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From Waste to Wealth

A Workshop exploring Environmentally, Socially and Financially Sustainable Wastewater Management for Rural and Informal Settlements



Introduction

Despite government commitments to socio-economic and political progress, millions of Ugandans face extreme hardships as they struggle to provide for their basic daily needs. One such need, identified by the Uganda government and many international and aid organizations, is access to safe water and sanitation. This problem is particularly evident in the informal settlements of Uganda's urban centers and in rural areas where millions of Ugandans are without adequate water and sanitation. Water and sanitation related diseases are among the top ten killers in Uganda and are especially problematic in urban informal settlements².

The 21st national objective as described in the Ugandan Constitution recognizes the importance of safe water and sanitation to building a better future and states that *"the State shall take all practical measures to promote a good water management system at all levels."*

From Waste to Wealth

The United Nations University, Institute for Water, Environment and Health (UNU-INWEH) is committed to addressing the water and sanitation challenges around the world. In May 2013, UNU-INWEH received a grant from Grand Challenges Canada to work with Ugandan partners to assess the feasibility of a sustainable wastewater management program in Uganda.

"From Waste to Wealth" takes the traditional view of wastewater as an end product to be disposed of and turns it on its head by suggesting that wastewater is a valuable resource that can be processed into commercial grade fertilizers and fuel. The vision of "From Waste to Wealth" is that the economic and social benefits of nutrient recycling, biogas generation, soil amendment and new livelihoods from wastewater management will be a financial incentive for communities to collect and treat their waste, forming the basis of a sustainable and affordable wastewater management framework. The goal of this project is to develop a multi-sectoral strategy for wastewater that is based on the "Waste to Wealth" concept. Carrying out this goal involves all wastewater stakeholders working together to design a comprehensive framework that will ensure implementation of an appropriate national program in Uganda.

Specifically, the objectives of this initiative include:

- Undertaking a feasibility assessment of biogas production;
- Estimating nutrient recovery amounts (especially nitrogen and phosphorous);
- Understanding potential socio-cultural facilitators and barriers;
- Developing outreach materials for education and awareness;
- Developing a business model approved by multi-stakeholder representatives; and,
- Supporting enlightened participants and development of a potential market

Background

Sanitation facts:

- Uganda loses approximately UGX 389 billion (\$177m USD) annually due to poor sanitation¹⁵
- 90% of households in Kampala are not connected to a sewage network, meaning that wastewater is discharged without treatment^{3,4}
- Approximately 9 million Ugandans do not have access to safe drinking water¹
- Approximately 23 million Ugandans do not have access to improved sanitation, of which 20 million are in rural areas¹

Household Food and Energy facts:

- Crop yield productivity is often below 50% in Uganda's rural areas.¹⁴
- Uganda loses some UGX 2.3 trillion (\$899 million USD) annually due to the effects of malnutrition⁷
- 73% of the population use traditional cooking stoves with efficiency estimated to be less than 10%³
- 90% of Ugandans depend on firewood for cooking⁵
- Every 20 years households consume 6 hectares of forest⁵
- Only 5% of Ugandans have access to electricity³
- Lighting energy cost is 20% of household budget⁶
- Average monthly cooking energy cost is UGX 67,000 (\$26) or 40% of the household budget⁹



UN Photo/Ian Steele

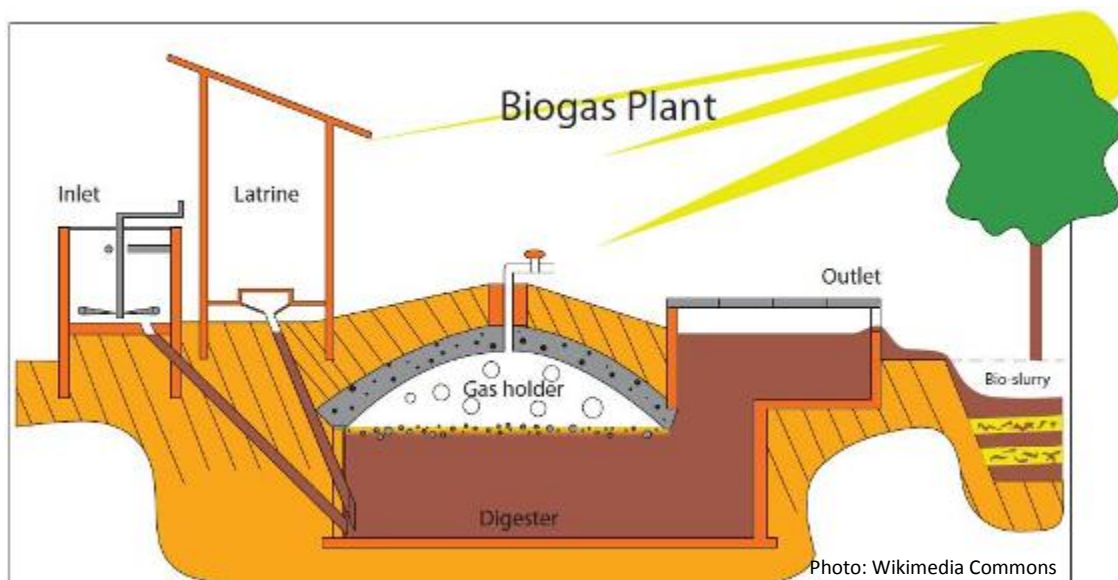
Health Impacts

- 400,000 people in Sub Saharan Africa die each year from the health impacts of hearth pollutants³
- 75% of Ugandans have reported concerns over respiratory health⁶
- A house with an open fire can have up to 75 times the maximum advised level of air pollution⁵
- Approximately 23,000 Ugandans, including 19,700 children under 5, die each year from diarrhea; nearly 90% of which is directly attributed to poor water, sanitation and hygiene¹⁵
- Poor sanitation is a contributing factor, through its impact on malnutrition rates, to other leading causes of child mortality including malaria and measles¹⁵
- Child (under 5) mortality is reduced by 2.45 per 1,000 with access to improved sanitation⁸

Making Waste Valuable

Waste can be used as a source of globally supply-limited nutrients, such as phosphorous, as well as being used to produce energy (through biogas) and fertilizer from the sludge. These can be achieved through simple anaerobic processes that convert commercial, farm and household organic waste into biogas and fertilizer.

How is Biogas Produced?



- A biogas digester is simply a sealed container that allows bacteria to break down organic material. When the bacteria “digest” the organic material they produce the by-product methane and CO₂ which is a fuel that can be used for lighting and cooking. There are two main reasons why this process takes place in a sealed container. First, because the type of bacteria that breaks down the organic material would die if exposed to oxygen; in other words they are anaerobic. Second, the sealed container allows for the capture and storage of gas to be used as a fuel.
- When the organic material has been digested by the bacteria it becomes an odorless liquid called bio-slurry which is an excellent fertilizer because the nitrogen in the organic material has been converted to ammonia allowing for immediate absorption into plants.

Benefits of Biogas Production

Using wastewater to produce biogas has many benefits:

- Biogas is a natural, renewable source of energy that is easily accessible from any digester
- By using biogas instead of wood for cooking, households are less exposed to the harmful effects of smoke inhalation which can lead to respiratory diseases⁶
- The reduction in wood consumption reduces deforestation and land degradation⁸
- Biogas can be a cheaper source of fuel when other fuel alternatives become more expensive⁸
- Using biogas reduces the amount of time woman and children spend in the collecting wood and is more convenient than charcoal, opening more opportunities for alternative activities⁸
- Every 2600 UDX (\$1.00 USD) invested in a biogas, latrine and sanitation system returns more than 11,700 UDX (\$4.50 USD) in economic benefits⁹
- There is a potential for over one billion cubic meters of biogas production in Uganda¹⁰

Benefits of Bio-slurry Production

- Bio-slurry improve crop output through soil amendment resulting in better food security
- Bio-slurry enhances the activity of beneficial soil microbes, while reducing algae growth in water from nutrient runoff¹⁰
- Bio-slurry fertilizer can improve the nutritional status of a household¹⁰
- Bio-slurry is an odorless by-product that does not attract flies or insects as does manure¹¹
- Bio-slurry reduces weed growth by 50% because seeds are destroyed in the digester¹¹
- Bio-slurry has a fertilizing value compared to manure and even commercial fertilizer for some crops¹
- Bio-slurry increases business opportunities because it can be sold for profit

Implementation Barriers and Challenges

While technologies exist to create waste from wealth and are familiar to many in Uganda, national scale implementation is not yet a reality. Scale up and out requires a framework that incorporates social, political, and economic realities to ensure sustainable and equitable implementation. Over the years there have been a number of biogas initiatives in Uganda resulting in the production of hundreds of biogas digesters. The issue, particularly in rural areas, has been access to material to build high quality yet financially and operationally feasible digesters. Unfortunately, the realistic option has been sub-optimal digesters that are relatively expensive (approx. UGX 2 million (\$800 USD)). The result has been the production of digesters that have all too often failed. Those who witness a failed digester will clearly lack confidence in the system. Until a reliable system is in operation it will also be more difficult to present as a business model.

Several studies of biogas implementation in Uganda have identified the following potential barriers:

- A lack of confidence in stated benefits of digesters⁶
- A lack of access to cheap, high quality, locally produced digesters (supply chain)⁶
- A Lack of access to financing for up-front capital investments⁶ (more generally, a system should not cost more than 25% of household budget¹³)
- Discomfort with using biogas from waste in the cooking process and a perception that food prepared with biogas would not taste as good⁶
- Biogas technology may be viewed by some educated Ugandans as a technology for the less educated and rural people¹⁰
- The footprint of biogas digesters may not be feasible, especially in the eastern region where household lot sizes are smaller¹⁰
- Site specific constraints include the availability of water and sufficient organic material; liquid manure is often required but not something normally collected and stored by households¹²
- A lack of alignment between national and family/community interests¹² and a lack of community involvement¹³
- A lack of trained and experienced individuals who can design, construct, establish and maintain digesters

Why a National Framework?

Ultimately, there is a need to move beyond grassroots implementation and develop a biogas sector that includes support services, financial incentives, technical information and research and development.¹⁰ This is because, despite the potential environmental, social and financial benefits of improved waste water management the rate of biogas adoption remains low. Strong leadership is required to create a national framework to reduce barriers, popularize and co-ordinate biogas uptake in Uganda. A self-sustaining system that can support a biogas sector needs the leadership of the Ugandan Government and the cooperation of all stakeholders. This will lead to key benefits, including economic, health and environmental improvements. However, a framework will require the following to be addressed:

Financial and technical feasibility:

- Optimal designs need to be identified that maximise economies of scale for specific settings
- Financial partnership models need to be developed, including for example, micro-loans programs to finance up-front biogas costs at the local level
- Research is required to improve design, lower costs and increase operability
- A national policy is required to create incentives for entrepreneurs to invest into the biogas sector

Social acceptance:

- Intensive public education campaigns of the social and financial benefits of biogas
- Implementing biogas education into the school curriculum
- The younger generation is more likely to adopt the concept of biogas production and are central in the shift to biogas¹⁰

Social, economic, and environmental sustainability:

- Individual access to sanitation is a human right and sanitation solutions cannot be left solely to the market which is susceptible to failure
- Co-ordination and cost-benefit sharing between sectors is essential for sustainable wastewater management
- “Waste to Wealth” may provide a solution to financing sanitation in hard to reach communities, such as informal settlements and rural areas

Case Study: Nepal

Nepal is a country with similarities to Uganda. While Nepal has a population of 26 million compared with 35 million in Uganda, Nepal has a nominal GDP of \$20 billion (Uganda's is \$21 billion) and both countries have rural electrification rates around 5%.¹⁶ Since the early 1990's Nepal has invested in a national biogas programme with significant achievements to date.¹⁹

1992

The **Biogas Support Programme (BSP)**, the first major biogas initiative, was created by the NGO SNV

1994

The **Nepal Biogas Promotion Association (NBPA)** was created as an umbrella organization of biogas digester construction companies and biogas appliances manufacturing that has been involved in promotion of biogas digesters through motivation and coordination of biogas companies

1997

The German development bank KfW began providing financial support for capital subsidy and credit

1996

The Ministry of Environment, Science and Technology created the **Alternative Energy Promotion Centre (APEC)**. In the years after it was created, APEC formulated a **national framework** for biogas in Nepal which included a national subsidy policy in 2000

2003

The **Biogas Sector Partnership (BSP)** was created as a Nepalese Government implementing agency and was designed to replace the SNV-managed Biogas Support Programme that began in 1992.¹⁹

Since 1992, more than **260,000** biogas units have been installed with 92% still in operation.^{18,21}

Main achievements include¹⁷:

1. Long-term commitment from support groups
2. Establishing of efficient public-private partnerships
3. Creation of a regulatory body
4. Emphasis on product quality and owner satisfaction
5. Established tiered subsidy programs (e.g. rural, poor)
6. Created biogas credit funds through local cooperatives for low-rate loans
7. Good monitoring and quality control mechanisms

Workshop Objectives

Creating a sustainable solution is not as simple as introducing and implementing new technology. The goal of this workshop is much bigger than that. Our vision for this workshop is to begin the process of creating a national framework for sanitation solutions by asking two important questions: **What do we need?** and **How can we implement?** The goals of the workshop include identifying key players and roles; existing mechanisms to support waste to wealth; the gaps and opportunities for scaling out a national strategy; and understanding the distribution of costs and benefits (both financial and social). This framework will be based on three important principles

- I. Sustainability: equitable solutions that empower the marginalized and are not at the expense of future generations
- II. Self-sufficiency: solutions that are built upon the principle of full cost accounting
- III. Legitimacy: solutions designed bottom-up and organized top-down

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