Implementation of Silage and Biogas Product by Empowerment

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Research Article

Implementation of Silage and Biogas Product by Empowerment Village Society in Rokan Hulu Regency, Riau Province

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Abstract

The livestock group is located in Pasir Makmur Village, Rokan Hulu Regency, Riau Province which has the potential resources in oil palm plantations and cattle populations. The aim of present empowerment study was to utilize and process palm fronds with silage technology as cattle feed and cattle feces as biogas. The service method was the Participatory Action Research and the development of practical knowledge in understanding the social, economic, cultural and environmental conditions of society. The results showed that palm frond silage could be used as ruminant feed due to of its smooth texture and low pH. Additionally, biogas with a capacity of 6 m3 can be produced from cattle with a maximum number of 5-6 cattles. The conclusion of this public service that silage by utilizing palm fronds in the ration can be used cattle feed, as well as cattle feces can be used bio gass to reduce people's living costs especially for ration feed and gass.

Keywords
Technology; Silage; Cattle; Livestock Group; Pasir Makmur

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Introduction

Rokan Hulu Regency in 2019 was recorded to have the largest oil palm plantation area of 480,655 Ha (Statistics of Riau Province, 2020). In addition, this district is also known as one of the livestock producing areas, especially cattle and buffalo. Based on existing data, Rokan Hulu Regency has the highest number of cattle populations compared to other Regencies and Cities in Riau Province. The cattle population in Rokan Hulu Regency is 31,334 heads (Statistics of Riau Province, 2020). The two advantages possessed by Rohul Regency have great prospects in the success of the government's program, namely the achievement of food self-sufficiency, especially meat and energy self-sufficiency. However, it is still unfortunate that the existing potential has not been managed optimally.

Palm fronds are a source of high crude fiber Elisabeth and Ginting (2003) with a value of 31.09% and lignin 16.90% (Imsya, 2007), so that when given directly to cattle, it is feared to disturb the digestive tract (Efryantoni, 2012). Therefore, it is necessary to process feed to improve the structure and nutrition of the oil palm midrib, one of which is silage. Silage is a technique for preserving feed or forage at a certain water content through a microbial fermentation process by lactic acid bacteria and takes place in a place called a silo (McDonald et al., 2002). Furthermore Bolsen and Sapienza (1993) stated that silage is feed produced through the fermentation process by lactic acid bacteria with very high water content in anaerobic conditions. The results showed that midrib silage mixed with palm kernel cake had a decrease in fiber fraction compared to without silage (Harahap et al., 2021).

Furthermore, a high population of cattle will produce urine and feces which have a large potential as well. This large waste is often used as compost. Utilization of cattle dung into compost is to reduce livestock manure and environmental pollution (Siswati, Nizar, & Ariyanto, 2021), besides being used as compost, it also has the potential as an energy source in the form of biogas, but the large biogas potential has not been used optimally. Biogas fermentation technology is an efficient technology in the treatment of animal manure that can be managed efficiently for further processing as a biogas product for the production of renewable energy and environmental protection (Akyürek, 2018). The total potential for biogas from livestock manure is 68% cattles, 5% goats and sheep and 27% poultry (Avcioğlu & Türker, 2012).

However, the potential of existing natural resources is not yet in sync with the economic conditions in the community, which is marked by the uneven distribution of the economy in all villages. This is indicated by the low level of education and employment opportunities for the community, causing a lot of unemployment. The economic condition of the farmers and rancher groups in Rambah Utama Village, Rambah Samo District, Rokan Hulu Regency, can be seen clearly the difference between households categorized as poor, very poor, medium and rich. In order to overcome these conditions, one of the government's efforts through the Animal Science and Health Office of Riau Province was to established a people's livestock center (PLC) in 2016. PLC is a place for active, participatory, systematic, and measurable learning processes by providing access to information, science, technology and strengthening control of livestock production and marketing carried out at PLC involving academics.

Based on these conditions, we have carried out community service activities with community groups for smallholder livestock centers regarding processing palm midrib in the form of silage and continued biogas processing to ensure the availability of cattle feed and energy.

METHODS

This service has been carried out for 5 months starting from March to August 2021. The research location in Pasir Makmur Village, Rambah Samo District, Rokan Hulu Regency with a travel time of 4-5 hours from Pekanbaru City, the service team had to pass through the vastness of oil palm plantations. The majority of this area is planted with oil palm so it has the potential to be used as animal feed. Palm oil waste, especially palm fronds produced, is only disposed of without any further processing.

Silage and biogas production were carried out in Pasir Makmur Village, Rambah Samo District, Rokan Hulu Regency, Riau Province, while the Silage Nutrition Analysis was carried out at the Nutrition and Feed Technology Laboratory, Faculty of Agriculture and Animal Science, State Islamic University of Sultan Syarif Kasim Riau. In this strategy, activities were carried out during community assistance in two stages:

Stage 1. Socialization and delivery activities were to motivate livestock groups in Pasir Makmur Village to be able to make silage feed products and process biogas independently
Stage 2. The method at this stage was Participatory Action Research (PAR) which is a combination of research and development of practical knowledge in understanding the social, economic, cultural and environmental conditions of the community. The procedure of silage feed processing technology can be seen in the picture below

Silage Feed Processing Technology

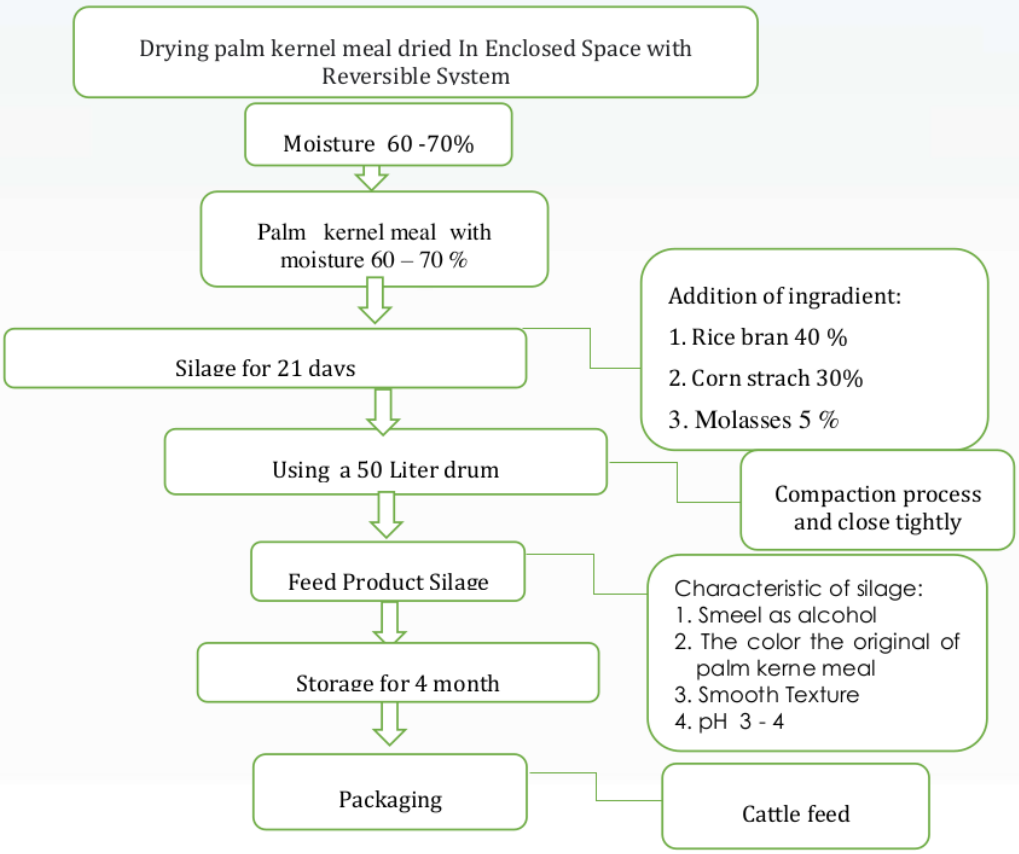

Figure 1. Procesing of feed silage

The purpose of silage making was to produce feeds that have a high dry matter and energy content and have highly digestible nutrients compared to fresh plants, microbial fermentation in silage produces a variety of end products and can change many aspects of the nutrition of the forage. High quality silage is produced due to change in the nutritional aspects of silage during storage of silage by compaction (Kung et al., 2018). Success in silage production and quality depends on two factors. The first is the nature of the material which determines the microbial population, buffer capacity, dry matter content, water soluble sugars, and chemical composition. The second factor is how silage works. A good silage fermentation method can be seen from the value of silage consumption and increased livestock activity, then the indicator of the success of silage making is fast and effective acidification, either without addition or by using inoculants (Oladosu et al., 2016).

The following is a picture of biogas processing that comes from cattle dung. The construction of biogas installations that have been done by the service team are as follows

Figure 2 . Biogas production and product tehcnical

Results And Achievements.

Social Conditions of the Community in the Study Area

The social conditions of the community in the SPR group were the majority aged 20-50 years with education between elementary and junior high school and have jobs as oil palm farmers and only a small part have jobs as livestock. This is different from Wahyuni and Barus (2021), who reported community service activities for oil palm farmers with an average age of 51-60 years. In addition to oil palm farmers, the community also works as breeders. Breeding is only a sideline business to increase the income of the people in Pasir Makmur Village with 2-5 years of experience raising livestock. The livestock business carried out by the community is still very traditional with the livestock commodity being Bali cattle. The condition of traditional livestock raising was seen from the rearing system, the majority of which are released in the pasture without proper and proper management control. There were some people who have kept their cattles in cages, but the maintenance of the cages was only at night, from noon until the afternoon, maintenance was also still released in the field. The cages used were also very traditional and do not meet the standards, including the construction of the cages that do not meet the requirements, the drainage of the cages was very bad and the frequency of cleaning the cages and animal manure was not controlled. This statement is in accordance with Mullik and Jelantik (2009) that Bali cattle with extensive farms have a shifting grazing system, no need for additional feed and lack of attention from farmers (Mullik & Jelantik, 2009).

Furthermore, the regulation of feed is also not managed properly, feed for cattle is only obtained from grazing fields with the livestock system released, so it is not clear what type, age and quality of feed consumed by the cattle is. The majority of the types of feed consumed by cattle are field grass or weeds around the house yard. The development of a cattle farming business at the location is only focused on as a sideline, meaning that raising livestock is a savings for the needs and needs of the community in emergency conditions, for example for school purposes, party activities and others. This condition has resulted in cattle raising only as an additional business without good livestock management. Even though raising livestock is a business that can be used as a main source of income. This is in accordance with the statement (Aziz, 2010; Kaumbata et al., 2020) that live stock of local is valuable livelihood of farmers for rural and urban communities to improve economic

Training Conditions for Silage Feed and Biogas

Service activities carried out in Pasir Makmur Village, Rambah Samo District, Rokan Hulu Regency received feedback on the implementation of the service that had been made. Service activities generate 80-90% feedback from the community even though most people have a low level of education but it is still easy to understand the training materials presented by the resource persons. The training activity began with presentations from resource persons related to the manufacture of silage and biogas feed. The scope of various activities is to provide understanding in increasing public knowledge regarding the manufacture and use of silage and biogas feed. Based on the analysis that the training activities have supporting factors, including the willingness and hard work

of the community to learn how to make good silage feed with renewable science and technology concepts, the nature of community togetherness, clear coordination between village communities so that all people have a sense of having an understanding of technology.
From the supporting factors of the training activities, the direct impact that can be felt by the community is providing information about investment opportunities in the field of animal feed processing which is very potential, providing information and knowledge to develop livestock business, especially silage and biogas feed processing, especially in the community, while the impact is not Direct was an efficient and sustainable business model for making silage and biogas feed. The conditions during the training can be seen in the image below

Figure 3. Training Conditions for Silage Feed

The results of the service showed that the palm frond silage produced was in a good category because it had a soft texture and had an acidic pH condition with a value of 3 -4. This indicates that the fermentation process is going well so that silage can be used as food for storage. This opinion is in accordance with what was conveyed by Schroeder (2004) that the faster the fermentation occurs, the more nutrients contained in the silage can be preserved. This is in accordance with the report with the statement McAllister and Hristov (2000) that the active silage process begins with oxygen trapped in the packaged forage stimulating biological and chemical processes by consuming nutrients and energy.
pH is one indicator to determine the size of the acidity. Usually corn and alfalfa plants have a pH level that ranges from 5.5 - 6 at the time of cutting. During fermentation produces a large amount of lactic acid (pKa of 3.86), which is produced by lactic acid bacteria, usually the acid found in the highest concentration in silage, and makes the greatest contribution to the decrease in pH during fermentation because it is about 10 to 12 times stronger than lactic acid. Other major constituents for example, acetic acid (pKa 4.75) and propionic acid (pKa 4.87)] are found in silage. Typical concentrations of lactic acid in silage that are commonly substrates range from 2 to 4% of dry matter, but can be much higher in silages with low dry matter concentrations of < 30% (McDonald, Henderson, & Heron, 1991). Silage quality standards can be seen in the table below.

Tablel 1.
Characteristic of silage

Character	Very good	Good	Currently	Bad
Color	Dark green	Brown green	Brown green	No Green
Mold	No mold	Little	More	Lots
Smell	Sour	Sour	Slightly sour	Bad smell
pH	3,2 - 4,2	4,2 - 4,5	4,5 - 4,8	>4,8

Source : Wilkins (1988)

Figure 4 shows the training process for making biogas and the biogas products that have been produced

Figure 4. Training Conditions of Biogas

The principle of making biogas is the anaerobic decomposition of organic matter (closed from the free air) to produce a gas which is mostly methane (which has combustible properties) and carbon dioxide. The anaerobic decomposition process is assisted by a number of microorganisms, especially methane. A good temperature for the fermentation process is 30-55^{0}C. At this temperature, microorganisms can work optimally to remodel organic materials (Ginting, 2007). Different sources of biomass or waste will produce different quantities of biogas (Werner et al., 2004). Biogas is a mixture of several gases, classified as fuel gas which is the result of fermentation of organic materials under anaerobic conditions, and the dominant gases are methane gas (CH4 50-70%) and carbon dioxide gas (CO2 30-40%), hydrogen sulfide (H2S). 0% - 3 %), water (H2O 0.3 %), oxygen (O2 0.1%-0.5%), hydrogen (H 1%-5%) and other gases in small amounts According to Efriza (2009). Whereas in another study the biogas produced contained CH4 (54-74%), CO2 (27-45%), as well as small amounts of NH3, N2, H2S and water (Sukmana & Muljatiningrum, 2011). Methane gas is flammable with a concentration of 5-15% in the air but methane is not toxic
The results showed that the biogas produced had good fire stability, this indicates that the biogas through the anaerobic fermentation process mechanism in producing CH4 is maximally fulfilled. Biogas generally contains CH4 (45-70%) and CO2 (30-45%) H2, (H2O), ammonia (NH3), and hydrogen sulfide (H2S) (Abbasi, Tauseef, & Abbasi, 2012; Gomez, 2013; Wellinger, Murphy, & Baxter, 2013). The biogas produced from the anaerobic fermentation process consists of methane (35-75%), carbon dioxide (25-65%), hydrogen (1-5%). Bio-methane in biogas is an energy carrier whose product is the same as natural gas (Lyytimäki, 2018; Yentekakis & Goula, 2017). The mixture of materials consisting of 50% food waste and 50% green waste using a batch anaerobic digester produced biogas volumes of 430, 372 and 358 mL/g, and methane yields of 245, 206, and 185 mL/g, respectively (Liu et al., 2009). Calculation of Biogas formation with a capacity of 6 M^3 can be seen in the explanation below:

Biogas (Digester) Normal = 1 m^3 = 11.6 kg/day
4 m^3 = 11.6 x 6 = 69.84 kg/day (Faeces + Urine)
1 Kg CH4 = 40 Liter Gas CH4

6 M^3 = 69,84 X 40 = 2793 Liter Gas CH4 (2.8 m^3)
1 m^3 gas CH4 equal to 0.62 Liter Kerosene
Means 2.8 m^3 x 0.62 = 1.736 Liter Kerosene (One family)
Result : 2.8 m^3 = 1.736 Liter Kerosene /day
Obtained from animal waste :

1. Adult female cattle produce Faeces = 10 – 17.5 kg/day and Urine = 3.5 – 4 Liter/day
2. Average needs Faeces dan Urine around 13 kg/day

A female cattle that can be kept in a cage to produce 13 kg/day (faeces + Urine) was 69,84 kg/13 kg = 5.37 (5 – 6 tail)

The calculation results of this study were in line with those presented Edwin and Joseph (2015) that Production of biogas from animal manure and agricultural biomass provides significant environmental benefits and is an additional source of income for farmers, biogas using livestock manure with 5 – 10 cattles can produce a minimum of 2 - 3 m^3 of gas which is sufficient for lighting and cooking needs. Biogas can be used for several purposes, including cooking to generate electricity. Biogas technology is the right choice to reduce environmental burden by decomposing materials organic. Livestock and agricultural waste are organic materials contains carbohydrates, proteins and fat can be processed to produce biogas, production of biogas from manure animals and grass have organic substrate which has high potential as a substrate biogas. Efficient grass in biomass production cellulose. Grass provides more benefits because it absorbs more carbon, requires less tillage and consume less fertilizers and pesticides, consume less water and can cultivated in infertile land so that it has the potential to produce bioenergy (Rodriguez et al., 2017).

Conclusion

The Service Model using the Participatory Action Research (PAR) method was an effective model to motivate farmers in changing the cattle rearing system that previously used an extensive system to a semi-intensive rearing system so that it shows that farmers take part in this research and service process. Community service participants in the SPR livestock group of Pasir Makmur Village took the training seriously and enthusiastically marked by a lot of feedback on the community Service activities. This service is the establishment of an independent and profit-oriented collective farm business through mentoring, escort, application of technology and information, transfer of knowledge

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