# *ROLLING-OUT BIOGAS PRODUCTION TO EMPOWERING RURAL WOMEN IN SUDAN*

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## Overview

Over the past few decades, Sudan's energy profile has evolved significantly, and the demand for energy has significantly multiplied to the extent that the gap between the production and demand has started to rapidly widen. Population growth and urban spread in the main towns has tremendously increased as a result of improved economic activities, and enhanced infrastructure including electricity supply and communication/media systems. As a consequence, the growth in demand for energy has surpassed the supply in term of quantities and energy type. Biomass in the form of firewood and charcoal consistently accounts for the largest share of primary energy supply in Sudan, at almost 60%. This use of firewood and charcoal is unsustainable and is contributing to the very high level of deforestation in Sudan. However, this can be quite quickly changed by switching to other available and presently relatively unutilized biomass forms, and production of biogas from anaerobic digesters can play a significant role in this.

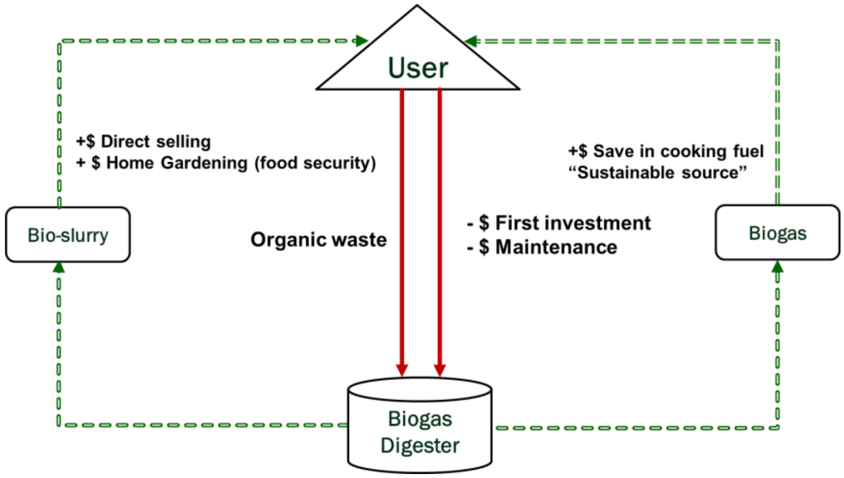
Biogas from anaerobic digestion is a potentially major source of energy in regions where housed livestock and other feedstock materials are present, and where the other conventional sources of energy (e.g. LPG and electricity) are not readily available. Installation of smaller-scale household biogas digesters is advanced in some African countries, with Kenya, Ethiopia, Cameroon and Uganda being among these. The driving priorities are similar to those in Sudan: reduction of deforestation, utilization of animal manures and food waste, reducing the negative health impacts of smoke in the kitchen or cooking area particularly on women, and capturing the benefits of better health and more time available for other economic activities.

The biogas technology is considered as an ancient technique, which was introduced to Sudan beginning in the 1970s, and its development was driven by the activities and experiments in the laboratories of research centers and colleges and at various universities, and units were successively set up thereafter at different times and places. These included homes, schools, camps, hospitals and prisons, for the purpose of cooking, lighting, cooling, and for operation of internal combustion engines (ICEs). Despite the research and investment in Sudan in the field of biogas production, the initial installations were not entirely satisfactory, with a diminishing of the number of units established in recent years for different reasons: technical problems (especially in the operation), gas storage, maintenance and after sales services; the high initial cost of biogas digesters, especially for households; lack of knowledge on the technology – despite the efforts of some national NGOs on promoting the technology, its uses and products; and absence of a business model that suited different market segments.

The objective of this work is to present a developed business model of anaerobic digestion of the wet organic waste forms of biomass that are sustainably and economically available at the household level. The main products of this anaerobic digestion process are biogas, which is a combustible gas consisting primarily of methane and carbon dioxide, and the digestate, which is the decomposed substrate after the anaerobic digestion process.

## Methods

This work is a proof-of-concept project that aimed to gain experience in technology, economy and management-related issues of a newly-developed, mobile biogas technology that includes a biogas storage container, which allows surplus biogas produced from a system to be shared with or sold to other households. This biogas system is a low-tech plug flow system for the production of biogas as cooking fuel for household. It consists of a 2 m3 to 3.5 m3 flexible bag connected to an inlet at one end, an overflow or digestate outlet pipe at the other end, and a gas outlet in the upper surface. The digester is placed inside a greenhouse or shadehouse for protection, and solar heating in winter with the anaerobic digester comes with a separate gas storage bag which is filled through pressure equalization. It can be easily carried and connected to the cooking stove. The gas is forced out of the portable gas storage by weighting it using some form of external loading. The digestate produced, is for use as a fertilizer in home gardening. The figure below shows the business model that introduced to the household.




**The social business model for digester user**

## Results

The use of biogas in this project as a cooking fuel has replaced the use of firewood and charcoal in the household. The principal listed benefits and impacts below not only refer to the implementation of this pilot project, but also to the long-term effects of a larger scale implementation of this concept.

1. Using of biogas as a cooking fuel replaced the use of firewood and charcoal. Thus, reduced the workload of women and girls to collect wood "which also consume time"; and reduced time spent in cooking. These reduced the burden on women to do household chores and gives them time to focus on other economically productive activities.
2. Cooking with biogas significantly reduced indoor air pollution, and relatively lower emissions levels, which will have a direct positive impact on health by reducing the risk of respiratory diseases caused by indoor air pollution due to smoke from open fires.
3. The digestate residue "bio-slurry" produced is a natural fertilizer for agriculture and home gardens. It improved the growth of crops and vegetables for consumption (so added food security) and sale (so generation of additional income).
4. With a short pay-back period, users of biogas will have access to a free and clean source of energy for the remaining lifespan of the technology. In households where fuel for cooking is purchased, the household will save this money.

## Conclusions

Sudan shares some significant common factors with many other countries which have developed a significant energy production using biogas from anaerobic digestion. These common factors include: the high volume of putrescible wastes produced by different communities and industries, the daily struggle of women and children to collect wood for cooking in rural areas, the large numbers of rural villages and small cites which are without access to LPG and are not connected to the main electricity grid, the high deforestation rate due to cutting wood for fuel, and the thousands of graduates who could be gainfully employed in developing this option, and who presently do not have jobs or who are working in menial jobs paying low income. Sudan can be counted as one of those countries which have abundant sources for biogas production and where this technology can have a great contribution in solving energy problems in rural areas and within the country generally. The mobile biogas system introduced in this project has proved elsewhere its viability for use by rural women. Also demonstrated elsewhere is that the use of biogas digesters means significant savings in time and money previously required to get cooking fuel, and that they empower rural women through the use of biogas for clean cooking, and the sale of surplus biogas to other households in the neighbourhood, as well as improving the crop productivity in home gardens. Overall, it has been shown that this use of household anaerobic digesters can help build a profitable, sustainable and inclusive cooking energy sector that helps people, planet and economy to thrive. The installation of biogas systems for producing clean cooking fuel contributes directly to many of the UN Sustainable Development Goals, including those directed at achieving no poverty, zero hunger, good health and well-being, gender equality, decent work and economic growth, and climate action. But, foremost among the SDGs, sustainable biogas production will significantly support the just and inclusive energy transition.