XXX Nairobi, Kenya

sustainable sanitation alliance

case studies of sustainable sanitation projects

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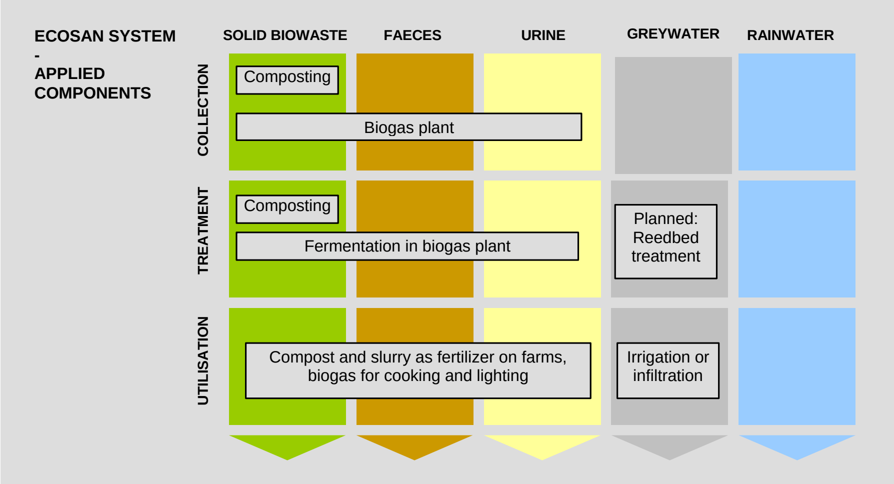
Compost and biogas plants for small scale farmers

Nairobi, Kenya (draft)



1 General data

type of project:
rural upgrading

project period:
January 2005 to December 2007

project scale:
3 entrepreneurs which offer services for construction and operation of biogas plants for a rising number of clients (22 clients in May 2006)

address:
Promotion of Private Sector Development in Agriculture (PSDA)
Nairobi, Kenya

planning institution:
GTZ, Ministry of Agriculture (PSDA)

executing institution:
GTZ, Ministry of Agriculture (PSDA)

supporting agency:
BMZ, Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

2 Objective & motivation of the project

- Implementation of cost saving and environment-friendly technologies for energy production, fertilization and irrigation.
- Productive utilization of agricultural waste.
- Distribution of resource-saving waste recycling technologies in rural and peri urban areas.
- Establishment of biogas plant contracting companies and service providers.
- Capacity building for these companies.
- Training of masons in the sizing, siting and construction of biogas plants.
- Training of engineers in the elaboration of concepts for biogas plants for waste and wastewater treatment.

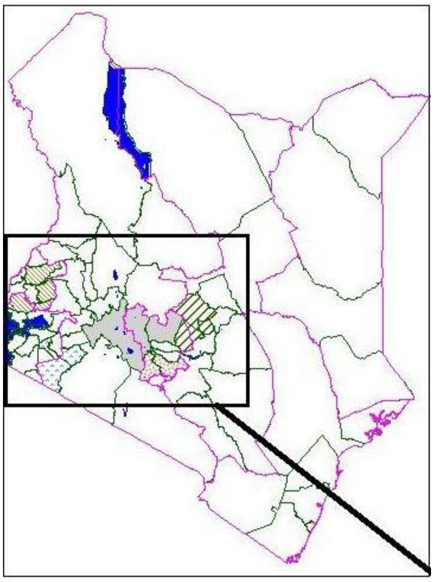


Figure 1: Project areas *(source: GTZ)*

- User training in handling biogas plants
- Training of local self-help groups in assembling and handling compost plants
- Support of packaging and marketing of compost products
- Development and establishment of credit facilities for enterprises and individuals to install biogas systems for waste and wastewater treatment and energy recovery.

3 Location and conditions

The project covers high agricultural potential areas in parts of Western, Nyanza, Rift Valley, Central and Eastern provinces of Kenya. The inhabitants are mainly small scale farmers with very small pieces of land. Firewood as the main household energy source has become short due to cultivation of land and destruction of the forest cover. Agricultural productivity is decreasing due to declining soil fertility. A large amount of waste and wastewater from farms is not used at all but polluting the environment. Hence cost saving and environment-friendly technologies for energy production, fertilization and irrigation are needed.

Figure 2: Vegetables produced with slurry *(source: AKUT)*

4 Technologies applied

- Biogas

Biogas technology is an old and well tested technology. It can be used to process organic waste into useful products. The bio-digester is a closed medium in which through anaerobic fermentation livestock, human excreta and / or other organic wastes generate methan or biogas and are at the same time sanitised and transformed into high quality semi-liquid fertilizer (slurry). This contains all original mineral elements needed for plant growth, but the reducing anaerobic medium improves the efficiency with which they can be assimilated, e.g. the conversion of part of the organic nitrogenous compounds into ionic ammonia. The biogas generated during the fermentation process can be used directly for cooking and lighting or to run a gas engine that can either supply motive power or generate electricity.

Figure 3: Construction of a biogas plant dome *(source: AKUT)*

So far one bigger biogas plant (91 m^3) for Moi Univesity in Eldoret and twelve 16m^3 plants on farms are in operation, 8 furhter plants are planned. They are used mainly for animal manure and biowaste. But since the project has just started in 2005, concepts for different types of feeding material and larger biogas plants have been developed. Due to some requests of rural schools it is anticipated that first plants combined with latrines will be constructed this year.

- Composting

Composting is also a well known technology which improves the handling of any organic residue by reducing its volume and weight and killing pathogens and weed seeds. After 8-10 weeks of compost ing waste is turned into a hygienically safe fertilizer ready for screening, packaging and sale or use. To meet the necessary quality of the substrate certain physical conditions and parameters like temperature, aeration, moisture, mixture of substances etc. are to be observed during processing. These can be assured by quite simple measures like correct piling, shifting, moisturization or addition of dry substances etc.

Biogas and composting technologies are easy to adopt and to apply. They can enable the agro-enterprises to not only treat waste but also add value to it by generating good quality fertilizer and energy.

Figure 4: Compost piles *(source: AKUT)*

- Reed bed filters

A number of organisations and enterprises have already expressed interest in using reed bed filters as an innovative technology. Wastewater is treated environment-friendly and quite effective by leading it through special planted sand filters. The technology has not yet been implemented in Kenya; hence the next target is to organize knowledge transfer by training of wastewater treatment engineers and construction masons while at the same time creating awareness and thus a market for them to offer the services in a self sustaining manner.

5 Type of utilisation/reuse

The targeted users of the technologies are all members of the agricultural sector from the producer (farmer) to the middlemen (wholesale markets), from processors (industries) to consumers (institutions and individuals).

The fundamental practise is treatment and utilization of wastes directly at the source and on the compound. Using biogas as cooking and lighting fuel in the producers´ households reduces the dependency on fossil fuel and firewood. But principally it can even be supplied into the electricity net.

Figure 5: Stove modified to biogas use *(source: AKUT)*

Slurry of biogas plants and compost are used as fertilizer or soil conditioner on the fields replacing petroleum based fertilizers.

Figure 6: Slurry application on vegetable field *(source: AKUT)*

Thus they contribute directly to the conservation of biodiversity and while reducing the cost of farm inputs such as fertilizer. In larger scale it can also be put on the market for sale. Presently it is applied mainly on cut flower fields of farmers appreciating organic fertilization.

6 Further project components

1. Collaboration exists with institutions such as National Council of Science and Technology, Kenya Agricultural Research Institute, Moi, Baraton and Egerton Universities in order to

- establish training for students and entrepreneurs in concept development, biogas plant construction and alternative gas use equipment sizing (generators, absorption chillers, sterilizing equipment).
- look into aspects of e.g. pre-treatment of organic waste with unfavourable pH or high or low moisture content as well as testing and development of safe use of digested slurry.

2. Credit solutions to support necessary investments for both technologies are presently being developed by the project and discussed with banks.

7 Project history

For several years certain local uncontrolled composting and biogas activities have been going on. Due to a lack of technological knowledge these often resulted in insufficient plants and / or poor products, which corrupted the reputation of the whole technology.

In the beginning the project focussed on education, awareness raising and PR through presentations in different forums and through brochures as necessary prerequisites for enabling stakeholders - including government personnel - to understand the project objectives and possible advantages. So far the project has been able to identify a number of interested contracting firms and service providers. These are presently being trained in both biogas plant construction and concept elaboration. In the long run the technology will mainly be spread by using their services.

8 Costs & economic benefits

PSDA mainly invests in know-how transfer, capacity building, workshop costs, training costs, overall management costs and backstopping which amount to app. € 120,000 / year.

Investment costs for a turnkey 16 m^3 biogas plant amount for instance to app. 1500 US$. Experience shows that an average investment of app. 80-100 US$ per m^3 digester volume can be taken.

Economic benefits must be updated.

9 Operation and maintenance

Operation of a biogas plant is mainly an issue of feeding the plant with the right mix of stock (e.g. animal manure mixed with water, biowaste). The fermentation itself produces biogas which is directly used or stored in the dome of the biogas plant. Maintenance entails the proper care of water traps, gas burner and lamps.

Operation and maintenance of both biogas and composting installations are done by the owners, who receive technical support by PSDA. In larger scale applications e.g. small scale enterprises could organize O&M measures against fees or marketing of the by-products.

Quality control of compost is mainly done by the laboratories at Kenya Agricultural Research Institute who undertake analysis and give the go - ahead to use or discard the compost fertilizer.

The people involved in the preparation of compost have to conform to basic hygiene guidelines that include wearing of dust masks, gloves, gumboots and regular medical checkups. No special equipment is used in the process.

In biogas plants all the process takes place self-acting. The digested slurry is comparatively sanitized and quite safe for handling during field spreading. After a couple of years biogas plants have to be evacuated and the slurry remaining at the bottom has to be removed.

Figure 7: Slurry effluent of a slaughter-house biogas plant *(source: AKUT)*

The emerging biogas is led through metal or plastic pipes to the point of use or collected in the upper part of the biogas digestor called dome for storage purposes called gas holder. From there it is led to the point of use (burner or lamp) by pipes. Gas piping is simply done by use of either galvanized pipes or plastic pipes with rubber hose for final connection to point of use.

Figure 8: Pressure lamp modified to biogas use *(source: AKUT)*

10 Design information & technical specifications

The basic construction of a biogas plant can be seen in figure 9.

11 Practical experience, challenges & lessons learned

The up-to-date technologies being offered for waste and wastewater treatment have received very good acceptance among the target groups. However a number of measures is fundamental to support an upscaling of the implementation of biogas and compost plants:

- Capacity building in biogas technologies

Problems experienced earlier in the biogas plant construction and uptake have been mainly quality related by semi trained or untrained masons. Until 1994 there have been several support programs for regenerative energies funded by diverse donors, that offered e.g. information literature or one-day trainings carried out by national NGOs.

A number of entrepreneurs who only participated in these far short work workshops or who were self trained by books, offered construction of inadequate biogas plants at the market, thus contributing negatively to the reputation of the technology.

The project now targets to closely monitor the masons under training to ensure that they maintain quality and are only allowed to undertake constructions after being properly trained. Follow-up supervision and establishment of a network will contribute to monitoring of the skills development. However an upscaling of implementation of biogas plants would help to meet the masons comprehensive training requirements.

- Capacity building in composting technologies

Although some private composting activities have been going on already for a number of years the used technologies were often inadequate, resulting in a poor quality product, unattractive to customers. The comprehensive capacity building being undertaken by PSDA has contributed immensely to the resurgence of interest in biogas technology as a waste and wastewater treatment as a value adding option.

Composting as a solid waste treatment model and the sale of fertilizer promises to be an acceptable option if the market uptake of compost fertilizers is developed. With proper training in the production of quality compost, and understanding of the economic advantages of using compost as an alternative to petroleum sourced fertilizer, producers and users can contribute to expanding the market and thus encouraging more sector investments.

Hence also composting in a larger scale, e.g. in composting groups or as a commercial activity, should be encouraged to motivate individuals and corporate investors to participate. A number of groups and individual investors are already interested in undertaking these activities as income generating enterprise.

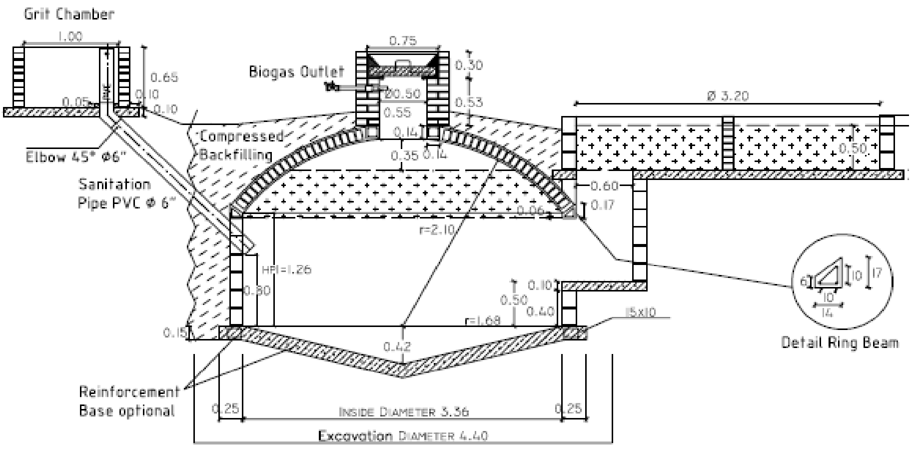


figure 9: section of a biogas plant *(source: AKUT)*

Figure 10: Workshop for constructors *(source: AKUT)*

- Credit facilities for users

Establishment of credit facilities for both biogas plant constructions and compost site establishments – as presently being investigated - would lead to further up-scaling. Since especially the biogas plant construction has to be undertaken as a whole, the capital investment is a burden to prospective clients requiring saving money for a long time before they are able to undertake construction.

- Policy change

The existing policy framework impede the development of biogas as an income generating option and reduces the financial viability. Enabling biogas owners to sell the generated electric energy to the national grid at a reasonable price – as practised e.g. in parts of Europe - would definitely increase the up-scaling of biogas technology since it would advance the return on investment.

Awareness raising at the council level to avail not only the waste, but also the necessary space for composting and to preferentially purchase the compost for e.g. use in town greening (which is an independent project implemented through the ministry of local government, covering all towns) would enable an up-scaling of activities. The project is already performing awareness creation in the clusters' municipal councils.

12 Sustainability of the system

Need to be updated.

13 Available documents & references

The following material will soon be available at the project via PSDA or consultants respectively:

- Biogas construction training manuals
- Biogas operation manuals
- Compost training manuals
- Biogas plant designs (different sizes)
- Composting layout designs
- Biogas and composting information brochures

Need to be updated.

14 Institutions, organisations & contact persons

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Maybe needs to be updated.

Case study of SuSanA projects

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