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Low cost biodigester as a sustainable energy solution for developing countries: Jiudao Yakou village, China, a case study.

B. Elizabeth Romo- Rábago*, Irene Herremans, Patrick Hettiaratchi and Renay Eng-Fisher
University of Calgary and EcoVillage of Hope Society. *beromora@ucalgary.ca

Introduction

Biogas is one of the most versatile energy sources. It can provide a sustainable development and access to clean energy. Currently, over 3 billion people worldwide use solid fuels, such as wood to supply their energy needs. These inefficient sources of energy are one of the factors that keep a large population in the developing world trapped in the vicious circle of poverty (1). Since biogas is generated by anaerobic degradation of human and animal waste, it can be a promising and affordable energy solution to abate poverty.

This study draws from a broad base of international case studies to evaluate the feasibility of implementing a low cost biodigester at the Jiudao Yakou village.

Study objective

The Jiudao Yakou village is a leprosy community located in the Yunnan province (Fig 1), which is classified as one of the world's biodiversity hotspots. However, Yunnan' natural resources are seriously under threat because its population highly depend upon local ecosystem for its food and resources (2).

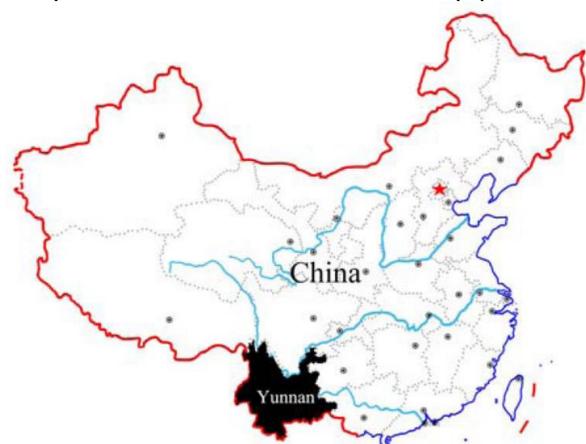


Figure 1. Location of Jiudao Yakou village (2).

Results

Table 2. Potential biogas production at the Jiudao Yakou village (4)

Amount of substrate	Substrate	Daily production (Kg/day)	Biogas yield (m ³ /animal/day) DM	Total Biogas yield (m ³ /day) DM
7	Cow manure	8	0.32	2.24
8	Pig manure	2	1.43	11.44
12	Chicken manure	0.08	0.01	0.12
93	Human waste	0.5	0.04	3.72
Total biogas yield at the village				17.52

Table 4. Summary of potential biogas benefits at the village (1 & 7)

	GHG e reduction	71.35 t CO ₂ eq/year
Environment	Deforestation reduction	8.3 ton/year = 138 trees
Economic	Fuel & Fertilizer reduction	> 5% savings
	Increase in crop yields	20 – 50 %
Social	Reduction in time for firewood collection	> 4hrs/day
	Health improvement	CO, CO ₂ , SOx, H ₂ S and PM below detection limits
Technical	Clean fuel for cooking	> 60% fuel needs covered by biogas
	Clean fuel for lighting	

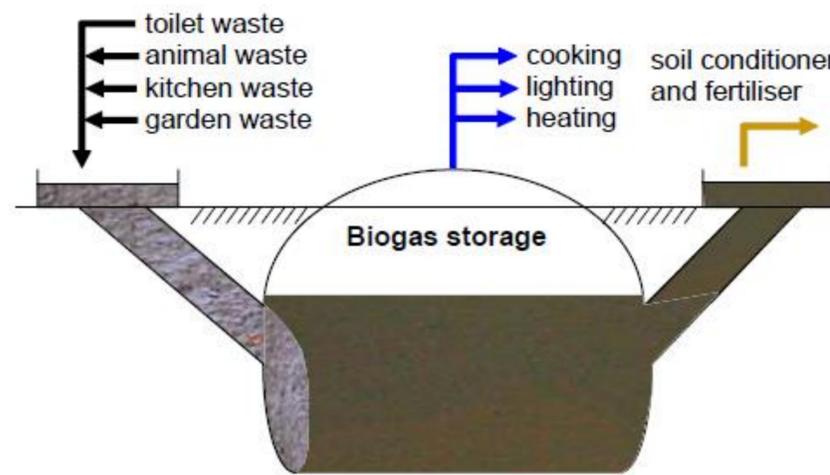


Figure 2. Diagram of a typical low cost biodigester (5)

Table 3. Technology analysis for a 16m³ biodigester (6)

Biodigester	Total cost & Lifetime span	Advantages	Disadvantages
Fixed Dome	\$2,000 - \$5,000 20 – 50 years	•Constructed underground •No moving parts needed •Keeps stable temperature	•Labor intensive •Technical supervision needed •Gas pressure fluctuates
Floating Drum	\$2,500 - \$6,000 5- 15 years	•Easy to operate •Constant gas pressure •Visible volume gas	•Rusty steel parts •High cost •High maintenance
Tubular Polyethylene	\$350 - \$500/household 2- 6 years	•Low cost •Easy to build, operate and maintain.	•Short lifetime span •Low gas pressure •Small scale

Conclusions

The installation of a low cost biodigester at the Jiudao Yakou village has the potential to provide the villagers not only with a renewable source of energy that has multiple environmental and socio economic benefits but it will also provide them with an efficient sanitary system that is relatively affordable and easy to operate and maintain.

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Table 1. Current situation at the village (3)

Annual income	\$80.37 CAD/year/ per capita
Farming land area	22.3 Ha
Electricity for lighting	12.6 kWh
Kerosene expenses	\$427.78 /year
Woodfire collection	13.8 ton/year = 230 trees
Human & animal waste	119.46Kg/day
Total Energy needs	27.45m ³ /day