Implementing Biogas Technology Project in Malvar, Batangas, Philippines

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Abstract –*This study sought to determine the environmental and social impacts of the biogas technology project of the municipal government of Malvar, Batangas, Philippines, through the Municipal Environment and Natural Resources Office. Document analysis and interview were employed in this study. Results showed that heat and electricity generation from biogas decreased dependency on electricity and fuel oil.In terms of social impacts, the biogas technology contributed to socio-economic improvement of the barangay in the form of job creation, technological and skills transfer through training in biogas production, contribution to continuous pursuing of energy neutrality and encouraged sustainability development at the community level. Aside from these, the technology was a source of organic fertilizer for the farming community of Malvar. It is recommended that commercial farms be strictly monitored and ordinances be imposed on them specifically on the use of biogas technology. The municipal government could partner with GOs and NGOs providing grant or equipment for such technology. For the monitoring of backyard farms, develop close coordination with barangay officials, if it does not work, plan a consultative meeting with agencies concerned to explain the hazards of improper disposal of hog wastes.*

Keywords –*biogas technology, solid waste management, organic fertilizer*

INTRODUCTION

Worldwide many efforts have been made into renewable energies to compensate the energy demand increase and to decrease the harmful effects of burning fossil fuels [1]. That is why, municipal solid waste management becomes a global issue [2]. Thus, the "Waste- to- Energy (WTE)" concept is gaining more interest in exploring this alternative renewable energy resource.

In the Asia-Pacific region, agriculture is vital to development [3] because nearly 60% of its population derives its livelihood from agriculture [4]. Agriculture plays an increasing role in the production of food and fiber, and other functions such as the management of renewable natural resources, landscape and conservation of biodiversity as well as culture [5],[6].

In the Philippines,agriculture contributed to 11.2% of the Philippian Gross Domestic Product (GDP) in 2013 [7]. The 30-35% of its rural population relies on agriculture for its main livelihood and over 12 million Filipinos (35%) are employed in the agricultural sector [8]. A sub-sector of agriculture is livestock (hogs, cattle, chicken, carabao, goats, and ducks) raised by farmers which is gradually increasing from 1999 to 2009 of about 1 to 5% a year. Hog production in 2013 was placed at 2 million MT in live weight, while in 2014, 11.8 million pigs were recorded [9]. Eighty percent of total livestock production is accounted for the swine industry of which 71% were raised in backyard farms[10]. A backyard farm has a capacity of at least 21 head of adultswine or 10 adults and 22 young swine[11].

One of the top three livestock producing regions is Region IV-A [9]. Another livestock industry proliferated in the region is cattle industry, which around 94% is raised in backyard farms.

Along with the employment opportunities brought about by the agriculture sector is the emission of about 2.5 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) per year, wherein swine sub-sector is accounted for over 50% of the total emissions [10].In fact, global pig industry generates the second largest source of greenhouse gas emissions (GHGs)[12].

On the other hand, according to World HealthOrganization (WHO) three billion people still cook using simple stoves burning solid fuels like wood, animal dung, crop waste and coal [13]. A WHO – United Nations Development Programme UNDP study revealed that Philippines belongs to the category of which 50 - 75% of its population does not

have access to modern energy servicesof which 29.5% is rural population. This poor availability of efficient and modern energy services is a fundamental barrier to economic and social development particularly in the rural community [14].Yet, increased demand for energy is also a critical reason for climate change and resource exploitation [15].

Though the Philippines is not a major emitter ofGHGs, Filipinos are the major "victims" of the impacts of climate change [16].

So to improve livelihood and employment opportunities that can enhance households incomes and quality of life in general in the rural areas, and to reduce GHG emisions, one of the causes of global warming, and to protect water and air from further pollution, biogas technology is one of the solutions.

Biogas is a renewable energy produced when biomass is subjected to biological gasification and a methane-rich gas is produced from the anaerobic digestion of organic materials. Biomass is the biological organic materials that are renewable and can be recycled into gas. The waste that are usually disposed off either into the sea, river, or on the land as solid materials, which causes pollution and constitutes health hazards to people and animals living around the area are converted into biogas by anaerobic fermentation [17].

Biogas refers to gas produced by fermentation of organic matter such as sludge, municipal solid waste or biodegradable waste. It is mainly composed of methane and carbon dioxide. It can be used for heating or cooking and can be likewise be used for generating electricity[18].

In the Philippines, the most prominent agencies promoting biogas technology are the Department of Environment and Natural Resources (DENR), Department of Science and Technology (DOST), Departent of Energy (DOE), and Department of Agriculture (DA). In fact, several laws were enacted to support the promotion of biogas technology such as in the Policy thrusts of Philippine Energy Plan [19];Section 3, Article c of Republic Act 8749 [20];Section 2 of RA 9275 [21];Section 30 of RA 9513 [22];Section 6 (f)(g) of Presidential Decree (PD) 984 [23]; PD 1586 [24];Section 58 of PD 1151 [25];Section 68 of DENR Administrative Order (AO) 34 series of 1990 [26]; DENR (AO) 35 series of 1990[27];Section 17 (b) 2 (vi) of RA 7160 [28]; andArticle 1, Sec 2 (h) of RA 9003 [29].

Additionally, the government enacted PD 1068 and 1159 to grant incentives for biogas projects as solutions to some major problems of pollution control, energy production and food production.

Likewise, the creation of Strategic Agricultural Action Plan of the Philippines acknowledges that biogas technology proves to further exploitation of methane gas from wastes and to promote environmental protection through better waste management [7].

As a result, a number of biogas projects have been put up through partnerships with different national and international non-government entities. The Bureau of Jail Management and Penology (BJMP) in Cagayan de Oro City, for example, was a recipient of a pilot project initiated by the International Committee of the Red Cross (ICRC). This project aimed to reduce local deforestation by eliminating the need for firewood, reduce the emission of GHGs by using carbon-neutral biogas, reduce surface and groundwater pollution, reduce costs of cooking fuel, and empower the prisoners through an inmate-run bakery fuelled partly by the biogas [18].

Another biogas project implemented through a partner NGO was Biogas Emission Reduction Project in Payatas dumpsite. This is the first clean development mechanism (CDM) project in solid waste management in the Philippines and in Southeast Asia. The project which converts biogas emissions into electricity was registered under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC)[30].

When it comes environmental protection, Malvar is one of the 1,514 municipalities in the country presumed to have passed environmental protection ordinances like the Environmental Code of Malvar. For the protection of its three river systems, the River Protection Ordinance is enacted in 1998, the Anti-Littering Ordinance in 1999 while the Selective Plastic Ban Ordinance in 2011.

With these ordinances to protect the three water bodies in Malvar, to ensure clean air and to reduce methane gas production from hog farming activities, biogas technology was implemented through the office of the Municipal Environment and Natural Resources (MENRO) in cooperation with partnernon-government organizations (NGOs).

So, this study was focused on the implementation of the biogas technology program of the local

government of Malvar which could be emulated as best practices by neighboring towns and cities in the province.

OBJECTIVE OF THE STUDY

This study sought to determine the environmental and social impacts of the biogas technology project of the municipal government of Malvar. Considered as a pilot project in collaboration with NGOs, this project implementation could be a model for nearby towns and cities with similar environmental protection and energy conservation advocacies.

MATERIALS AND METHODS

This paper employed the descriptive research method to discuss and describe the biogas technology project implementation. Interviews and document analysis were primarily used to gather information. An interview seeks to describe [31] and pursue in-depth information around the topic [32].MENR Officer Editha U. Eusebio was interviewed using conversational interview. This was conducted to make the interview remain as open and adaptable as possible to the interviewee's nature and priorities.Follow –up interviews were also performed to clarify and confirm issues in the documents obtained. Document analysis, which is a tool for obtaining relevant documentary evidence to support and validate facts, was applied to the reports like Monthly and Annual Accomplishment Reports of the Office, and municipal environmental ordinances. Intensive reading was done for the analysis of various Republic Acts (RA), Presidential Decrees (PD) and Administrative Orders (AO) relevant to the subject of the study. These readings were downloaded from the internet.

RESULTS AND DISCUSSION

A. Hog Farming Ventures in Malvar

In a report by Bureau of Agricultural Services [33], the Philippines in 2011 had 12.20 million pigs divided into commercial and backyard farms according to the number of pigs and the types of operations. Commercial farms account for 34% while backyard farms stand for 66% of the pig population (Fig. 1).

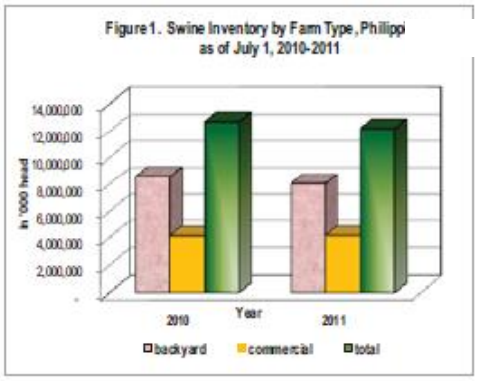

Figure 1. Swine Inventory by Farm Type in the Philippines, July 2011 (BAS)

Of the swine industry, sows accounted for 12.36 percent; fatteners shared 29.55 percent and piglet or weanling classified as others had 23.80 percent (Fig. 2).

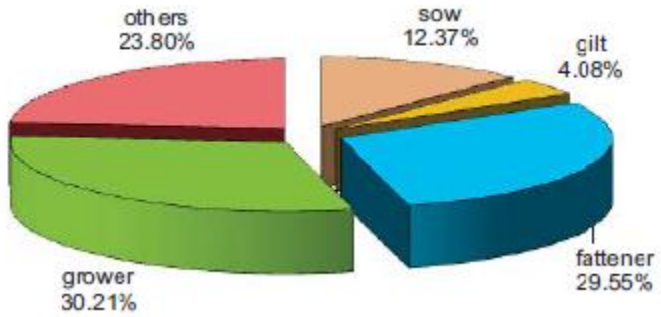

Figure 2. Swine Inventory by Classification in the Philippines, July 2011 (BAS)

Figure 3. Map of Malvar, Batangas (with 15 barangays)

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Malvar (Fig. 3), a second class municipality of Batangas with eight rural and seven urban barangays and a population of 9,585 households [34] has four commercial farms for sow and five for fattener. On the other hand, Malvar has 10 backyard farms for 100 sow, 12 backyard for 316 fattener, and 11 backyard for 1,859 piglets mostly located in the rural barangays (Table 1).

Table 1. Hog Farming Activities in Malvar

Barangay	Swine/Hog				
	Sow		***Fattener***		***Piglet/***
	CM	BY	CM	BY	***Weaners***
BagongPook	20	24	150	86	20
Bilucao	0	22	-	25	53
Bulihan	0	4	-	1	13
Luta Norte	0	0	-	0	12
Luta Sur	0	0	-	0	0
Poblacion	8	0	21	15	0
San Andres	50	16	200	48	163
San Fernando	0	1	500	9	10
San Gregorio	0	10	-	45	2
San Isidro	0	12	-	29	17
San Juan	0	3	-	22	-
San Pedro I	16	0	-	2	25
San Pedro II	0	5	-	6	38
San Pioquinto	0	0	-	28	-
Santiago	160	3	1200	0	1560
TOTAL	**254**	**100**	**2071**	**316**	**1913**

*Livestock population 2013 – MENRO

[Legend: CM – Commercial BY - Backyard]

Usually, smaller household and backyard farms excrete waste to surface waters or dispose of waste material in an open pit to decompose, or simply landfill the waste material close to the stalls [10]. Livestock manure when released into the water or accumulated in the soil may pose serious threats to the environment [35]. In addition, poor manure management may result in inadequate sanitation because manure contains microorganisms and multi-cellular parasites that may later contaminate water resources and may ultimately cause illness and gastrointestinal infections among human beings [36].

And this is also the problem in Malvar. MENRO has difficulty monitoring all hog farming activities particularly the waste disposal activities.

Therefore, there is air and water pollution, leading to decrease in freshwater supply, and leaving 50 biologically dead river systems out of the 384 major systems in the country [37].

In fact, backyard or commercial farms in Malvar have affected river tributaries particularly the San Juan River which drained towards Laguna de Bay. A tributary of this river was converted by commercial hog owners into open lagoon for hog wastes (Fig.4).

Fig. 4. Polluted river tributary of San Juan River

Commercial farms, on the other hand, have budget to put up biogas facility which is a major requirement in securing business permit. However, based on the report of MENRO, these commercial farms do not have operational biogas facility, just mere props, thereby emitting the methane gas in the atmosphere.

Because of this, the MENRO imposed a compliance report and strict monitoring of these farms.

B. Biogas Technology Implementation in Malvar

In support of various legislations regarding the promotion of biogas technology and river protection, Malvar government through MENRO constructed a biogas facility with 4 cubic meter digester and 6 cubic meter hydraulic pressure tank at Poblacion, Malvar, Batangas. This is in collaboration with XANADU Cooperative through Mr. Guillermo Maala, general manager. The cooperative provided the space (for pig pen) and number of hogs and feeds (for the hogs) for this project. Though implementation is primarily the function of the MENRO, maintenance is the basic function of the cooperative.

On the other hand, another NGO collaborator,

Ecological Development Foundation Inc. whose main thrust is to promote and adopt organic farming technologies and transfer of technologies on renewable energy, offered its technology model for Biogas Facility for Backyard Farming(Fig. 5). The facility can support 20 heads of hogs. It started its operation in August 2012 and since then it was able to generate methane gas connected to one stove used for continuous cooking for one hour.

Figure5.Biogas technology project in Malvar

This was the first ever technology and skill transfer through local training and implementation of new process and technology in biogas production in the barangay.

Aside from these, the technology had supported the flagship program of the municipality in making Malvar the organic capital of Batangas by providing source of organic fertilizer through the effluent sludge. Last year, 600 farmers were provided with organic fertilizer [38].

Unfortunately, at present due to high price of piglet and feeds, the pigpen is now loaded with native pigs, making biogas emission minimal, limited period for cooking and lesser sludge used as fertilizer.

Because of this experience, the municipal plan of putting barangay biogas facility for backyard hog farming in the barangay level was delayed. Instead, eco-waste centers and a three- year solid waste management plan for the 15 barangays would be pursued.

This implies that biogas technology can also be done in the remaining six urban and seven rural barangays with either commercial or backyard farms since the first ever biogas technology project had been successful. This can only be done through community collaboration among LGU, NGOs and the community members themselves. Success of this project can be measured through the environmental and social impacts as perceived by community members through triangulation methods.

CONCLUSION AND RECOMMENDATION

Based on the results discussed, biogas technology had been functional and successful in producing methane gas used for cooking, in bringing technology and skills transfer and in making effluent sludge as source of fertilizer if it had maintained and sustained the number of hogs in the pigpen.

It is recommended that commercial farms be strictly monitored and ordinances be imposed on them specifically on the use of biogas technology. The municipal government could partner with GOs and NGOs providing grant or equipment for such technology. For the monitoring of backyard farms, develop close coordination with barangay officials, if it does not work, plan a consultative meeting with agencies concerned to explain the hazards of improper disposal of hog wastes.

In addition, since Malvar has one cattle farm for CDO and a horse racing track (MetroTurf), it is recommended that biogas technology be also implemented because a study revealed further that cow dung has great potential for generation of biogas and its use should be encouraged due to its early retention and high volume of biogas yields [39].

A potential of biogas production is the solid waste collected from the Malvar Public Market and urban barangays going to the Materials Recovery Facility (MRF). The 60 truckloads of waste per week can be turned into energy just like the MSW (Municipal Solid Waste) leachate. Leachate COD (Chemical Oxygen Demand) strength has significant effect on the ultimate amount of biogas yield as well as the methane content [2]. The methane extraction project in Payatas Dumpsite is an innovative project converting waste to energy by harvesting methane. The project has provided an alternative power source of 200-kilowatt power capacity fueled by methane emitted from the decomposting waste [40]as it limits GHGs as well [41].

Another recommendation is set for the limitations of this study. A study that deals on the analysis of substrate composition and methane yield is highly suggested for future researchers. Future research should delve on the computation of the amount of

LPG or fire wood replaced by biogas, amount of GHGs prevented from being emitted as LPG or firewood is replaced by biogas.

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