalks, leaves, roots, seeds, seed shells), organic waste from households as well as energy crops (Kasinath, 2021). Biogas on a household scale with 2-4 livestock or a manure supply of approximately 25 kg/day is enough to use a reactor tube with a capacity of 2500-5000 liters which can produce biogas equivalent to 2 liters of kerosene/day and is able to meet the cooking energy needs of one rural household with 6 family members. According to Sulistiyano(2016), organic biogas from cow manure with 1 kg can produce as much as 40 liters of biogas.

This program also contributes to the sustainable development goals or SDGs in goal number 7, clean and affordable energy because this program produces New Renewable Energy, then contributes to goal number 8, namely decent work and economic growth because this program has a direct economic impact for breeders and farmers so as to improve the economy of breeders and farmers. Then the program also contributes to goal number 11, namely sustainable cities and

settlements because it supports economic, social and environmental relations between urban, suburban and rural areas by strengthening national and regional development planning. Furthermore, this program contributes to goal number 12, responsible consumption and production due to the efficient use of cow dung waste.

METHOD

This community empowerment program has been carried out in the Watang Bacukiki Village since 2021 until now. The number of participants involved was ten families who were members of Kelompok Peternak Tangguh in Watang Bacukiki Village, Parepare City, South Sulawesi, Indonesia (see Figure 1). Based on the research results of Fathurrohman et.al (2015), it shows that the majority of farmers still do not know the function and benefits of biogas from cow dung. This community empowerment program has three main activities, namely Assistance in the manufacture of biogas installations, and training on how to manufacture and operate continuous system biogas installations for the community. As well as the implementation of innovative flexible tank applications made of rubber (used car tires) as portable biogas containers. This activity involved the City of Pare-pare Environmental Service and the City Research Agency of Pare-pare. Through training and mentoring programs, it will help farmers to gain knowledge as well as skills in making their own products. Farmers are given practical procedures for producing organic fertilizers and plant pesticides. The pre-test and post-test were used to determine the community's perspective on utilizing organic waste in the manufacture of organic fertilizers and vegetable pesticides. According to research by Pratiwi(2019), the process of processing livestock waste into biogas can reduce greenhouse gas emissions and create a clean and renewable energy source. Biomass, which has great potential for exploitation, is a very important substrate for the supply of renewable energy. Anaerobic digestion is used as an effective method for converting biomass into energy (Al Seadi, et.al, 2003). The fermentation process carried out in this research is in accordance with research findings by Erikkson (2016) which shows that the optimal fermentation time for biogas production from organic waste is 20 days.

Figure 1. Location of community empowerment program

RESULTS AND DISCUSSION

The implementation of this program has been carried out since 2021 by forming a Kelompok Peternak Tangguh in the Watang Bacukiki Village. The biogas installation in Watang Bacukiki Village consists of two reactors measuring 12 m^3. One reactor can accommodate manure from nine cows and produce gas that can be utilized by five households for cooking

activities. So that the total beneficiaries of this activity will be ten families in 2021. The total reactors from 2021 to 2023 will be seven reactors, so there are 65 families who are now utilizing biogas by using pipes and ban. The results of the biogas installation are shown in Table 1.

Table 1. Reactor Biogas in Watang Bacukiki

Reactor	Capacity (m^3)	#Cow	#Pipes Usage in the House	#Ban
Reactor 1 (2021)	12	9	5	-
Reactor 2 (2021)	12	9	5	-
Reactor 3 (2022)	14	10	5	-
Reactor 4 (2022)	14	12	5	-
Reactor 5 (2023)	12	10	5	10
Reactor 6 (2023)	12	10	5	10
Reactor 7 (2023)	12	10	5	10

Apart from that, with the application of flexible tanks made of rubber (used car tires) as a container for portable biogas. Previously they only operated biogas fuel at livestock locations, but now we are providing training on how the biogas produced can be put into a container so that it can be used at home for cooking, namely by utilizing unused truck tires. In addition to having an impact on improving environmental quality, the use of biogas fuel is also able to have an economic impact on society. In addition to being a more environmentally friendly fuel, the use of biogas also creates cost savings for household needs that were originally needed to buy fuel for cooking. With this innovation, the number of beneficiaries of community empowerment activities has increased to 65 families. In addition, a study by Ningsih (2018) shows that the use of biogas from livestock waste can provide significant economic benefits for farmers and local communities, apart from environmental aspects.

Biogas produced from cow manure contains energy or power (shown in Figure 2). Biogas is a fuel that can replace diesel oil, gasoline, firewood, or wood charcoal. As a comparison, 1 m^3 of biogas is equivalent to 0.4 kg of diesel oil, 0.6 kg of gasoline, and 0.8 kg of wood charcoal (Darwis, 2015). In this program, we use fixed dome digester design. Base on Zhoeu et al. (2014), anaerobic digester technology is extensively acceptable as an efficient process to treat and utilize food waste because it has been proven to be promising method for waste reduction and energy recycling. The production of biogas is based on a profound technology whose output is principally used for electricity generation and also for the valorization of organic residues (Kougias and Angelidaki, 2018). After the biogas is formed, it can be utilized because biogas has many benefits wherein the biogas contains flammable methane gas. The presence of this gas can be used for various purposes.

Figure 2. Empowerment activity of cattle farmer group, producing biogas energy

Processing of livestock manure which produces biogas energy also produces waste. This waste can be used as fertilizer for plants. Where the waste produced can be in the form of solid and liquid, so that waste in solid form can be produced into compost. Meanwhile, liquid waste can be used as liquid fertilizer to spray short-lived plants such as vegetables. In addition, this waste has its own advantages because after leaving the digester tube it automatically undergoes a ripening process because the tool has undergone a decomposition process so that the waste can immediately be processed back into compost and liquid organic fertilizer (Apriantika et al., 2022)

In Figure 3, for cooking fuel purposes, the biogas that has been produced can be channeled to a gas stove. The gas stove must match the stove specifically with the biogas stove so that the resulting flame is blue, because when using a

gas stove the thing that needs to be considered is the suitability of the mixture of biogas and air. If the mixture of biogas and air is right, the resulting fire is blue and has high heat.

Figure 3. The installation of biogas on the stoves

In an era of energy crisis, biomass-based bioenergy has been given special attention (Pavičić,2022). The energy that is released from biogas makes it a suitable fuel in any country for heating and cooking purpose. Biogas can also be used in an anaerobic digester where the energy in the gas is converted into electricity and heat using gas engine (Sorathia et al., 2012). Using biogas can improvement of the environmental quality through CO2 emission reduction (Soccol et al., 2011). Biogas utilization has potential monetary benefits and can be a potential source of rural communities (Sarker et al. 2020). The benefits of using biogas are not only found in the production of alternative energy but also in that it is the solution to a myriad of environmental problems because, through proper disposal and processing of agricultural and household waste, biogas production can prevent methane emissions into the atmosphere (Kucher, 2022). The ecological influence of biogas production has great importance. This is the environmentally friendly processing of biomass, organic waste, and by-products of animal origin through methane fermentation. As indirect environmental effects, we can identify the prevention of contamination of groundwater, surface water, and soil (Romaniuk, 2018).

CONCLUSION

The results of this community empowerment activity provide benefits for the community in the Bacukiki sub-district. Cow feces have only become waste and have been left alone. After this community service activity, the community is able to process cow feces into biogas so that it can help the government and 65 families in using subsidized LPG. Members of the Kelompok Peternak Tangguh are very grateful for this activity and hope to continue in the following years. This biogas installation is an example for other members of the Kelompok Peternak Tangguh in the Watang Bacukiki Village in particular and the Watang Bacukiki Village community in general.

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