BIO GAS PRODUCTION AT HIGHLANDS AGRICULTURAL COLLEGE

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ABSTRACT

The purpose of this project was to develop a Bio-Gas system which is cost effective and feasible for a village situation in PNG. People, who live in town or city, have electricty and gas, but most of the people, who live in villages, do not have electricity supply and gas. These village people are using kerosene or firewood for cooking and lighting in their houses. Bio-gas system can be another very effective technology in a PNG village. The reasons for developing a Bio-Gas system at H.A.C. (Highlands Agricultural College) are based on the following four factors:

1. Pig is a very valuable animal in the society of PNG and the people have many pigs in their villages. The resource of bio-Gas system is excreta from pigs and it is easy for village people to get these resources.

2. PNG is located in Tropical Zone, and the climate is suitable for fermenting excreta to produce methane gas.

3. Structure of Bio-Gas system is very simple, and the maintenance is easy.

4. Introduce Bio-Gas Production as a course component of Agricultural Machinery at H.A.C.

INTRODUCTION

Manure is a valuable product. It contains a lot of nutrients for plants and can therefore be used as fertilizer. Manure is not seen as a waste in every country. Some see it as a valuable by-product of the pig industry. Apart from providing plant nutrients it can also be utilized in other areas.

Our neighbours in the South East Asian Countries collect and store the manure especially from pigs to produce bio gas for cooking. In commercial as well as in other pig production systems it is necessary to maintain a good waste management program. This is very important in preventing the spread of diseases and in maintaining the overall hygiene and sanitation in the farm. Pig manure can be used to produce an odourless and highly inflamable gas when organic matter (pig manure) decomposes in the absence of oxygen. It is a mixture of methane, carbon dioxide, water vapour and traces of other gases.

This article outlines the work we have done on bio gas at Highlands Agricultural College with the help of Mr Tsutomu Day (Japanese Overseas Cooperation Volunteer) from Japan.

PRINCIPLES

a) Bio-Gas

Bio-Gas is a System of producing gas from fermented excreta of livestock such as pigs, poultry and cows.

b) Amount of produced Gas;

One Kilogram (1kg) resources of Bio-Gas can produce 500 m^3 of methane gas in a temperature range of 20-25 °C for two months.

c) Volume of fermentation tank.

The volume of fermentation tank can be decided as follows:

1. Necessary volume of Bio-Gas.

The necessary volume of Bio-Gas is 1 m^3 to generate for cooking, and 2.2 m^3 to generate electricity in a day.

2. Necessary amount of resource.

The necessary amount of resource is 2 kg excreta from livestock to produce 1 m^3 of bio-gas in a day.

3. Necessary volume of fermentation tank.

The fermentation tank within a 1 m^3 volume can produce 0.5 m^3 of methane gas.

d) Utilization of Bio-gas

A Bio-Gas System can be used in applications requiring cooking or lighting, electrical input of generator and to produce liquid fertilizer.

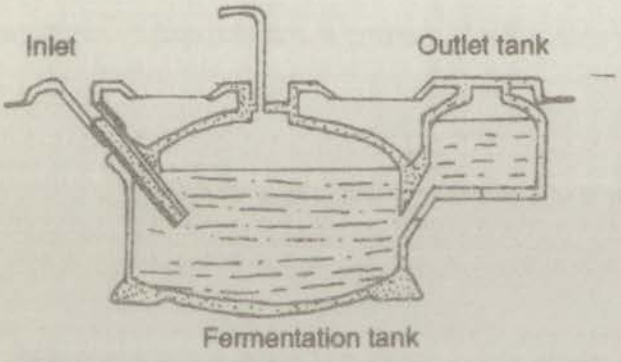


Figure 1. **A typical Bio-Gas tank**

e) Construction of Bio-Gas system
A common design of Bio-Gas System is shown in figure 1.

The Inlet and Outlet are connected to the fermentation tank with pipes. Inspect the construction of the Bio-Gas plant for the following:

1. Check the gap for leaking excreta from fermentation tank and outlet tank.

2. Check the gap from gas escaping from the upper part of the fermentation tank.

PROJECT IMPLEMENTATION

Bio-Gas system was constructed at H.A.C. during May to August 1993.

1. Materials

List of Materials

- Block - 144
- Iron Pole - 4 mm x 20 m
- Iron Pipe - 20 mm x 0.3 m
- Iron net - 8 m^2
- Stop cock - 1
- Vinyl chloride pipe - 150 mm x 3 m
- Cement - 20 kg X 25
- Sand - 1 m^3
- Gravel - 1 m^3
- Inlet (ceramic ware)
- Timber (to make foundation)

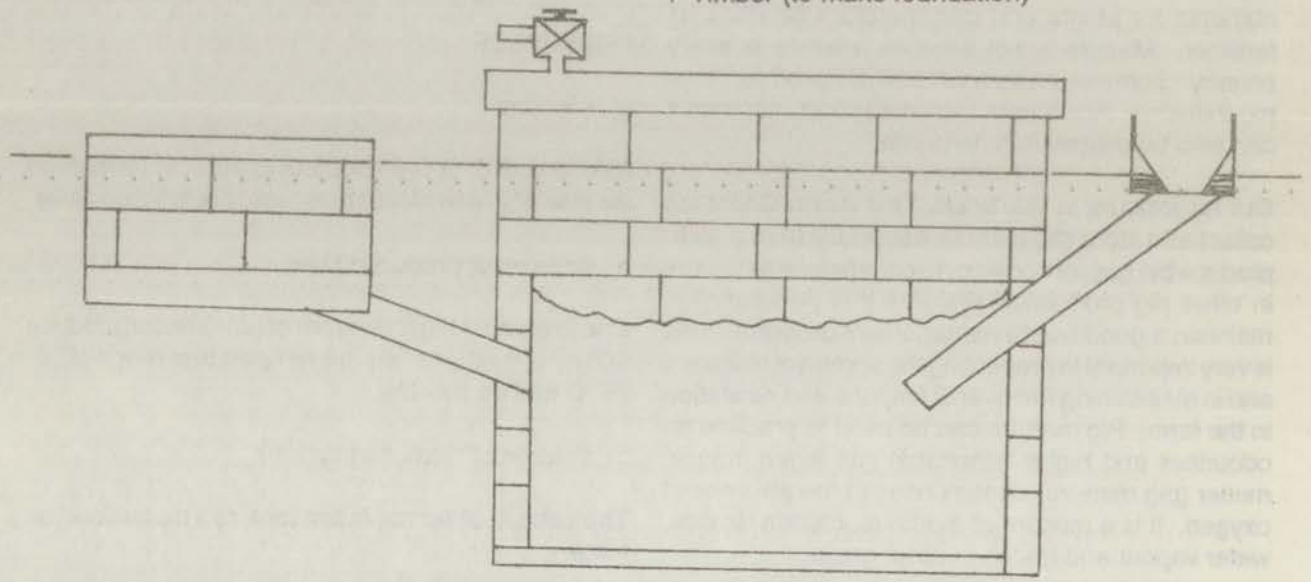


Figure 2. **Bio-Gas System, Constructed at H. A. C.**

2. Design

Fermentation tank:

Volume of fermentation tank was decided as follows: (refer principle-c)

a. The purpose of this project was to produce methane gas for cooking and lighting, therefore necessary volume of produced Bio-gas is 1.5 m^3.

b. Piggery of H.A.C. has around 25 pigs, therefore there is no problem with the resources of Bio-gas system.

c. Temperature of H.A.C. is around 10 - 25 °C every day. Therefore, the volume of gas produced from 1 m^3 fermentation tank is expected to be around 0.4 m^3.

In these circumstances, the volume of fermentation tank was calculated as follows: 1.5 m^3 : 0.4 m^3 = 3.75 m^3

Therefore, the necessary volume of fermentation tank is 3.75 m^3 for this project.

The final volume of designed fermentation tank is 3.96 m^3, see fig-3. (1.54 mx1.54 mx1.67 m = 3.96 m^3).

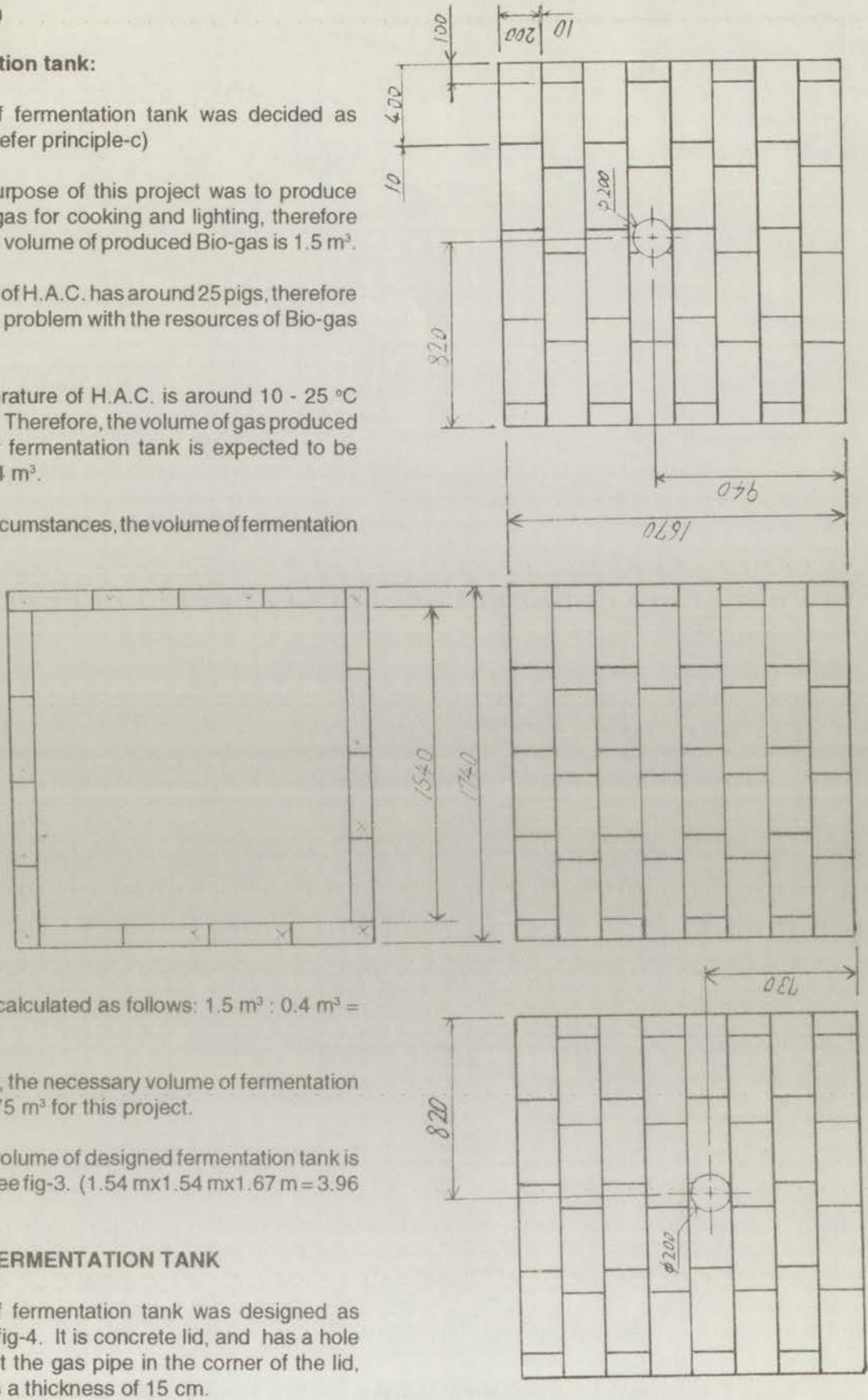


Figure 3. **Fermentation tank**

LID OF FERMENTATION TANK

The lid of fermentation tank was designed as shown in fig-4. It is concrete lid, and has a hole to connect the gas pipe in the corner of the lid, which has a thickness of 15 cm.

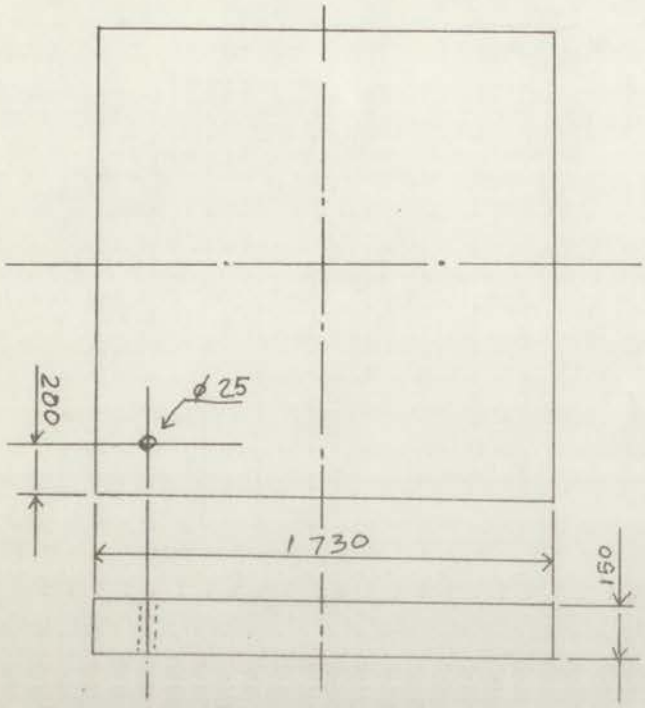


Figure 4. Lid of Fermentation tank

Outlet tank

The outlet tank is made of blocks, and has concrete lid. See fig-5 and fig-6.

3) **Location:**

The bio-gas system at H.A.C. is located near the piggery. The location is very good for the management of this system, because it is close to the source of excreta, the waste can easily be disposed and it gets a lot of sunshine.

The position of the fermentation tank, outlet tank and inlet was decided according to the following plan. See figs. 8 - 9.

4) The process of making Bio-gas system:

1st, 2nd, 3rd day (18th, 19th May, 3rd June)

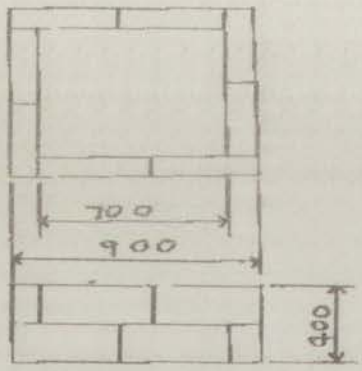


Figure 5. **Outlet tank**

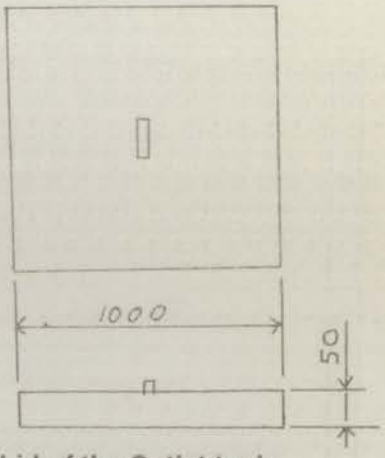


Figure 6. **Lid of the Outlet tank**

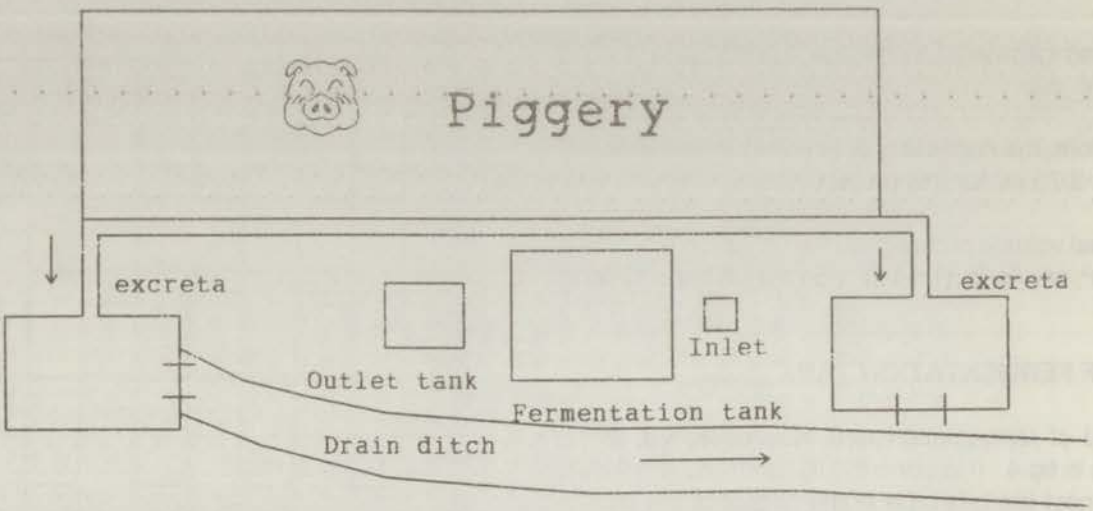


Figure 7. **Location of Fermentation, Outlet in relation to the Piggery at H. A. C.**

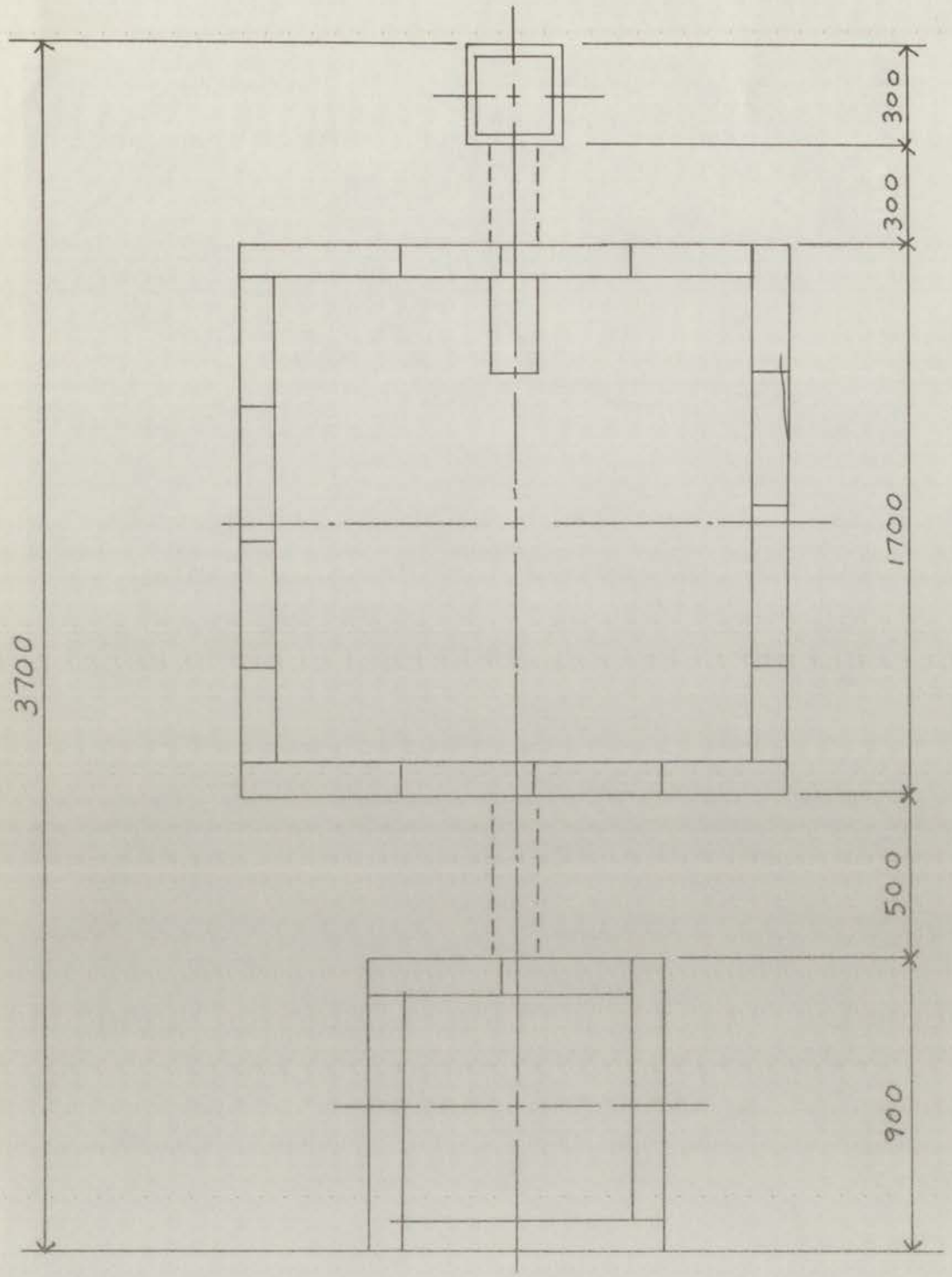


Figure 8. **Longitudinal section of the Bio-Gas system at H. A. C.**

Dug a hole in the ground, that shape is referred to in figure 6, figure 7.

4th day (8th June)

Laid the foundation of a fermentation tank.

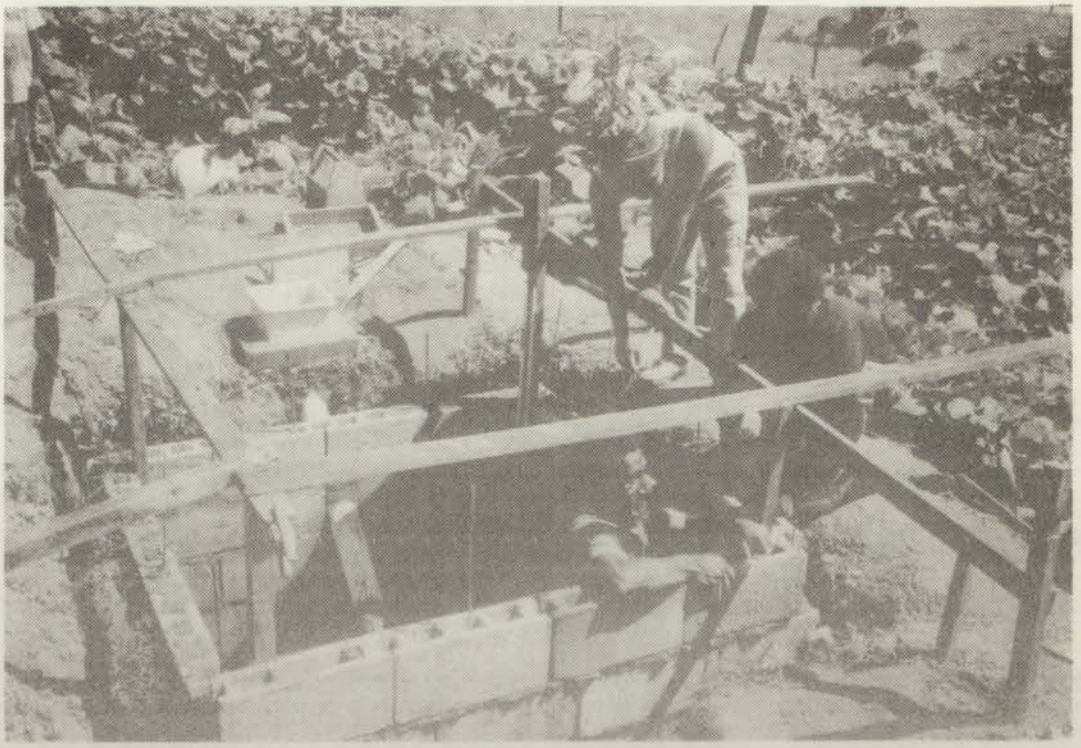
(1) Made a frame to fit into the inside diameter of the fermentation tank.

(2) Put the frame in place, and cemented the outside of the frame.

5th, 6th day (9th, 10th June)

Built the wall of fermentation tank.

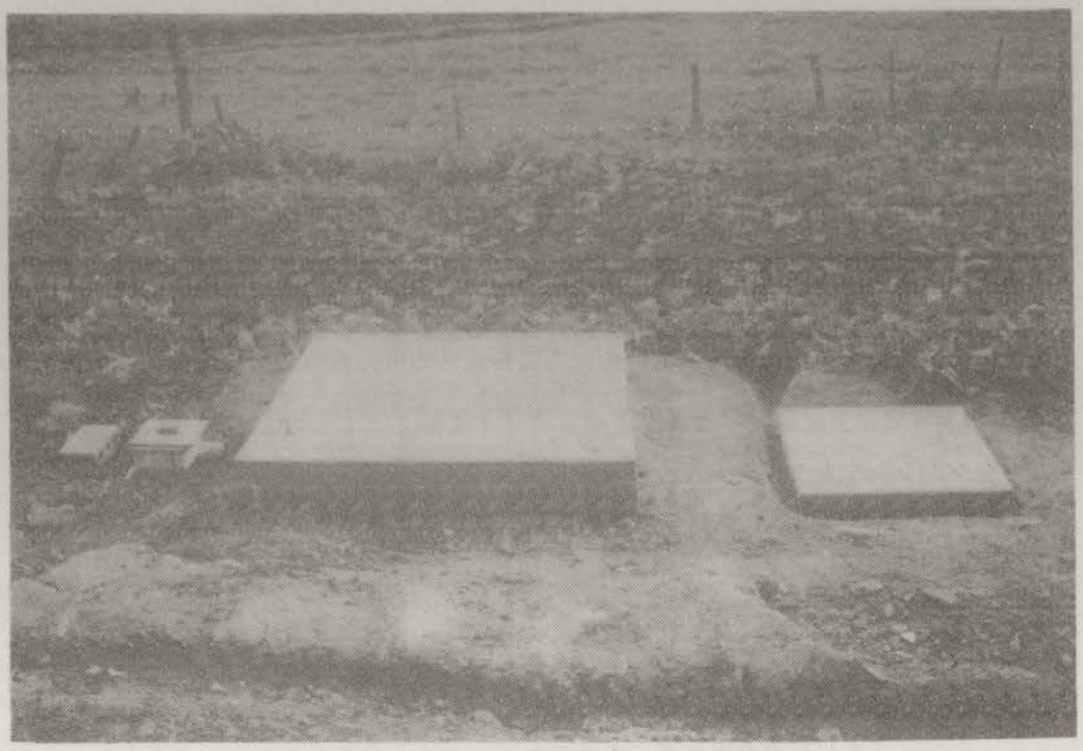
(1) Laid the blocks on the foundation level.
(2) Cemented the blocks.



Laying of the layers of blocks

Cementing of the floor of fermentation tank

Putting of iron rods into the holes of the blocks



Completed Bio-Gas Plant (top view)

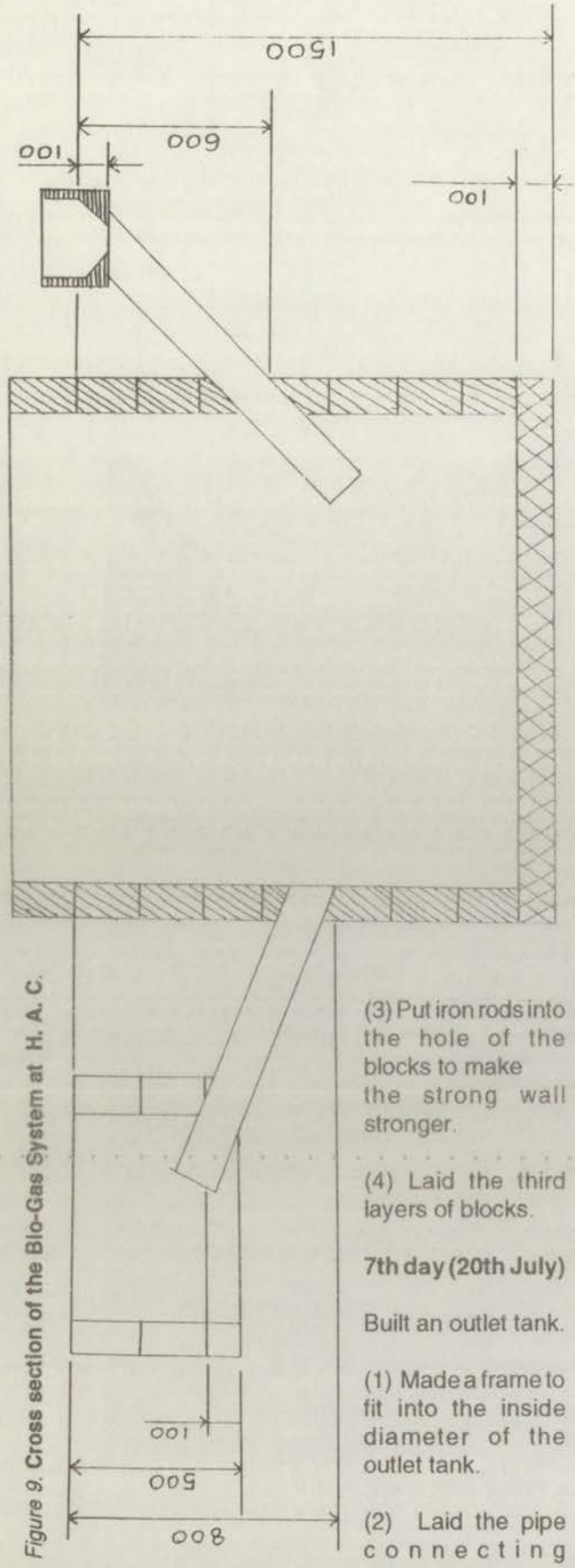


Figure 9. **Cross section of the Bio-Gas System at H. A. C.**

fermentation tank and the outlet tank.
(3) Placed the frame on the top of the outlet tank, and cemented the outside of the frame.
(4) Laid the blocks on the foundation level.
(5) Cemented the blocks.
(6) Put iron rods in between the blocks.
(7) laid the second layer of blocks.

8th day (21st July)

Placed fourth layer of blocks for the fermentation tank and made an inlet.

(1) Laid the fourth layer of blocks.
(2) Made a foundation frame for the inlet and fixed a pipe connecting fermentation place and inlet.
(3) Placed inlet in the foundation frame. Inlet is the ceramic vessel.
(4) Cemented the inside of frame.

9th day (22nd July)

Laid the 5th and 6th layer of blocks.

10th day (27th July)

Laid the 7th and 8th layer of blocks.

11th day (28th July)

Plastered the wall, and around the connecting pipe.

12th day (29th July)

Cemented the floor of the outlet tank.
Cemented the wall of the fermentation tank.

13th day (16th August)

Cemented the floor of the fermentation tank.

14th day (17th August)

Made a lid for fermentation tank.

(1) Built a frame on the fermentation tank
(2) Put the bords in the frame, and put iron rods and fence on the bords.
(3) Made a hole of gas valve on the bords.
(4) Put a gas valve.
(5) Cemented the inside of frame.

15th day (18th August)

Made a lid of outlet tank.

(3) Put iron rods into the hole of the blocks to make the strong wall stronger.

(4) Laid the third layers of blocks.

7th day (20th July)

Built an outlet tank.

(1) Made a frame to fit into the inside diameter of the outlet tank.

(2) Laid the pipe connecting

(1) Made a frame, and placed on the vinyl seat.
(2) Placed the iron fence in the frame.
(3) Cemented the inside of frame.

CONCLUSION

The negative attitude towards pig manure in PNG is forcing farmers to adopt ad hoc solutions often without the necessary guidance and know how.

Existing technology on pig manure is mainly based on transferring the problem to another site rather than treating the problem on site. This is not a long term solution. Pig manure should not be a problem at all in PNG. As stated earlier it used to be a perfect fertilizer and still is.

We have got to think positive and realize that pig manure is a part and parcel of our pig production system. The production of bio-gas using pig manure is inexpensive and can be easily tried elsewhere in PNG.

REFERENCES

Lee, W.J., (1989), Utilizing manure is better than disposing of waste, Misset International, Netherlands, pp. 11-13.

Thornton, K., (1989), What to do with manure? Misset International, Netherland, pp. 8-9.

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