THE TECHNOLOGY MODEL ON SMALL SCALE PLANT-LIVESTOCK INTEGRATED SYSTEM FOR TRADITIONAL ISLAMIC BOARDING SCHOOL ("*PESANTREN*") IN RURAL AREA

Hardoyo, Budi Kusarpoko, M.C. Tri Atmodjo, Andi Marjono, Yusmiati
B2TP BPPT Negara Bumi Ilir Lampung, Indonesia

Abstract: The village which islamic boarding school or pesantren stay need some improvement thet one of them is renewable energy. Integrated/combined farming is one good way to optimize the use of resources and to maximize income (Faridah, 2001). Ruminant livestock is a type of other livestock types that plays an important role in sustainable agricultural systems because this type of livestock produces fertilizers and can utilize agricultural waste as their fodder. Manure can be an alternative energy source for livestock farmers. An anaerobic digester will partially convert manure to energy in the form of biogas which contains methane. The main product of cassava crops is cassava. In this research was used a toxic cassava which usually plant around pesantren. That could use as food material. The cassava leaf could used as source of silage production, which the silage quality is good until 60 days of storage. This silage was prepared for drying season which in that time is difficult to find out the fresh feed. The cow dung are able to used as green manure fertilizer for cassava plant. The cow dung was fermented by anaerobic bioreactor to achieve biogas and liquid waste (slurry). The biogas with methane as main component is bioenergy that able to used as mantel lamp (Petromax) for lightening and gas stove for cooking in Pesantren. The Slurry is able to used as fertilizer and the eel cultivation.

Key Words : Bioreactor, Biogas. Cassava, Cow dung , Methane

I. INTRODUCTION

There are some million of village in Indonesian as agraris environment, have potential for supporting program food, feed and energy secure. The relationship beetwen plant and Livestock as tradisonal farming is the
optimizing of utilization of land resources, human resources, and capital resources for producing food, feed and renewable energy

At the village, Farmer and the family usually have traditional islamic boarding school or " pesantren" use as the educational facilities**.** Pesantren or Pondok Pesantren are Islamic boarding schools in Indonesia. *Pesantren* provide to Indonesian citizens at low cost; although today some modern *pesantren* charge higher fees than previously, they are still significantly cheaper than non-*pesantren* educational institutions. The traditional pattern was for students to work in the headmaster's rice fields in exchange for food, shelter, and education.

Farming done by most farmers in Indonesia is an integrated farming system or integration with the aim to increase income through several commodities made either from crops, plantations and livestock. Farming done using both an integrated system and diversification leads to integrated business making

one farming to another farming mutually beneficial. At first, farmers diversify farming to meet a variety of needs of family consumption (Rusastra *et al.*, 2004).

Integrated/combined farming is one good way to optimize the use of resources and to maximize income (Faridah, 2001). Ruminant livestock is a type of other livestock types that plays an important role in sustainable agricultural systems because this type of livestock produces fertilizers and can utilize agricultural waste as their fodder.

Integrated crop/livestock agriculture is recognized for its capacity to 1) fertilize soil with an on-farm input, livestock manure; 2) encourage and allow growers to maintain semi-permanent pasture fields, which can improve soil quality; 3) increase crop yield; 4) enhance on-farm biodiversity and related ecosystem services such as pollination, and
weed/pest management; 5) enhance economic gains to growers; and 6) confer social benefits to growers and communities.
Manure can be an alternative energy source for livestock farmers. An anaerobic digester will partially convert manure to energy in the form of biogas which contains methane.
The aim to study biogas production on dairy farms are:

- manure is easily collected on dairy farms where cows are routinely confined
- biogas is most efficient when used directly for heating, and
- dairy farms have a year-round demand for hot water.

In the digester, bacteria decompose organic materials in the absence of air with the release of methane and carbon dioxide. Acid-forming bacteria break down or liquefy the volatile solids, changing them in to simple fatty acids. The methane-forming bacteria then convert these volatile acids to methane and carbon dioxide. These bacteria are sensitive to changes in their environment. Rapid disgestion and efficient biogas production occur within limited ranges of temperature and are influenced by the composition of the raw material.

Silage is fermented, high-moisture stored fodder which can be fed to cattle, sheep and other such ruminants (cud-chewing animals)[1] or used as a biofuel feedstock for anaerobic digesters. It is fermented and stored in a process called *ensilage*, *ensiling* or *silaging*, and is usually made from grass crops, including maize, sorghum or other cereals, using the entire green plant (not just the grain). Silage can be made from many field crops, like cassava leaf.
As other forages, cassava leaf can not stand for long time without any treatment, consequently the excess of cassava leaf are sometimes left in the field underutilized. Preservation of the excess of cassava leaf available, such as through silage making, will maximize and improve the efficiency of the excess cassava leaf utilization as feed. As silage, the excess of cassava leaf available can be stored and utilized for a longer period of time as a protein feed supplement. Hang (1998), Kayouli and Lee (2000), Ly and Rodríguez (2001) reported that silage making is an appropriate method to conserve cassava leaf as feed.The application of small scale food-energy technology based on waste-integrated system (3-5 cows) is a fortune to develop innovation technology for support food, feed and energy selfsufficient

II. METHODE

Cassava leaf as feed (Silage)

Cassava Leaf was processed to be Silage according to the procedure below :

1. The side product of cassava plant is cassava leaf. The Cassava leaf including young stems, petioles and leaf were harvested from farmer's cassava field when the tubers were being harvested.
2. The leaf were spread out on a roofed and well ventilated floor for a night to let them be wilt, then chopped using a hand operated chopping machine.
3. The chopped cassava leaf was weighed and then thoroughly mixed with wet cassava waste at a weight ratio of 4 parts of the chopped cassava leaf : 1 part of wet cassava waste.
4. The mixture was then put in polypropylene plastic bag of 60 cm width by 100 cm length and compacted to expel air from the bag.
5. The bags were then tightened using rubber bands and stored for three months.

Biogas Production

In this experiment was used Cow dung used as source of biogas production. The type anaerobic bioreactor was used in this research is 8 m^3 of fixed dome bioreactor as Fig 1

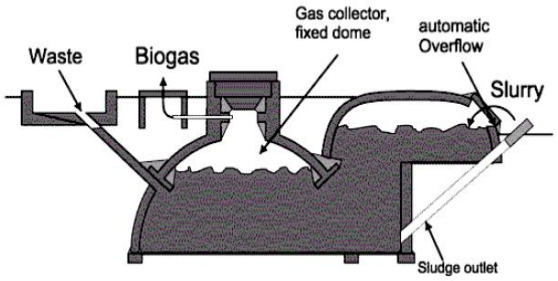

Figure 1. The Biogas Reactor

The condition use in the bioreactor are :

- Inlet slurry Feed or influent is the mixture of cow dung and water by 1 : 1 (w/w)
- Daily inlet slury Feed is 150 kg/day
- The hidrostatic retention time is 14 days until 30 days
- Empty volume reactor for gas collector is 15-20 %
- The variable were analyzed are caracterisic biogas, influen and effluent COD

III. RESULT AND DISCUSSION

The Silage from Cassava Leaf

The nutrition content in the silage from cassava leaf presented at Table 1

Table 1. The Nutrition content

Component	%				
	0-days	15-days	30-days	60-days	90-days
Water	55.04	51.38	51.07	58.13	58.02
Ash	2.79	2.60	2.33	2.60	2.62
Carbohydrate	26.08	28.25	28.30	28.30	28.27
Fiber	8.76	8.05	8.65	8.70	8.65
Fat	1.80	1.95	1.40	1.50	1.45
Protein	15.66	15.70	11.90	11.21	11.80

From Tabel 1, shown that the content of nutrition of cassava leaf silage, have not significant quality decreased until 90-days fermentation.

– Cassava leaf silage thus has the potential to serve as a protein bank to correct nutrient deficiency, especially during the dry season where most of ruminant livestock are fed low protein diets based predominantly on crop-residues and native grass. The Cassava leaf could used as source of silage production, which the silage quality is good until 60 days of storage. This silage was prepared for drying season which in that time is difficult to find out the fresh feed.

Biogas Production

a. The composition biogas

The composition of produced biogas presented at Tabel 2

Table 2. The composition of produced biogas

Component	%
CH4	53,8
N2	11,5
CO2	34,7

b. COD

The concentration of feed (influent) and slurry (effluent) of anaerobic reactor showed at Table 3

Table 3 The COD of Influent and Efluent

Unit	COD (mg/l)
Influent	90.150
Efluent	30.850

c. C/N

The C/N retio of the feed (influent) and slurry (effluent) of anaerobic reactor showed at Table 4

Table 4 The C/N retio of the feed (influent) and slurry (effluent

Unit	C-org.	Ntotal	C/N
Influent	69.2	1,98	35,0
Efluent	52,4	2.18	24.0

d. Utilization of biogas

This biogas are able to use for some appliances as table 5.

Table 5. The appliances of biogas

Biogas appliance	Power supply (kW)	Biogas consumption (10 mbar) ($m^3\ h^{-1}$)
Gas lamp	0.8	0.18
'fridge burner	0.8	0.18
Domestic burners	1.2 to 5.5	0.3 to 1.2
Commercial burners	5.5 to 17	1.2 to 4
Dual-fuel engines	per kW out	0.56
Spark engines	per kW out	0.7

Source :F. David 1996

The Technology Model of Plant-Livestock Integrated for Traditional Pesantren (Islamic Boarding School) as following:

– The main product of Cassava crops is cassava. In this research was used a toxic cassava which usually plant around pesantren.. The cassava was treated to be cassava flour (tapioca). That could use as food material
- The Main product of cow are meat and milk as the food for human.
- The Cow dung are able to used as green manure fertilizer for cassava plant.
- The Cow dung was fermented by anaerobic bioreactor to achieve biogas and slurry.

- The Biogas with methane as main component is bioenergy that able to used for cooking and lightening (Petromak) in Pesantren.
- The Slurry is able to used as cassava fertilizer and the eel pond.

IV. CONCLUSSION

1. Cassava leaf silage has the potential to serve as a protein bank to correct nutrient deficiency, especially during the dry season where most of ruminant livestock are fed low protein diets based predominantly on crop-residues and native grass.

2,The Cassava leaf could used as source of silage production, which the silage quality is good until 60 days of storage. This silage was prepared for drying season which in that time is difficult to find out the fresh feed.

3. The Cow dung are able to used as green manure fertilizer for cassava plant.

4. The Cow dung was able to fermented by anaerobic bioreactor to achieve biogas and slurry. The Biogas with methane as main component is bioenergy that able to used for cooking and lightening (Petromak) in Pesantren.

5. The Slurry is able to used as fertilizer and for the eel cultivation.

REFERENCE

Aprizal, D., 2001, Evaluasi Pengelolaan Limbah Di Industri Tapioka Rakyat (ITTARA) Terpadu (Studi Kasus di PD. Semangat Jaya Kecamatan Negeri Katon, Kabupaten Pesawaran), Tesis Program Studi Magister Teknologi Agroindustri, Jurusan Teknologi Hasil Pertanian, Fakultas Pertanian, Universitas Lampung, Bandar Lampung

Bamualim, A., dkk, 2008, Sistim Usaha Tani Tanaman-Ternak hal 19-33 Dalam Sistim Integrasi Tanaman Pangan-Ternak Bebas Limbah, Pusat Penelitian dan Pengembangan Tanaman Pangan, Bogor

Bolsen KK, Ashbell G, Wilkinson JM 2000. 3 silage additives. Di dalam Wallace RJ, Chesson A, editor. Biotechnology in animal feeds and animal feeding. Weinheim. New York. Basel. Cambridge. Tokyo : VCH. P 33-54

Firdaus, F., 2005, Studi Pendahuluan Pembuatan Biogas Dari Sampah Buah-Buahan, Skripsi Jurusan Kimia, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Lampung, Bandarlampung

F,David, 1996. The biogas Stove design.. Kingdom Bioenergy Ltd.

Hardoyo, dkk, 2014, Panduan Praktis Membuat Biogas Portable Skaqla Rumah Tangga Dan Industri, Andi Publisher, Jogyakarta.

Haryanto Budi,2009, Inovasi Teknologi Pakan Ternak Dalam Sistem Integrasi Tanaman-Ternak Bebas Limbah Mendukung Upaya Peningkatan Produksi Daging, Pengembangan Inovasi Pertanian 1(3), 2009, 163-176

Haryati, Tuti, 2006, Biogas, Limbah Peternakan Yang Menjadi Sumber Energi Alternatif, Journal Wartazoa, vol 16 no 4.

Hasanudin, U., 2006, Present Status And Possibility Of Biomass Effective Use In Indonesia, Proceeding Seminar Sustainable Society Achievement by Biomass Effective Use, EBARA Hatakeyama Memorial Fund, January 24-25, 2006, Jakarta

Hendroko, R.,mddk., 2008, Sinergi Bio-metana Berbahan Baku Limbah Jatrofa carcass dan Pangan.

Jenie, B. S. L. dan W.P. Rahayu, 1983, Penanganan Limbah Industri Pangan, Kanisius, Yogyakarta

Kalsen, C. 2005. What is sustainable agriculture and how we do it? Better Crops 89(1) : 22-23

Priyanti, A., dkk, 2007, Model Ekonomi Rumah Tangga Petani Pada Sistim Integrasi Tanaman-Ternak : Konsepsi dan Studi Empiris, Watazoa, vol 17 No 2, 2007

Rosadi Dadang, dkk, 2012, Kerangka Acuan Pembangunan Instalasi Biogas Dari Air Limbah Domestik di Pondok Pesantren Al Ashriyah Nurul Iman, Bogor

Steenbrink,K.A. Pesantren, Madrasah, Sekolah . Jakarta : Lembaga Penelitian, Pendidikan dan Penerangan Ekonomi dan Sosial, 1986. The Development of Islamic education in