

Processing Horse and Cow Manure Waste in the Production of Fertilizer and Biogas at Flores Bajawa Agricultural College

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ABSTRACT: Horses and cows have long been domesticated animals in Indonesia, one of which is at the Flores Bajawa Agricultural College. Horse and cow manure, which are solid waste products generated from metabolism, can generally pollute the environment, so they need to be processed. Therefore, it is necessary to conduct research on the utilization of horse and cow manure waste in the production of manure fertilizer and biogas. Manure is usually made from liquid or solid livestock waste mixed with food scraps, which will later function as humus. Biogas is a gas produced from organic waste such as animal and human manure stored in an airtight environment. The purpose of this research is to understand the utilization and processing of horse and cow manure waste into fertilizer and biogas. The methods used in this research are observation and experimentation. Fertilizer is made from a mixture of horse and cow manure. Meanwhile, biogas from horse and cow manure is produced with three treatments and various fermentation periods of 7, 14, and 21 days. One way to process horse and cow manure waste is to convert it into organic fertilizer and biogas. The fertilizer and biogas that have been produced are used to enrich agriculture and also as a source of fuel. The longer the fermentation time of the fertilizer and biogas, the better the nutrient content of the fertilizer and the greater the volume of gas produced in the biogas production process.

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INTRODUCTION

Livestock waste consists of liquid, solid, and gas waste (Fajri et al., 2020). Liquid waste can consist of urine and feces, while solid waste can consist of leftover feed, carcasses, and feces. If feces and urine are left around the pen, they can produce bacteria and viruses that can cause diseases in animals.

Horses are one of the animals that have been domesticated for a long time. In recent decades in developed countries, horse farming has evolved into one of the options for livestock and tourism businesses. In urban areas of Indonesia, people keep horses for pleasure, but in rural areas, they keep them for transportation convenience, especially in regions that are difficult to reach by car. Horse manure poses a threat to the environment by polluting the air, water, and soil, causing pollution for the community. The production of biogas and bokashi fertilizer is one of the methods that can be done.

Horse manure, which is solid waste produced from the metabolism of horses, can generally pollute the environment, so it needs to be processed. Hidayati et al. (2010) According to Darmawan Risal (2019), horse manure contains 0.55% N, 0.30% P, 0.40% Ca, and 75% water. They also have a high carbon (C) value in the ash after burning.

The availability of nutrients in the soil is a factor that can affect plant growth and production. The use of fertilizers plays a very important role in meeting the nutrient needs of plants. (Syah, 2019). Organic and inorganic fertilizers are two types of fertilizers commonly used to meet the nutrient needs of plants. Inorganic fertilizers have the advantage that nutrients are available to plants immediately after application. However, continuously using inorganic fertilizers can damage soil quality.

Therefore, to maintain the physical, biological, and chemical conditions of the soil, organic matter is necessary. Organic fertilizers can be added to the soil to provide organic matter. Manure is a type of organic fertilizer made from animal waste or dung, such as cows, goats, horses, chickens, and so on (Putra et al., 2017).

Often, the processing of waste such as feces and urine is neglected. The stigma of small-scale or traditional farming that views livestock as savings rather than a business commodity that generates profit from production. As a result, the waste that is directly disposed of can damage the ecosystem. (Mansyur et al., 2021). Manure can be made from livestock feces. The use of

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manure is very beneficial for soil health because it contains microorganisms and soil biota that remain alive, making the soil more fertile.

In general, horse manure needs to be processed because it can pollute the environment. To ensure the horse population continues to grow, the development of forage as the main feed source must be carried out to support the survival, growth, and production of livestock.

Biogas is a flammable gas produced from the fermentation of organic materials by anaerobic bacteria (Mujahidah et al., 2013). Methane gas is a greenhouse gas that is more dangerous than carbon dioxide because it is highly explosive and is the main factor causing global warming at a rate of 1% per year (Ratnaningsih et al., 2009). Methanogenesis is the process of methane gas formation with the help of methanogenic bacteria such as *Methanobacterium*, *Methanobacillus*, *Methanosarcina*, and *Methanococcus*. The energy contained in biogas depends on the concentration of CH₄ (Dewi et al., 2019).

Biogas is a gas produced from organic waste such as animal and human excrement stored in an airtight environment. Methane gas is produced through anaerobic decomposition that occurs naturally during the fermentation process of feces. The properties of methane gas produced from biogas are better than non-alternative fuels because the animal waste used as raw material decomposes into methane gas when burned. Because it comes from organic materials and waste, biogas methane is more environmentally friendly and renewable.

All materials that come from living organisms are called organic materials. Organic materials mainly consist of carbon (C), hydrogen (H), and oxygen (O). Some types also usually contain nitrogen (N) and sulfur (S). Bacteria produce biogas from organic materials in an anaerobic process in a vacuum. Most of the gas produced during processing or fermentation consists of methane with the molecular formula tetrahydrocarbon (CH₄) or methane and carbon dioxide with the molecular formula carbon dioxide (CO₂). If the methane content in the mixture is more than 50%, the mixture is flammable. Additionally, a material has a high potential for gas production if its organic content is also high and it has a C/N ratio between 20:1 and 40:1 (Kartono, 2020).

Bokashi fertilizer is a solid organic fertilizer made through the fermentation or decomposition process of organic materials using EM4 technology. Organic fertilizers usually come in solid or liquid form and provide organic matter as well as the ability to improve the chemical and biological properties of the soil (Shobib, 2018).

Bokashi fertilizer made from horse manure can improve soil physical properties, water retention, increase nutrient availability, and is expected to enhance plant productivity. The advantage of inorganic fertilizers is that they contain nutrients with active compounds, allowing plants to use them immediately after application. This is an important way to increase the need for nutrients in the soil.

Flores Bajawa Agricultural College (STIPER FB) is a higher education institution established by the Ngada Regency Government and the Catholic Church of the Ende Archdiocese. The Ngada Catholic Community School Foundation (YASUKDA) is the manager. A shared concern is the low number of human resources with higher education, the underutilization of complex agricultural potential, the high poverty rate, and accessibility issues. Humanistic, character-based, and globally oriented education is intended to produce skilled graduates who are ready to work, possess entrepreneurial insight, are capable of creating, and can develop knowledge to utilize resources and contribute to the nation's intellectual advancement (Limbu et al., 2024).

Considering the potential of the Flores Bajawa Agricultural College, which has its own horse and cattle livestock, it is necessary to conduct research on the utilization of horse and cattle manure waste in the production of organic fertilizer and biogas in the area of Flores Bajawa Agricultural College.

METHOD

The methods used in this research are observation and experimentation. Observation and experimentation were conducted to determine the techniques for producing fertilizer and biogas from horse and cow manure waste.



Figure 1. Horses and Cows Waste

RESULT AND DISCUSSION

Making Fertilizer from Horse and Cow Manure

Tools and Materials

The production of fertilizer from horse and cow manure uses several materials such as EM4 bacteria, sugar, water, horse manure, cow manure, charcoal, and bran; the tools used are saws, nails, sack buckets, bamboo, shovels, and hoes.

Manufacturing Process

First, mix the EM4 bacteria, sugar, and water, ensuring all ingredients are perfectly blended. Second, mix horse and cow manure, rice husks, and bran evenly, then pour the mixture with the EM4 solution. Third, mix slowly and evenly until the water content is between 30 and 40 percent. The desired moisture content is then tested by squeezing the material. The completed mixing must be done well. Fourth, the mixture is placed in a dry spot (or can be put into a bucket or sack) and left for 4 to 7 days. Fifth, the burlap sack can be opened after the material becomes bokashi. Black bokashi, crumbly, not hot, and odorless.

Organic Fertilizer

Organic fertilizer is a solid or liquid fertilizer used to improve the physical, chemical, and biological properties of the soil by making it from organic or natural materials such as plant, animal, and human residues. Organic fertilizers consist of many organic materials rather than nutrient content, such as compost, worm castings, peat, seaweed, and guano. In fact, organic fertilizers also contain other organic compounds that help plants, such as humic acid and fulvic acid.

Manure is usually made from liquid or solid livestock waste mixed with food scraps. Among other things, manure functions as mulch. The structure of the soil is maintained or preserved by humus, which makes the soil easy to cultivate (light) and rich in oxygen. It is also a source of nutrients such as nitrogen, phosphorus, and potassium, which are very important for the growth and development of plants, and it enhances the soil's ability to retain water. Additionally, humus contains many microorganisms that can break down organic waste in the soil, producing more humus.

Horse Manure Fertilizer

Fertilizer made from horse manure is among the easily decomposable ones. This is caused by its chemical composition, which contains compounds that allow bacteria to thrive. Horse manure should be applied one week before planting because it decomposes quickly. This is done so that the nutrients contained do not get lost. (Sutejo, 1999).

Manure greatly aids plant growth because it can fill nutrient deficiencies or be directly given to plants as nutrition. According to Tiddal and Nelson in Sarief (1986), each animal has a different level of nutrient content.

Production of Biogas from Horse and Cow Manure

This research was conducted using an experimental method with three experimental samples. The process of mixing cow and horse manure is the first step in the experiment. Researchers found three treatment variations in a total feces weight of six kilograms. The first treatment is 70% cow, 30% horse, and five liters of water. The second treatment is 50% cow, 50% horse, and five liters of water. The third treatment is 30% cow, 70% horse, and five liters of water. After mixing, the biogas fermentation process begins. The flame test was conducted on days 7, 14, and 21 to observe the productivity of the biogas produced.

The tools used for the biogas fermentation process are water gallons, weighing hoses, Y-connectors, stopcocks, black tape, scales, and inner tubes. Biogas fermentation is carried out for up to 21 days.

Biogas is a product of fermentation by anaerobic bacteria that consists of several stages. The first stage that occurs in the early stages of fermentation is the breakdown of the chemical structure of existing organic materials, including cow dung and straw, by anaerobic bacteria into simpler molecular structures, such as the conversion of polysaccharides into monosaccharides and the conversion of proteins into peptides and amino acids. After being decomposed, the material will be acidified by the acid produced by anaerobic bacteria. Simple compounds that were successfully hydrolyzed were previously converted into acetic acid, hydrogen, and carbon dioxide. The process of forming acetic acid by anaerobic bacteria requires oxygen and carbon dioxide, which are taken from the dissolved oxygen in the solution. This is the basis for the need for a large amount of water to meet the needs of anaerobic bacteria, as water serves as the medium. The process of acid formation in anaerobic conditions will play a role in the subsequent formation of methane gas (Irfan dkk. 2023).

Based on the experimental results conducted by the researchers, the production of biogas from horse and cow manure was already visible from the 14th day. This is evidenced by the flame spurting from the ignition flame, indicating the release of gas from the biogas digester. On the 21st day, a biogas production trial was also conducted, resulting in more biogas with a stronger odor than in the previous test. A trial was also conducted on the 7th day, but there was no flame spurting, indicating that not much gas was produced during fermentation. Differences in results were obtained in each trial at different times, proving that a good fermentation process by anaerobic bacteria in the digester can still occur every day. This result shows that the longer the biogas fermentation time, the better and more gas will be produced.

CONCLUSION

One way to process horse and cow manure waste is to convert it into organic fertilizer and biogas. The fertilizer and biogas produced are used to enrich agriculture and also serve as a source of fuel. The longer the fermentation time for the fertilizer and biogas, the better the fertilizer content and the greater the volume of gas produced in the biogas production process.

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