

## Biogas Technology in Agricultural Regions, Tanzania

### Themes

- ★ Renewable energy
- \* Linkages with other environmental goals
- ❖ Technical capacity development
- ❖ Awareness, culture and practices
- \* Poverty alleviation (MDG 1)
- \* Gender equity and empowerment (MDG 3)

### PROJECT DATA

**Name:** Promotion of Low Cost Biogas Technology to Resource Poor Farmers in Tanzania  
**Implementing Organization:** Foundation for Sustainable Rural Development, or SURUDE (NGO)  
**Location:** Tanzania, with replication in other African countries  
**SGP Contribution:** \$88,016 (two grants)  
**Start Date:** January 2001

### ENERGY OVERVIEW

**Energy Resource:** biogas  
**Technology:** tubular plastic biogas technology  
**Application:** cooking, limited lighting  
**Sector:** agriculture/livestock  
**Households Served:** more than 1000 households in Tanzania  
**Cost per system:** \$100  
**Total energy provided:** a 4 m<sup>3</sup> volume digester produces 1 m<sup>3</sup> gas per day, equivalent to 0.5 liters of kerosene

### BACKGROUND

Farming is the major rural activity in Tanzania, but this does not generate sufficient income. As in most of Africa, fuel wood and charcoal are the primary sources of energy for Tanzania's rural population. On average each rural household spends ten hours per week searching for fuel wood. In urban or peri-urban areas, households spend considerable amounts of money on fuel wood and charcoal. Consumption of charcoal and fuel wood is a serious factor in deforestation, air pollution and carbon dioxide emissions. When all forest uses are included, the deforestation rate in Tanzania is around 100,000 hectares per year. In addition, Tanzania's 13 million cattle also produce greenhouse gas emissions; dung that is left to degrade produces significant amounts of methane and carbon dioxide.

### PROJECT DESCRIPTION

#### Overview

This project seeks to address technical, financial, and informational barriers to the implementation of biogas technology in order to increase incomes, improve home air quality, and reduce carbon dioxide emissions. The project's strategy is to integrate livestock into the farming system and promote the production of biogas for energy.

### Implementation

The project began when scientists from Tanzania learned about a low-cost, tubular plastic biodigester being used in Vietnam. They adapted it to Tanzanian conditions, and then began seeking ways to integrate its use into the farming system, ensuring its sustainability.

### Technology

The biodigester produces gas that can be used as fuel for cooking and heating, as well as for lighting, with proper equipment. It costs about \$100 and takes about 4 hours to assemble. For proper functioning, the digester requires the excreta from 1-2 cows, 5-8 pigs or 4 able-bodied people on a daily basis. The digester also requires an adequate water supply, ideally operating on 2 parts water for one part manure. Cows can provide a steady supply of manure, and farmers are helped to obtain them through a "Heifer-in-Trust" scheme under which a farmer is loaned an in-calf heifer, and agrees to give the first two female calves to neighbors.

### Environmental Benefits

**Global:** Using biogas for cooking reduces the need for fuel wood and charcoal. Each biogas unit is estimated to reduce deforestation by 37 hectares per year. Since it also uses cow dung that would otherwise have degraded, further greenhouse gas emissions are avoided.

**Local:** Reduced deforestation helps preserve forests and all of the services they provide, such as biodiversity and maintenance of water quality. In addition, the promotion of agro forestry practices in conjunction with livestock helps protect soil fertility, prevent erosion, and reduce the risk of overgrazing problems often associated with cattle.

### Local Livelihood Benefits

**Health:** Reduced use of kerosene and wood for cooking improves air quality in the home, decreasing the incidence of respiratory and eye problems. The benefits are particularly great for women, who spend the most time in the household and do the cooking.

**Poverty Alleviation:** Biogas production integrated with cattle raising and farming provides a reliable source of cleaner fuel as well as increased income and employment opportunities. The sale of milk in Tanzania generates significant income relative to the sale of crops, thereby increasing the family's income. Women generally control this income, and studies have shown that income from the sale of milk goes toward school fees for children, improved housing, clothing and transportation equipment (such as bicycles). In addition, a large percentage of dairy farmers use hired labor. Therefore, increased incorporation of cattle into farming methods increases employment opportunities. The production of biogas also produces a slurry that is very effective as a fertilizer. Farmers have effectively used it in banana cultivation and vegetable gardening. Studies by Sokoine Agricultural University in Tanzania have shown that the use of this fertilizer helps maintain soil quality over time, thereby improving crop yields.

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**Reduced drudgery:** Women and children do not have to spend as much time looking for firewood. Cooking with biogas is also faster than with firewood. As a result, the drudgery of women is lessened. Some households have reported that some men now help their wives cook since using biogas is so easy.

**National Benefits:** Increased use of biogas reduces Tanzania's overall reliance of charcoal, wood and fossil fuels.

### Capacity Building Activities

SURUDE conducts two major types of training:

Training for farmers to incorporate livestock and biogas into their farming system. More than 1000 farmers now use this system.

Training for biogas technicians to install and repair biogas systems. In Tanzania, SURUDE has trained 50 technicians.

### Beneficiaries

Rural, farming families benefit most from biogas. Women benefit especially, since biogas reduces their workload, improves their access to income through the sale of milk, and reduces health problems.

### Partners

Founded in 1994, SURUDE is a membership organization currently involving about 250 farmers. SURUDE's main office is located in Turiani, about 200 km west of Dar Es Salaam. Five sub-centers are being established in the various regions of Tanzania in an effort to further spread the use of biogas technology incorporated with farming and livestock practices. Many important partners that have been critical in advancing SURUDE's work:

Farmers are SURUDE's most important partners, as they are integrally involved in developing and distributing new techniques and technologies. Farmers are involved in local community-based organizations whose activities help support the integration of biogas and new farming systems.

**Universities:** SURUDE has worked closely with the Sokoine University of Agriculture and several other universities in Denmark and other European countries. They assist the organization in data collection, research, monitoring results, and developing new products.

**Companies:** A Danish company called Superflex has helped produce and distribute the tubular plastic biogas digester.

**Funders:** SGP and UNDP, as well as the Ashden Trust in Great Britain, have been critical funding and technical assistance partners.

**Government:** The Tanzanian government supports SURUDE by providing agricultural extension services, into which biogas and livestock practices are being incorporated. The Ministry of Energy and Minerals, responsible for promoting renewable energy, also supports SURUDE's work. SURUDE's efforts help to achieve goals contained in the Action Programme for the Development of Tanzania 2001-2010.

**International networks:** SURUDE has worked with the UNDP/Africa 2000 Network, through which it has helped promote biogas in other African countries, including Cameroon, Uganda and Nigeria.

## LESSONS LEARNED

### Environmental Management

SURUDE's ability to successfully and sustainably address environmental management issues is due in large part to its close work with farmers themselves, who provide feedback and input, and its collaboration with university research programs that have helped monitor and report on results. Since biogas production requires a steady supply of biodegradable material, it can be combined successfully with livestock farming. In addition, the slurry produced as a by-product can be used as an effective fertilizer to improve crop yields.

Biogas use is sometimes hindered by a lack of sufficient water. Designs that use less water, or that are incorporated with rain-water catchment systems, need to be developed to ensure greater adoption of this technology.

### Barrier Removal

**Financial:** The Heifer-In-Trust program seems to have been effective in making cattle available to income-constrained farmers. However, financial barriers still exist in obtaining the biogas systems. Each system costs \$100-120, and although the system more than pays for itself over time through income generation and savings on fuel purchase, this up-front costs represents a large percentage of many farmers' yearly income. Micro-finance systems must be developed to ensure the spread of this technology. In Turiani, a women's organization called Kamuuu has established a revolving credit fund with support from SURUDE. Each family contributes a set amount of savings per month, and farmers then can then acquire credit on a revolving basis.

**Technical:** SURUDE's primary contribution to reducing technical barriers is its development of the tubular plastic biogas digester adapted to Tanzanian conditions. SURUDE worked with a Danish private company, Superflex, which helped to develop and distribute the model. Through experience, SURUDE has identified several ways in which the digester can be further improved, such as integrating rain water harvesting with biogas systems, improving its durability, and developing a biogas-powered lighting system. SURUDE is currently applying for expanded funding to undertake these research efforts and further spread biogas technology in Tanzania and other African countries.

One other technical barrier that SURUDE has begun to overcome is the availability of technicians who can install and repair biogas systems. SURUDE has trained them in Uganda as well as in Tanzania. However, SURUDE seeks a great need for more technicians, as there are only 50 in Tanzania at this time. Overcoming this barrier will require additional funding to start a larger technician training program.

**Informational:** Affecting the farming, livestock and energy use

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practices of farmers is SURUDE's main goal. Several lessons may be drawn from SURUDE's experience with this.

First, SURUDE's partners have been critical to helping overcome informational barriers. First, universities have been involved in conducting research, and establishing record-keeping methods for farmers to collect information to be analyzed. The government's agricultural extension service has also helped to promote the introduction of biogas and livestock into farming systems. Both of these partnerships appear to be extremely effective ways to obtain information for analysis, and disseminate information about best practices.

Second, researchers who have sought to establish record-keeping practices among farmers in conjunction with SURUDE have found that farmers will keep records of information necessary for analysis – such as the calves' birth dates, and the amount of milk produced and sold – but they are more likely to do so when they see how this information is used to benefit them. Thus, the project is involving farmers in the process so that they can see the results of their efforts. Also, recording systems need to be simple and track as few parameters as possible.

### Scaling Up

SURUDE has been extremely successful in scaling up its activities to reach five different regions of Tanzania, and also to begin spreading the biogas technology to other African countries. It

seems that there are several key elements to achieving this:

The technology is relatively low cost. Therefore, a reasonable number of farmers can begin using it without very significant financial assistance. Only very small loans would be necessary to make the biogas available to almost all farmers who could benefit.

Links with agriculture, the source of livelihood for a large portion of Tanzania's population, have helped the project build partnerships with government programs related to agriculture as well as those related to energy. Word has spread about biogas through the government's agriculture extension services, not just through energy-related programs which are smaller. Since agriculture is important in all African countries, biogas has appeal in many parts of Africa.

### SOURCES CONSULTED

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