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Optimizing Cattle Farm Waste Management Through the Application of Biogas Technology in Kondoano Village, Mowila Subdistrict, South Konawe Regency

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ABSTRACT

Cattle waste is one of the common problems in cattle farms. Through proper processing, waste can be turned into new products with higher added value. This community service program takes the form of technical guidance provided by the Faculty of Animal Husbandry Team at Halu Oleo University to farmers. This activity aims to improve farmers' knowledge and skills in processing ruminant manure waste so that it can become an alternative energy source through the use of biogas technology. This activity was carried out in Kondoano Village, Mowila District, South Konawe Regency. The method of implementation began with a site survey, analysis of the problems experienced, exploration of the potential in Kondoano Village, technical guidance, and evaluation of the activities. Kondoano farmers were given additional knowledge through technical guidance on the application of biogas technology by utilizing livestock waste to produce energy and reduce environmental pollution. This activity involved a team of lecturers from the UHO Faculty of Animal Husbandry, students, and farmers. This technical guidance has been able to provide additional knowledge for the community to independently process livestock waste into biogas.

INTRODUCTION

Livestock farming plays an important role in driving the community's economy, especially since Indonesia is an agricultural country with most of its population working as farmers and ranchers. Population growth has led to an increase in food demand, particularly for livestock products (Adawiyah et al., 2016). Therefore, livestock farming, especially ruminant farming, is very important in meeting the community's meat needs. However, efforts to increase livestock populations also result in an increase in the amount of waste produced, which indirectly affects environmental health.

Cattle farming generally produces two types of waste, namely solid waste and liquid waste. Solid waste includes cow dung and feed residues, while liquid waste comes from the washing of pens, livestock sanitation water, and cow urine (Wita Fidela et al., 2024). If not managed properly, these wastes can cause environmental pollution. Cattle are one of the livestock species that contribute significantly to greenhouse gas emissions. Cattle waste is a major problem because it can reduce environmental quality, disrupt human health, and increase greenhouse gas emissions, which are estimated to reach around 12% of total global emissions (Yusuf & Priadie, 2014). Until now, cattle manure has generally only been used as organic fertilizer. Therefore, more environmentally friendly waste treatment alternatives are needed, such as anaerobic processes or fermentation to produce biogas (Fitriati et al., 2021). The use of biogas technology in rural areas has great potential for development, given that most of the population works in the livestock and agriculture sectors.

Biogas is the result of processing livestock manure by microbes under anaerobic conditions. The gas production process occurs during fermentation and has the potential to produce gas

from methane formation (Kartono, 2020). Biogas technology is considered an effective solution to overcome the energy crisis, especially in developing countries (Amheka & Tuati, 2018; Rizki & Fithriana, 2024). The application of this technology can reduce people's dependence on firewood, while also reducing the negative impact of smoke from burning, which is harmful to human health, especially for women and children (Suryani et al., 2015). In addition, the use of biogas also contributes to reducing the rate of deforestation and various other harmful impacts on the environment.

One of the areas with a high livestock population in Southeast Sulawesi is South Konawe Regency, particularly Mowila District. However, cattle manure waste management in this area is still not optimal. The community generally just lets the cattle manure pile up or burns it before reusing it as manure. Some residents also use dry cattle manure without burning it as fertilizer. In general, the livestock husbandry system applied is limited intensive, where pens are built around houses. This type of husbandry has an impact on the cleanliness of the surrounding environment, as livestock waste can cause various environmental problems, such as the emergence of toxic gases, soil pollution due to manure accumulation, and water pollution (Khairi et al., 2025).

Cow manure waste in South Konawe Regency is organic waste produced from cattle farming activities. This waste is produced continuously, especially when the number of cows in Kondoano village increases. Currently, this waste is processed by burning, which also produces smoke that disturbs the surrounding residents. Limited human resources in processing cow waste are also an obstacle, which can slow down the processing process. However, if the processing is carried out collectively by all villagers, the benefits can be enjoyed by all residents. The application of biogas technology in processing livestock waste in Kondoano Village, Mowila District, through community service activities is expected to be a form of the role of universities, especially the faculty of animal husbandry, in helping to solve existing problems in the community.

METHODS

This community service activity was carried out in Kondoano Village, Mowila Subdistrict, South Konawe Regency, Southeast Sulawesi Province. The approach used in this activity was through training and assistance in the production of biogas from livestock manure. This community service program was carried out in three main stages, namely the socialization stage, the biogas installation construction stage, and the assistance stage.

During the socialization stage, a consultative approach was taken to educate cattle farmers about the importance of converting livestock waste into a source of biogas energy. Through simulations and demonstrations, the fermentation process and methane gas formation were explained so that the community could understand the natural mechanism of livestock waste processing and the benefits of biogas. This socialization activity is expected to encourage the community to build their own biodigesters and utilize the by-products as organic fertilizer.

The second stage is the construction of the biogas installation. At this stage, a pilot system is implemented, in which one of the residents' farms is selected as the location for the biogas installation, which will later serve as an example for the rest of the community. Through this pilot program, it is hoped that the community will learn to design and install digesters independently after participating in training. Once the installation is complete, residents are invited to witness the fermentation process that produces ready-to-use energy, with an emphasis on the safety aspects of biogas, which is considered safer than LPG gas.

The third stage is the assistance stage, which includes assisting the community in managing the biogas installation that has been built and monitoring its use in daily life. In addition, the community will also be provided with guidance on how to maintain and repair any problems that may arise in the use of the biogas that has been produced.

The equipment and materials used in the construction of biogas installations include building materials, pipes, PE plastic, cow manure, probiotics, and water. Building materials are used to construct permanent installations consisting of mixing tanks and sedimentation tanks. Pipes are used as channels to transport cow manure from the inlet to the installation, as well as to channel the gas produced

to PE plastic as a container for storing and distributing biogas energy.

RESULTS AND DISCUSSION

Sosialization

This activity was conducted for livestock farmers in Kondoano Village, Mowila Subdistrict, South Konawe Regency. At this stage, discussions were held to analyze issues related to livestock waste experienced by the community. Through the discussion activities in this socialization, programs were agreed upon to overcome the problems, namely, the application of biogas technology. Through this socialization activity, several problems faced by the community in utilizing livestock waste were also identified, including: (1) Limited knowledge related to waste management, (2) Limited information about biogas, and (3) Low community interest in livestock waste management.

Technical guidance was provided in Kondoano village by a team consisting of lecturers and students on the utilization of livestock manure waste into biogas. This activity was intended to provide additional knowledge to the community, especially regarding livestock manure, which has been considered worthless or only processed into compost, can be maximized as raw material for biogas. Through this activity, it was revealed that only a few farmers were able to utilize this technology due to a lack of knowledge and adequate tools. Farmers usually just dispose of their livestock waste and leave it as it is, thereby damaging the environment and disturbing the surrounding community with its pungent odor. Lecturers and students explained the benefits and uses of processing livestock manure into raw material for biogas production. The team conducted a demonstration of livestock manure processing with the help of the community participating in the technical guidance. The biogas produced was then left to settle for approximately 14 days until methane gas formed and could be tested as fuel for cooking.

Figure 1. Socialization Activities for Livestock Farmers in Kondoano Village, Mowila District

Biogas Installation Construction

The main structure of biogas production is the digester, which functions to collect methane gas produced from the decomposition of organic matter by bacteria (Ali Wardana et al., 2021). The biodigester design introduced to the community is a simple model that is easy to implement independently. This biodigester can be made using 0.4-micron-thick PP plastic combined with PVC pipes. The structural design of the biodigester is shown in Figure 1, where the top has two holes. The first hole functions as an inlet for raw materials, while the second hole acts as an air vent when raw materials are fed into the digester. The inlet and outlet for raw materials are located at both ends of the biodigester to facilitate the process of feeding and removing slurry.

Figure 2. Preparing to Build a Digester

After the digester manufacturing process is complete, the next step is to install pipes connecting the digester to the gas storage tank. The gas storage tank is made of clear plastic that is rolled up and tied at one end, then connected using a plastic hose. The hose is equipped with a tap that functions to channel gas to the stove. The gas storage tank is made of the same plastic material as the digester and is connected via PVC pipes. This container can store methane gas that can be used for cooking for approximately 1-2 hours. During the biogas installation assembly stage, all components are assembled and placed in an area close to the location of use, while the biodigester is positioned close to the source of raw materials and connected directly to the gas storage tank using a ½-inch pipe. A T-pipe is installed between the biodigester and the gas storage tank and is immersed in a bottle filled with water beforehand.

Figure 3. Digester Installation

The gas tank and gas stove are connected via a ½-inch pipe and a ½-inch hose. A tap valve is installed on the gas stove hose to regulate the gas pressure. The stove used is a commercial LPG gas stove that is easily available to the community, but it has been modified to accommodate the lower pressure of biogas compared to LPG. The installation of the gas tank and biogas stove was carried out jointly by the community and the service team, assisted by students. The direct involvement of the community in the implementation of the program is expected to provide direct experience and knowledge that is easier to understand and easier to pass on to other communities.

Figure 4. Livestock Manure Management

Assistance

After the biogas installation is complete, the next stage is to assist in operating the system that has been built. At this stage, the installation is filled with livestock waste as the main raw material for biogas production. The biogas production process begins by mixing livestock manure and water in a 1:1 ratio, which is the optimal ratio for fermentation. The mixture is then fed into the biodigester until it reaches 2/3 of its capacity, indicated by some of the mixture coming out through the outlet pipe. Before use, this mixture is left for 14 days until gas begins to form. After the 14th day, additional raw materials are added daily to 1/3 of the biodigester's capacity. The gas produced is channeled into a prepared gas tank, then directed to a stove to test the flame quality. The test results show a blue flame, indicating that the biogas produced has a good methane content. Through this assistance activity, the community is equipped with knowledge about the function of each component of the installation, how to make repairs if damage occurs, procedures for utilizing biogas as a safe fuel, and measures to prevent potential hazards.

Evaluation of Activities

This activity was evaluated to assess the implementation of the installed biogas system. The evaluation results showed that the community was able to utilize the biogas produced for their daily energy needs, and that they understood and could explain the functions of each part of the biogas system. The biogas system that was installed was able to operate effectively and had great potential for long-term use. The evaluation results also show a high level of interest among other communities around the pilot installation to replicate and implement biogas installations in their own areas. Based on the evaluation results, it was found that the application of biogas technology among the farming community in Kondoano village has benefits and great potential for long-term use by the community.

CONCLUSIONS

This community service activity has had a positive and tangible impact on the local community, particularly cattle farmers, by providing practical solutions to the long-standing problem of livestock waste management. Through participatory assistance and technology transfer, farmers have gained new knowledge and skills in managing cattle waste in a more systematic and environmentally friendly manner. As a result, waste that was previously considered a burden and a source of environmental pollution can now be managed effectively, contributing to cleaner surroundings and improved community awareness of sustainable agricultural practices.

Furthermore, the application of biogas technology in this activity has proven to significantly enhance the value of cattle waste utilization. Livestock waste is no longer merely disposed of but is transformed into renewable energy that can be used for household needs, thereby reducing dependence on conventional energy sources and lowering household expenses. In addition, the residual by-products of the biogas process can be utilized as organic fertilizer, supporting sustainable farming systems and strengthening the local circular economy. Overall, this activity demonstrates that biogas technology is

not only technically feasible but also socially and economically beneficial for rural communities.

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