

Extension of Biodigester Construction to Produce Domestic Gas and Organic Compost on Family Farms

By

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Abstract

In the current context of gradual deterioration of the environment, research into sustainable use of natural resources at a local level is clearly a long-term solution. In African countries and particularly in Cameroon, important issues are at stake. Indeed, even where there is a biological balance, ‘unecological’ practices increasingly threaten the environment: uncontrolled woodcutting, destruction of virgin forests to grow crops used for biofuel, destabilisation of the local economy and reversal of concepts of an equal society. Peasant households face several limitations for efficient biogas production, including low livestock production (three pigs) and population density (150 people/km²). Lack of energy infrastructure also constitutes a major constraint in rural areas. To solve this problem, farmers could combine energy and manure production to optimize use of waste. The aim of this article is to reinforce conditions in which a biodigester could be sustainably built and used by farmers to optimize biogas and organic-manure production in an integrated crop–livestock system.

Introduction

Rural poverty and recent price rises for basic essentials in the countryside have caused increasing difficulties for rural families. Natural resources are coming under growing pressure from uncontrolled gathering of wood for heating and the creation of new plots of land for agriculture.

In this delicate context, the long-term regulation of sustainable management practices for natural resources, and the use of organic waste from small-scale cattle rearing at a local level is

particularly significant. We would like to emphasize the need for increasing the number of biogas digesters built to produce domestic gas and organic compost in rural farms. Inspired by our pilot project, we would like to set out some of the successes and challenges we encountered.

What is the Context, What is at Stake?

The assumption that principles of industrial ecology can be applied at the local family-farm level leads to the following research and development questions:

- Can the production of biogas contribute to creating village ‘pockets of sustainability’ and serve as a path to sustainable development?
- What are the minimum requirements for rural biogas and compost production to be effective in a farm unit?
- How can the energy produced be used?
- What are the effects of organic fertilizers on rural farm productivity?

But the conclusion was that fostering the creation of rural more environmentally-oriented organisations was the way forward.

Mixed agriculture (a combination of cattle-rearing and crop cultivation) is the major source of income in the humid forested zone of Cameroon. In terms of cattle-rearing, pigs are reared predominantly in addition to poultry and small animals; the recent domestication of the cane rat has led to widespread production. Crop and animal husbandry is not widespread for several reasons including lack of access to production facilities. With the exception of pork production where there is a real driving force motivating production, there are few opportunities to generate income. The situation is entrenched by limited development of infrastructure, a lack of technical support to exploit the full potential of products and by-products of local human activities. Making use of pig manure would clearly be a way forward to add value to pig rearing locally and throughout the country.

EWB’s starting point in initiating this action is the need for better correlation between increasing the use of biogas and fostering a move towards exploitation of waste from cattle rearing, in order to stimulate measures for regulation of woodcutting for heating.

By this initiative EWB wishes to take a position on the two linked objectives of sensitising rural populations to the challenges of protecting the environment at the same time as promoting the use of the technology necessary for their wellbeing.

From Target to Real Impact?

In quantitative terms the aim was to evaluate the number of factors needed (biological waste, time, human skills and financial resources) for the biogas digesters to function efficiently and effectively, using a participatory approach in transfer of technology.

At the same time, EWB aimed to improve technical capacity of the producers and lay down guidelines for good environmental management practices. Specifically, the aim was to try manual construction of digesters on the one hand, by using simple masonry tools and locally available materials, while on the other hand making use of animal manure and in particular pig manure mixed with water and vegetable waste available from rural cultivation.

Technology should be transferred by:

Simplifying/Adapting the Process

The simplified technology functioned well. Technical suggestions for improving the farmers' biodigestion systems are known (materials, reservoir entrances and exits, inspection panel, mixture area, etc.). The results varied according to the material types and the composition of the farm and household wastes. This initiative also facilitated extension of research findings by providing rural populations with a simplified technology for producing environmentally-friendly energy.

Cost of Construction of Artisanal Micro-biodigester

Labour needed amounted to 24 work-days (wd) to prepare the terrain, 180 wd for the construction work, 36 wd for plumbing and 120 wd for finishing work over an average period of 4 weeks. A 2 m × 3 m biodigester made by non-qualified labourers cost €702 and the average production was 413 litres of biogas for from 1.22 kg of manure per day. The average energy production potential was 2.29 kW/m³.

Interesting Features of Products Achieved

The system is based on daily fermentation of a large organic mass composed mainly of pig manure, in the presence of anaerobic bacteria. To improve farm hygiene, the manure has to be properly managed. In these experiments, we obtained materials with good levels of minerals. This simplified biogas-production system can be used to produce methane, as a replacement of wood, for cooking. After getting rid of the first gas, the gas that was obtained had a clean blue flame.

What are the Lessons of the Project?

Technology well suited to the Rural Context

A biodigestion unit can be optimized through 90 days of biomethanization in a farmer's pigsty with about 20 sows. During that period, biogas production goes up. Waste with a high proportion of pig manure produces up to 2.7 times more biogas than waste of mainly plant origin. However, it is important to know the plant/animal matter ratio that allows for optimal biogas production.

Compost requires good storage and fulfils a small part of the crops' requirements for nitrogen, phosphorus, calcium, magnesium and trace elements. The application of organic manure contributes to considerable increases in maize yields. With bags selling at €21.34, the farmers can earn €855 per hectare of maize planted. In groundnut plots, the manured plots yielded little more than the fresh field. Although the fact that there was not enough difference in groundnut yields between manured plots and fallowed plots suggests that producers can almost maintain the fertility of the soil and reduce deforestation by stabilizing cropping areas.

EWB suggest that small rural households need an average of 20 kWh/month. Assuming a production level of 137 kWh/month, the biodigester could supply six rural households. Since an average family spends around €655 on energy per year, a biodigester pays for itself in five quarters, but due attention has to be given to the capacity/needs ratio to convince rural areas to implement integrated artisanal biogas-production systems.

There are no definite conclusions on profitability. Parameters other than biogas production have to be borne in mind. Determining whether the biodigester is economically viable requires a preliminary estimate of labour costs for the collection of organic waste.

On the other hand, a higher rate of fires can be associated with the volatilization of biogas when inappropriately used by less skilled people. In order to protect peasant populations from fires risks, further studies on adequate risk-reduction strategies must be considered.

What are the Prospects?

If quantitative results correspond largely to objectives determined initially, the outlook seems to offer both potential and constraints. And in terms of ecological practice, populations must play their part in changing their behaviour with regard to energy. On the other hand, it was observed that there were some promising positive effects for following up the project at a local level. Real networks of producers need to be put in place to apply ecologically viable practices. Developing these attitudes will help improve and diversify activities while reinforcing producers' technical capacity and fighting climate change.

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