
# How Could the Uptake of Biogas Technology be Increased in Uganda?

Bernhard Heikoop

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## Abstract

Many Ugandans face quality of life and livelihood challenges associated with sub-optimal sanitation, dependence on wood and charcoal for fuel, and decreasing agricultural productivity. These challenges are manifested in health issues related to water-borne diseases, respiratory diseases from indoor smoke inhalation and dwindling agricultural livelihoods. Biogas technology has been identified as a socially, economically and environmentally sustainable solution for addressing these issues and more. The Government of Uganda has recognized the need for a national policy framework which encourages the uptake of biogas technology. This paper identifies methods and tools that can potentially aid in the policy making process toward a national biogas framework. The premise of these tools is a collaborative policy process that includes vertical and horizontal communication between government, NGO, private sector, and community stakeholders which this paper argues is necessary for improved policy making. These tools can be used to create a more efficient and effective collaborative process by identifying influential supply-side champions of biogas and extracting relevant demand-side information to improve policy and the uptake of biogas technology.

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## List of acronyms and abbreviations

| | |
|---|---|
| **BDS** | Business Development Service |
| **IFAD** | International Fund for Agricultural Development |
| **NGO** | Non-government organization |
| **PRAs** | Participatory Rural Appraisals |
| **SIDA** | Swedish International Development Agency |
| **UNICEF** | United Nations Children's Fund |
| **USD** | United States dollar |
| **VCA** | value chain analysis |
| **WHO** | World Health Organization |

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## Introduction

Uganda's underdevelopment in sanitation, energy supply and agricultural productivity has negatively affected the quality of life and livelihoods for many Ugandans. Nearly 66 percent of Ugandans live without basic sanitation and are exposed to sanitation related diseases such as diarrhea, malaria, and measles (Cheng *et al.*, 2013; WHO/UNICEF, 2012; Uganda Ministry of Water and Environment, 2012, March). Over 90 percent of Ugandan households rely on wood and charcoal as the main source of energy resulting respiratory health issues and unsustainable levels of deforestation (Hivos, n.d.; Okello *et al.*, 2013; National Biomass Study Project, 2003). Furthermore, agricultural productivity continues to decrease nearly 0.3 percent per year due to soil nutrient depletion, slowly eroding the livelihoods of many farmers (Gollin *et al.*, 2010; Nkonya *et al.*, 2005). The government of Uganda and the literature has identified biogas technology not only as means for replacing a sub-optimal fuel supply but also for its ability to address the problems of the lack of basic sanitation and access to agricultural fertilizers (Katukiza *et al.*, 2010; Okello *et al.*, 2013; Pandly *et al.*, 2007, Smith *et al.*, 2013; Yu *et al.*, 2013). The goal of this paper is to help improve the quality of life and livelihoods of Ugandans by utilizing the many benefits of biogas technology. While feasibility studies indicate that the long-term benefits of biogas outweigh the upfront costs (Pandey *et al.*, 2007), the literature has identified the upfront cost of a biogas system as well as a cultural bias against biogas as a fuel for cooking as two important barriers to biogas uptake (Okello *et al.*, 2013; Pandey *et al.*, 2007; Smith *et al.*, 2013) As one possible solution to these issues, the literature has identified the setting up of a national biogas framework that promotes biogas adoption and organizes the provision of personal financing to drive the demand for biogas technology and services (Okello

*et al.*, 2013). The purpose of this paper is to identify a few methods that can help to improve the policy process to inform the design of a biogas national framework and lead to effective uptake of biogas technology.

Section 2 of this paper details background information on sanitation, energy supply and agricultural productivity in Uganda, and how it affects the quality of life and livelihoods of many Ugandans. Section 3 details the functioning of biogas technology and discusses how biogas could improve the quality of life and livelihoods of Ugandans. Section 4 details why biogas adoption is presently limited in Uganda. Section 5 presents the current policy-making context and potential ways for improvement in Uganda. Section 6 details potential methods to identify what aspect in the process of participatory policy-making makes adoption of biogas limited in Uganda. Section 7 discusses how much increase in biogas technology adoption could be expected in Uganda from an improved policy-making process, and the effort required. Section 8 concludes this paper.

## Background on Ugandan sanitation, energy and agricultural issues

*Sanitation*

The government of Uganda faces the challenge of meeting its sanitation Millennium Development Goal set in 1990 to halve, by 2015, the proportion of people without sustainable access to improved sanitation (United Nations, 2006). Since 1990 the percentage of Ugandans without access to improved sanitation has only dropped from 73 percent of the population to 66 percent in 2010 (UNICEF & WHO, 2012). The Uganda Ministry of Water and Environment (2012, March) estimated that Uganda loses approximately USD 177 million annually due to

poor sanitation. The sanitation situation is particularly dire in the city of Kampala where 90 percent of households are not connected to a sewage network and wastewater is often discharged without treatment (Okello *et al.*, 2013; Air Water Earth ltd, n.d). Rural Uganda also faces waterborne diseases from poor sanitation which increase health care expenditures and reduce educational performances of children, especially girls (Mukungu, 2000). Poor sanitation has affected the quality of life for many Ugandans. Every year 23,000 Ugandans, including 19,700 children under 5 years old, die as a result of diarrhea; nearly 90% of which is directly attributed to poor water, sanitation, and hygiene (Uganda Ministry of Water and Environment, 2012, March). Poor sanitation is also a contributing factor, through its impact on malnutrition rates, to other leading causes of child mortality including malaria and measles (Uganda Ministry of Water and Environment, 2012, March). In Kampala Uganda, large sanitation infrastructure projects are cost prohibitive and rural citizens simply cannot afford to purchase their own sanitation system (Katukiza *et al.*, 2010). Even small projects such as providing household or community latrines are infeasible and unsustainable solutions for many Ugandans because of the expense associated with removing raw sewage and that fact that untreated waste removed by commercial services is often relocated into wetland areas (Air Water Earth Limited, n.d).

*Energy*

Access to energy is crucial for the development of any country (Okello, *et al.*, 2013). While access to energy did not make the list of Millennium Development Goals, it has been cited by United Nations Secretary-General Ban Ki-moon as the very foundation for all the Millennium Development Goals (United Nations, 2010, September). Uganda has traditionally relied on biomass (wood, charcoal) as a primary source of fuel with the production and supply managed

by the informal sector (Okello, *et al.*, 2013). Inefficient use of wood is associated with pollution, deforestation and related issues such as undesirable change in biodiversity, wood scarcity, and degradation of land and water resources (Okello, *et al.*, 2013; Pandey *et al.*, 2007). The National Biomass Study Project (2003) estimated deforestation in Uganda will result in a decline of forest area from 0.3 hectares per-person in 1991 to 0.1 by 2025. Alarming rates of deforestation inspired the Ugandan Government to announce a nation-wide three-month ban on harvesting of all types of timber in 2012 (Lutaaya, 2012, March 6). Wood scarcity is an escalating economic and social problem in Uganda contributing to both the increased cost of fire wood and the increased time required to collect it. Pandey et al (2007) calculated that the average household in Uganda spends nearly one hour per day collecting fire wood. The traditional indoor hearth is a standard feature in most Ugandan homes. Studies indicate, however, that 400,000 people in Sub Saharan Africa die each year from the health impacts of smoke inhalation (Okello *et al.*, 2013). This is because a house with an open fire can have up to 75 times the maximum advised level of air pollution (Hivos, n.d). Surveys completed in Uganda indicate that 75 percent of Ugandans have reported concerns over respiratory health which is most likely related to heart cooking (Smith *et al.*, 2012, Nov 19).

*Agriculture*

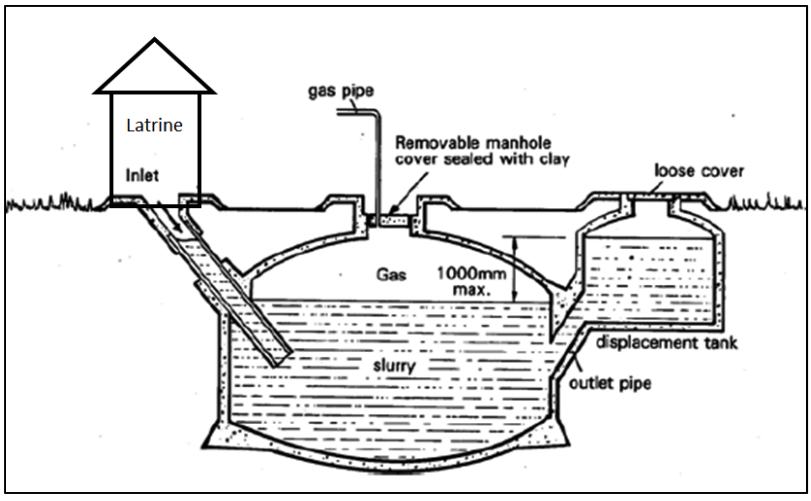
The rural Ugandan economy is primarily agrarian with 66 percent of the population (23 million) directly employed in agriculture (Uganda Bureau of Statistics, 2010). Because fertilizers are used sparingly, crops annually deplete nearly 1.2 percent of their soils nutrient stock which has been predicted to reduce annual crop production by 0.31 percent (Gollin *et al.*, 2010; Nkonya *et*

*al.*, 2005). This is a critical livelihoods issue for many farms where productivity is already below 50 percent (Schillebeeckx *et al.*, 2012). For the average Ugandan household purchasing fertilizers to replenish nutrient depletion requires 20 percent of their income derived from agriculture production (Katukiza *et al.*, 2010) While the causal relationship between poverty and land degradation in Uganda is unclear, there are clear linkages between poverty and land management practices (Katukiza *et al.*, 2010). Subsistence farmers lack inputs and technology to help them increase their production which further erodes income (IFAD, April 2012).

## What is Biogas technology and how can it reduce Uganda's sanitation, energy and agricultural issues

The human waste input, anaerobic digestion process, and the slurry and methane outputs of biogas digester, can be part of a solution to the issues of sanitation, energy and agriculture. Biogas is produced in a biogas digester (see figure 1) which is simply a sealed container that anaerobic bacteria 'digest' organic material in a fermentation process.

**Figure 1: Biogas Digester (adapted from: Fraenkel, 1986)**



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.

Biogas technology can utilize human waste and other organic material such as manure and foodstuff as an input for the production of biogas and slurry. In essence, a biogas plant becomes a waste treatment plant where waste is properly disposed of and treated. By treating waste, biogas creates improved sanitation conditions and in rural areas biogas digester latrines do not require waste removal services since the slurry can be directly utilized. The anaerobia digestive process also provides the additional benefit of reducing harmful pathogens in waste (Holm-Nielsen *et al.*, 2009).

Biogas technology as a source of renewable energy can reduce Uganda's dependence on firewood as a main source of fuel for cooking and lighting. Methane is a cleaner burning fuel that can reduce indoor pollution and its negative health effects. Furthermore, by reducing the use of wood for fuel, biogas technology can reduce the challenges associated with deforestation and wood scarcity. Biogas production also potentially saves time for women and children due to a reduced need for collecting fire wood which can potentially create improved educational conditions for children and livelihood opportunities for women. Additionally,

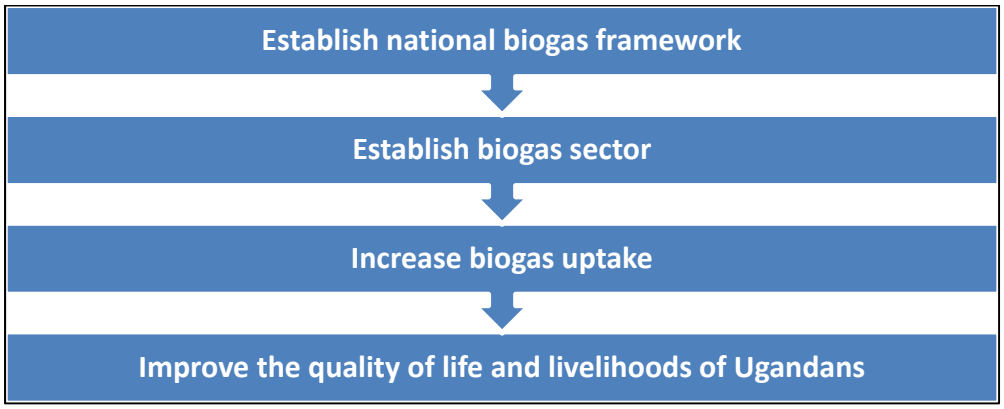
biogas technology could also create local job opportunities for digester production and service. These benefits translate directly into financial savings. A biogas feasibility study for Uganda found that the average financial internal rate of return from biogas fuel alone is 8% which provides a convincing rational for Ugandans to invest in biogas technology (Pandey *et al.*, 2007). Biogas as a source of high quality fertilizer can help reverse current trends of decreasing productivity due to soil nutrient depletion and increase food security (Smith *et al.*, 2009). By increasing food output, slurry can also improve the nutritional status of a household (Pandey *et al.*, 2007). While increases in agricultural output are difficult to predict, the African Biogas Partnership Program (n.d.) notes that slurry used for agricultural purposes has witnessed a "tremendous increase in agricultural produce, and revenue generation from the sale of extra bio-slurry to other farmers" (paragraph 4). A further livelihoods benefit of slurry, especially in urban applications, is that slurry can be sold for a profit. This is in stark contrast to a traditional latrine which requires a service fee for emptying. Additional benefits of slurry include that fact that it is odorless and does not attract flies or insects as does manure, and it reduces weed growth by 50 percent, compared to manure, because seeds are destroyed in the digester (Walekhwa *et al.*, 2009)

The returns on investment and additional benefits of biogas technology make it a very attractive technology for any household in Uganda prompting the Uganda Ministry of Energy and Development set a goal in 2007 to increase biogas units to 100,000 units by 2017 (Uganda Ministry of Energy and Mineral Development, 2007). To date around 2500 units have been installed prompting a need to investigate the factors which are prohibiting biogas uptake.

## Why has biogas adoption been limited in Uganda?

Despite the fact that biogas provides the user with many financial and social benefits, biogas adoption in Uganda has been limited, partly because of the upfront cost of a biogas digester and a social stigma against its use (Smith *et al.*, 2013). The upfront cost of a biogas system in Uganda currently ranges between USD 800-1000 (Pandey *et al.*, 2007). This represents a substantial investment for the average rural household with a monthly income of around USD 90 (Uganda Bureau of Statistics, 2010, November). Furthermore, generations of Ugandans who have utilized the traditional hearth for cooking and as a centerpiece of the home, feel that cooking with wood improves the taste of the food and that that an alternative fuel derived from human waste is less appealing (Smith *et al.*, 2013). Both the Ugandan Government and the literature have identified the need to move beyond grassroots implementation and develop a biogas sector that includes financial and support services, along with research and development as part of a market chain (Okello *et al.*, 2013; Pandey *et al.*, 2007). A national policy framework designed to mitigate financial and cultural barriers to biogas adoption may be part of the solution to develop an effective biogas sector (figure 2).

**Figure 2: From a Framework to Improved Quality of Life and Livelihoods (Source: Author)**



## Current policy making context and potential methods to aid biogas policy making

As a democracy, the policy making process in Uganda is similar to most democratic countries. In Uganda, the development of policy is usually done by the relevant ministry or in some cases the cabinet itself. An issue is identified by the minister and a draft policy memorandum based on guidelines provided by the Cabinet Secretary and senior management is prepared. The president can, and often does, initiate policy by directing a minister to prepare a cabinet memorandum. In the case where a new law is required, ministers prepare the proposed legislation; a bill is created by legal counsel and eventually presented to parliament (Opio-Lukone, 2002). Public/stakeholder consultations are not formalized in the policy process and usually range from informal consultations to an organized meeting with the public/stakeholders. In the 1990s, the President Yoweri Museveni led a political, administrative and financial decentralization initiative to improve service delivery and citizen participation in policy making with the aim of improved rural development (Jeppsson, 2001; Bashaasha *et al.*, 2011; Saxena *et al.*, 2010). Uganda faces participatory challenges similar to most democracies, namely, the tendency of democracies to gravitate towards reduced citizen participation; a phenomenon Robert Michels (1966) called the "iron law of oligarchy" (Olsen, 1982). Challenges to stakeholder participation usually include the dominance of more powerful interest groups and community (citizen) stakeholders who are generally disinterested in policy processes (Olsen, 1982). Vincent Opio-Lukone, Deputy Secretary to the Cabinet (Uganda) noted that currently, participation consists primarily of consultation exclusively between the government

and its foreign aid donors without including national stakeholders, a practice that can result in resistance by national stakeholders.

Despite these challenges of mobilizing stakeholder participation, it remains an important mechanism for facilitating poverty reduction and rural development (Kakumba, 2010). Increased stakeholder participation in the policy-making process in agriculture-based economies such as Uganda would allow for linkages and improved mechanisms that in turn have the potential to boost agricultural productivity and livelihoods (Kakumba, 2010).

Improving community participation in biogas policy making begins with the selection of an effective method for participation. There are countless participatory forms and methods listed in the literature which is hardly surprising given the fact that aspects such as culture, nature of participants, necessary level of engagement, purpose of participation, objectives, kind of policy problems and the stages of the policy process, as well as contextual factors such as political, social, cultural, geographic, economic and historical all determine what specific method should be chosen (Holland, 2007; Reed, 2008). In general, the various methods developed in the literature can be organized according to the method's level of participation. Tufte and Mefalopulos (2009) classified the level of participation into four categories which include (1) *passive participation* where stakeholders participate by being informed of a pending project (2) *Participation by consultation,* an extractive process where stakeholders are surveyed by outside researchers or experts (3) *participation by collaboration* where stakeholders actively participate to improve pre-designed project, and (4) *empowerment participation* where primary stakeholders are considered equal partners who initiate a process and take part in the analysis. Development practitioners have warned of the risks associated with using passive and

consultative participation methods for development policy. Information gathered for development projects using passive participation or participation by consultation can be unreliable due inflexible information gathering techniques and a number of biases which, according to Chambers (1994) include:

a. *special bias*: results from visits that are generally to easily accessible places
b. *personal biases*: outsiders generally interact with more elite, male, locals
c. *User bias*: outsiders are more likely to interact with the users of the service
d. *Active bias*: outsiders are more likely to interact with the active and able bodied
e. *Seasonal bias*: one season can vary drastically to the next and influence perceptions
f. *Timing bias*: visiting during work hours can mean the poor are inaccessible
g. *Diplomatic bias*: results from avoiding embarrassing or conflict-prone topics
h. *Professional bias*: from the socio-economic chasm between outsider and poor
i. *Project bias*: visitors are often shown project showpieces which skews reality

Biogas technology offers potential for boosting rural productivity and livelihoods and stakeholder participation to the policy process may help facilitate the creation and establishment of a successful biogas sector. The challenge is therefore to improve stakeholder participation to the policy-making process and ensure successful establishment of a biogas sector in Uganda. To examine stakeholder participation for the purpose of an improved policy making process, this paper will divide stakeholders into two categories; the first being community stakeholders which represent the demand-side of biogas technology. The second category will consist of tools for all other stakeholders including government, private sector, financial services, NGOs et cetera who generally represent the supply side (see table 1). The

reason for creating these two categories is because the policy recommendations put forward in this paper fall into either one of the two categories.

**Table 1: Demand and Supply Side Tools**

| Demand Side | Supply Side |
|---|---|
| • Participatory Rural Appraisals (PRA) | • Power analysis<br>• Social Network Analyses<br>• Stakeholder Analysis Matrices<br>• Micro-political Mapping<br>• Value Chain Analyses |

The next section deals with methods for improving community (demand side) participation.

## Community participation as a method to improve biogas policy making

Avoiding the biases mentioned in the previous section requires collaborative methods of participation. Tufte and Mefalopulos (2009) describe participation by collaboration as a process that does not usually drastically alter project plans, but it does require active involvement to determine how the project should be achieved. This level of participation involves horizontal communication and capacity building among all stakeholders. While there may initially be a dependence on outside facilitators and experts, this level of collaboration can eventually take on a more independent form of participation. Therefore an improved biogas policy making process should seek out methods which utilize collaboration. One such group of collaborative methods that has been used extensively in development is *Participatory Rural Appraisals.*

*Participatory Rural Appraisals* (PRAs) encompass a wide range of tools that have been developed and extensively used over the last 30 years, achieving widespread recognition by

development practitioners (Holland, 2007). The purpose of PRAs are to enable both vertical and horizontal communication among stakeholders, including government, local communities, private sector, and NGOs to work together to plan context appropriate programs (Abdullah *et al.*, 2012). The aims of PRAs are to help strengthen the capacity of communities to plan, make decisions, and to take action towards improving their own situation. Considered one of the most popular methods for gathering information in developing countries, PRAs were initially designed as a shift in paradigm from top-down and blueprint approaches to a bottom-up and learning process. PRAs are designed to get an internal perspective of realities which is less likely to happen when administering a survey designed externally. PRAs also rely on visual instead of verbal or written communication which is of benefit to those who are illiterate. The experience sharing methods of PRAs have become an alternative to survey questionnaire methods. PRAs as a methodology requires local citizens using their own creativity and capacity to conduct analyses, strategy and action plan. PRAs are, in essence, a medium through which practitioners can learn from citizens (Cavestro, 2003).

Recently, Melamu et al. (2010, October) used stakeholder collaboration during the concept design phase of an urban biogas project in South Africa. Among some of the beneficial outcomes of the process was the fact that they were able to sensitize citizens to biogas technology which is significant given that negative images of biogas as a “dirty” gas is one of the most significant barriers to biogas technology adoption.

PRAs are not without its challenges and critiques. The most significant challenges arise with improperly administered or resourced PRAs. The result has been that all too often the demand for PRAs trainers exceeds supply creating pressure to send ill-experienced trainers on the field

who may have possess behavioral or attitude issues (Kumar, 2002). Critics wary of PRAs question the horizontality of the process and wonder whether development experts' can "easily shake off the professionalism by which they define themselves and the role which they have acquired over several years" (Pardhun, 2011, pp.3). Critics also question whether facilitators can remain neutral despite the fact that development agencies are always associated with resources leaving participants "equipped to produce knowledge that the project needed, while their 'needs' are strongly conditioned by project deliverables" (Pardhun, 2011, pp.4). Critics further note that true inclusiveness is hard to fulfill with workshops often dominated by elites recreating the inequality that may exist in the local context. More fundamentally, critics also argue that a democratic process of decision making is not always compatible with local decision making practices (Pardhun, 2011). These challenges to successful PRAs need to be taken seriously and practitioners need to be aware of and trained as to how to these challenges can be mitigated.

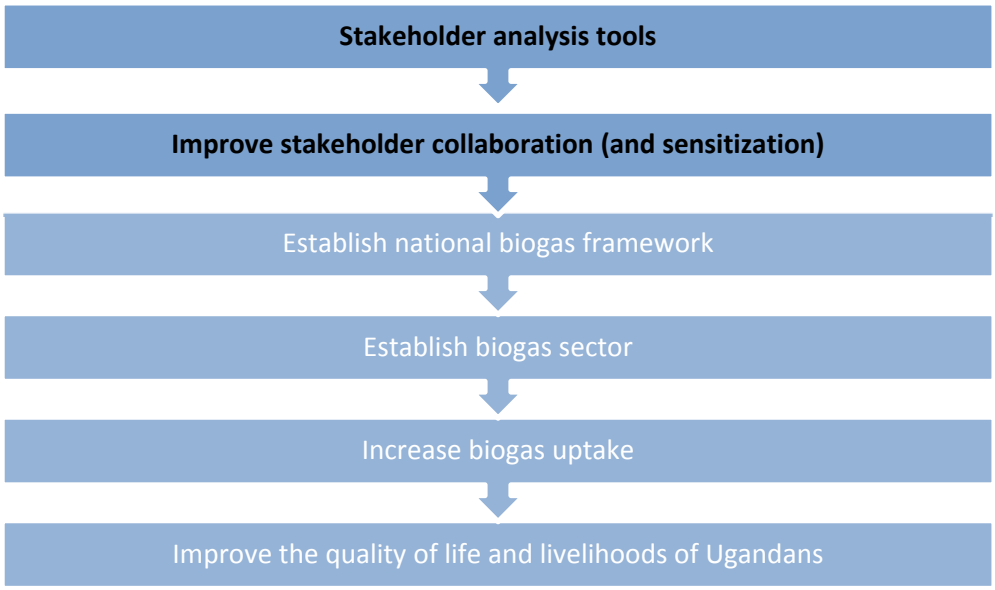
Having discussed a method of community collaboration to improve policy making, the next section will examine methods to improve supply-side collaboration.

## Supply Side collaboration to improve policy making

With limited resources, it is in the best interest of a government to be well informed about a stakeholder's level of influence and support so that government resources used in the consensus building process can be used efficiently. This information can allow a government to identify influential stakeholders and their level of support or opposition. Understanding a stakeholder's level of influence in the dissemination of biogas technology can prioritize their

level of influence in the policy process while understanding their level of support can be used to determine where blockages to biogas technology dissemination may occur. For these reasons, this section will suggest some tools that may be used to (1) identify stakeholders and their level of influence (2) identify stakeholders level of influence versus their level of support and (3) identify factors that may impede the uptake of biogas technology. The contribution of both the supply and demand side tools is demonstrated (figure 3).

**Figure 3: From a Framework to Improved Quality of Life and Livelihoods (Source: Author)**




## Tools to aid an effective supply-side collaboration

*Power analysis*

Identifying stakeholders and their level of influence is a research driven process which includes gathering and analyzing information. Holland (2007) with the support of the World Bank recently published a sourcebook of *Tools for Institutional Political, and Social Analysis of Policy*

*Reform* which highlighted Power Analysis as an effective tool for identifying stakeholders and their level of influence (power) in the policy process. Developed initially by the Swedish International Development Agency (Sida) to analyze actors, one of the greatest strengths of Power Analysis as a tool has been its ability to inform how external actors (e.g donors, NGOs) can engage with stakeholders in any given country context (Holland, 2007). The core issues addressed in a power analysis can be summarized by the following questions (Bjuremalm, 2006, pp. 15-16):

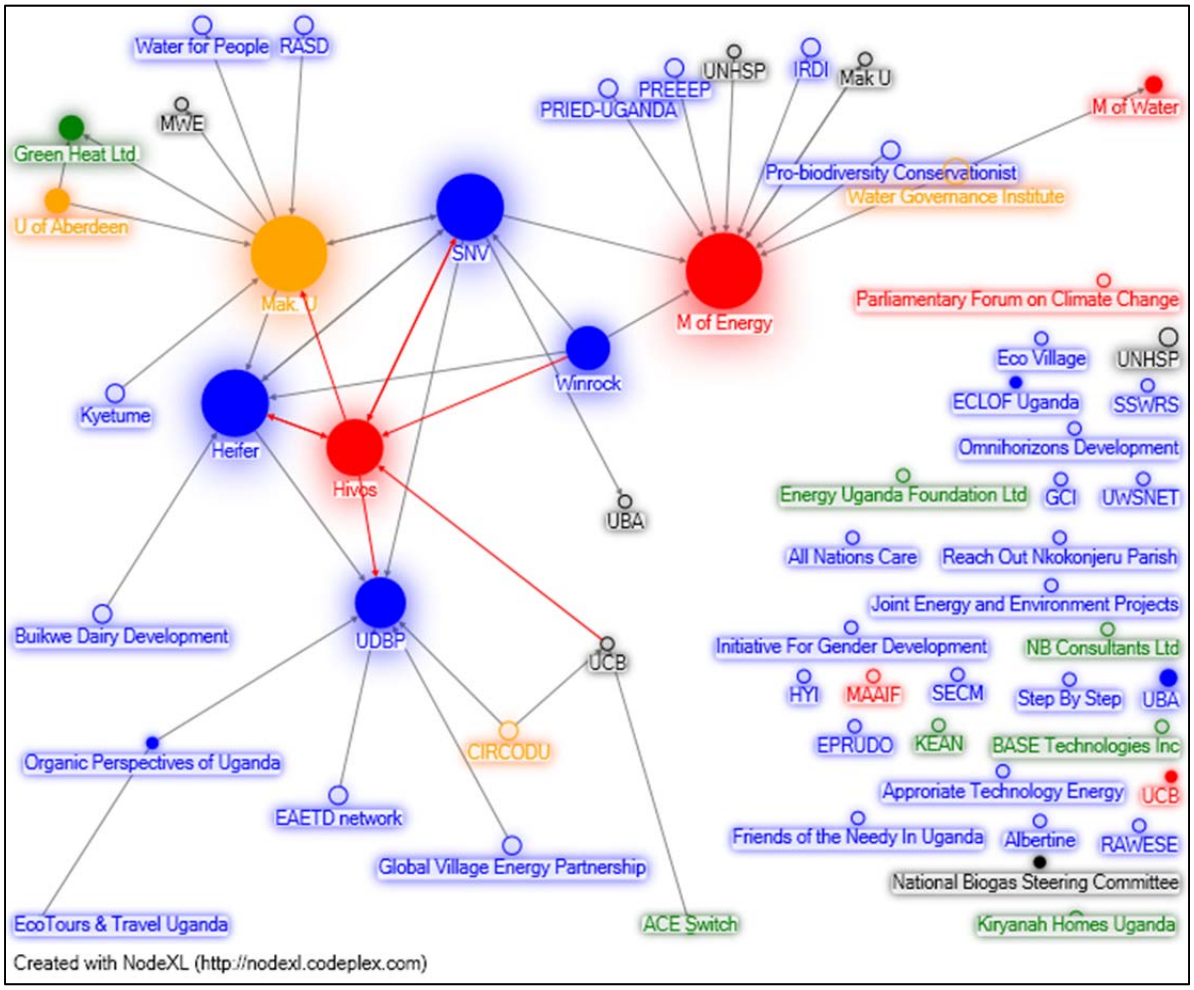
- How is formal and informal power distributed in society and according to gender?
- How are power relations distributed in the private sphere?
- What kind of informal and formal power is being exercised, how is it exercised, how is it perceived, and by whom?
- What types of hidden dimensions exist?
- How do belief and cultural practices legitimize and reinforce material power structures?
- Is the state apparatus characterized by too much/too little constructive power (power to) or controlling power (power over)?
- Which are the major conflicts of interests related to power/powerlessness, politics of poverty and democratization processes and how are these conflicts manifested?

*Social Network Analyses*

A second tool which can also be used to effectively identify stakeholders and their level of influence is Social Network Analyses. Davis (2003) notes that at the core of development are

social networks and not abstract and disembodied processes of change. A network analysis is used to map the network of institutional connections while indicating the relative strengths of the connection. A network analysis offers a visual display of the actors and their association with each other; a process which exposes which actors are more highly connected to each other. The benefit of a social network map is the ability to identify linkages between actors that are not obvious because the information is often imbedded in multiple sources of data, for example, in websites, reports etc. Because a connection between two actors is established based on flows of information, resources, and knowledge, social network mapping can also be used to understand power relations (Holland, 2007). By extrapolation, the more linkages to an actor or institution the more power or influence an actor may possess. Figure 3 is an example of a biogas social network map of stakeholders based on a preliminary search of Ugandan institutions involved in biogas. The data represented here is Ugandan stakeholders who were found to have a direct connection to the dissemination of biogas technology whether as a policy maker, NGO project funder, or as a business. After a list of stakeholders was created, further data was collected to determine if there were any partnerships in the biogas projects. If a partnership was found between stakeholders, the data was entered into social network software program (NodeXL) after which a network map was created to visualize the connections. The map produced (figure 3) was used to identify the influential stakeholders based on their connectedness. The map could also be used to identify missing linkages in the dissemination of biogas based on what an ideal biogas value chain should look like.

**Figure 4: Social Network Map of Ugandan Biogas Stakeholders**




*Stakeholder Analysis Matrices*

A stakeholder analysis matrices is a simple tool to determine graphically where stakeholders lie on an influence (low vs. High) and level of support (support vs. oppose) continuum. Maps can be used to display influence over decisions or influence over implementation. The following is an example of how stakeholder analysis matrices were used in a Zambia land reform policy process. First a list of stakeholders is created (table 2) with each receiving a number and symbol.

**Table 2: Key Stakeholders of Zambia Land Reform (Source: Jorgensen and Loudjeva, 2005, recreated by Holland, 2007)**

| Government and state agencies | Private sector | Civil society |
|---|---|---|
| 1 The President | 16 Commercial farmers | 25 Chiefs |
| 2 Ministry of Land | 17 Small-scale farmers | 26 Landless |
| 3 Lands Tribunal | 18 Surveyors | 27 Herders |
| 4 Judiciary | 19 Lawyers | 28 FHHs, CHHs |
| 5 Office of the Vice-President | 20 Foreign investors | 29 Minority ethnic groups |
| 6 Ministry of Legal Affairs | 21 Commercial banks | 30 Zambia National Farmers Union (ZNFU) |
| 7 Ministry of Local Government and Housing | **Donors** | 31 Local NGOs |
| 8 City, Municipal, and District Councils | 22 USAID | 32 International NGOs |
| 9 Ministry of Agriculture and Cooperatives | 23 WB/IMF | 33 Media |
| 10 Ministry of Works and Supply | 24 DFID, GTZ, EU | |
| 11 Ministry of Commerce, Trade, and Industry | | |
| 12 Ministry of Tourism, Environment, and Natural Resources | | |
| 13 Ministry of Finance | | |
| 14 Parliament | | |
| 15 Police Force/Ministry of the Interior | | |

In the example here of Key Stakeholders of a Zambia land reform initiative, #33 in the stakeholder box (table 2 above) represents the media, information gathered from the power analysis regarding the media's influence over decision making and their level of support of the policy is used to plot their position on a standard X, Y axis map (figure 4). Likewise information gathered from the power analysis regarding the media's influence over implementation and their level of support of the policy is also plotted on a graph (figure 5). The graphs show the overall level of support for the policy as well as the influential champions of the policy. Melamu et al. (2010, October) found that identifying champions of a policy is critical to the success of the policy.

**Figure 5: Stakeholder Influence over Decisions (Source: Jorgensen and Loudjeva, 2005, recreated by Holland, 2007)**

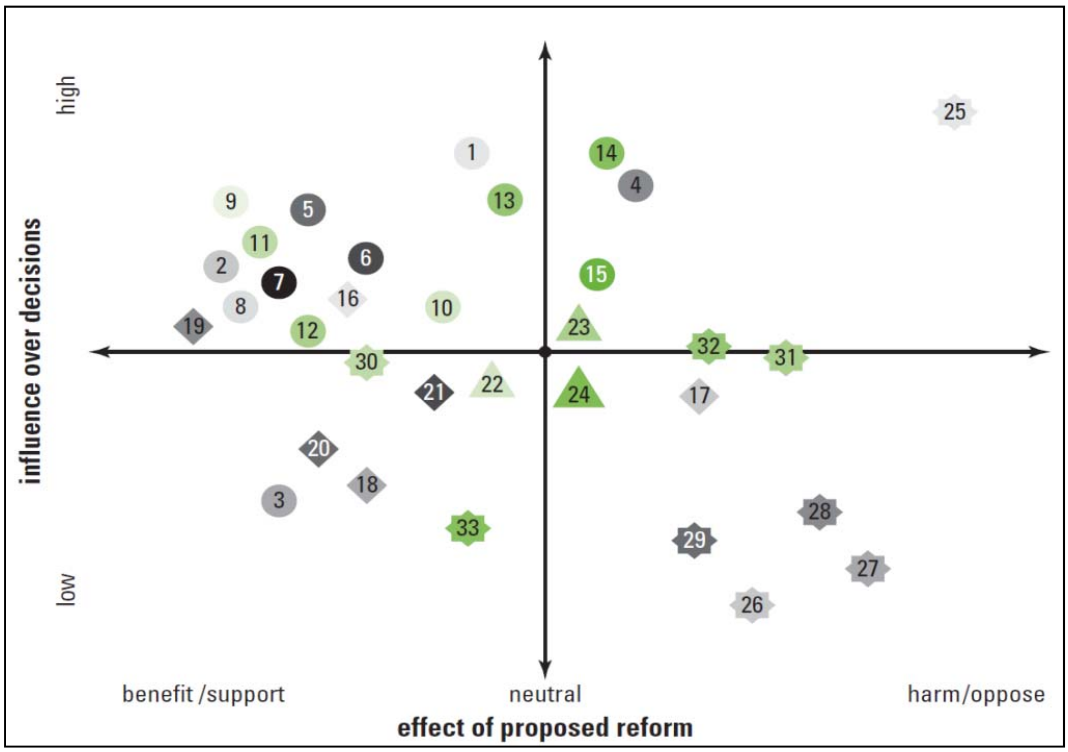
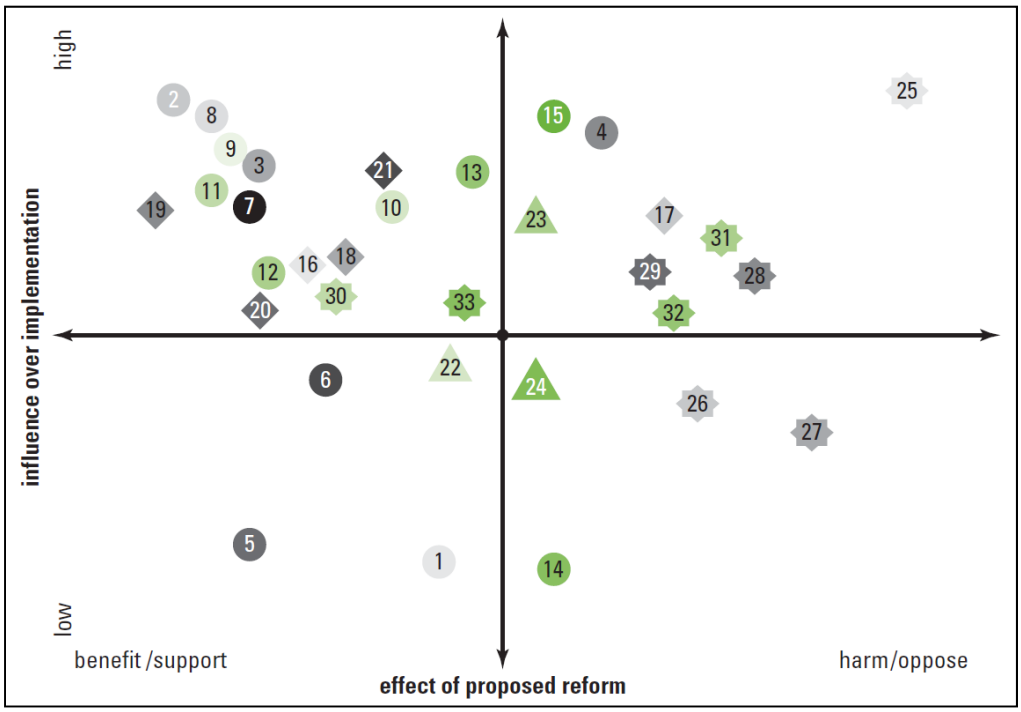


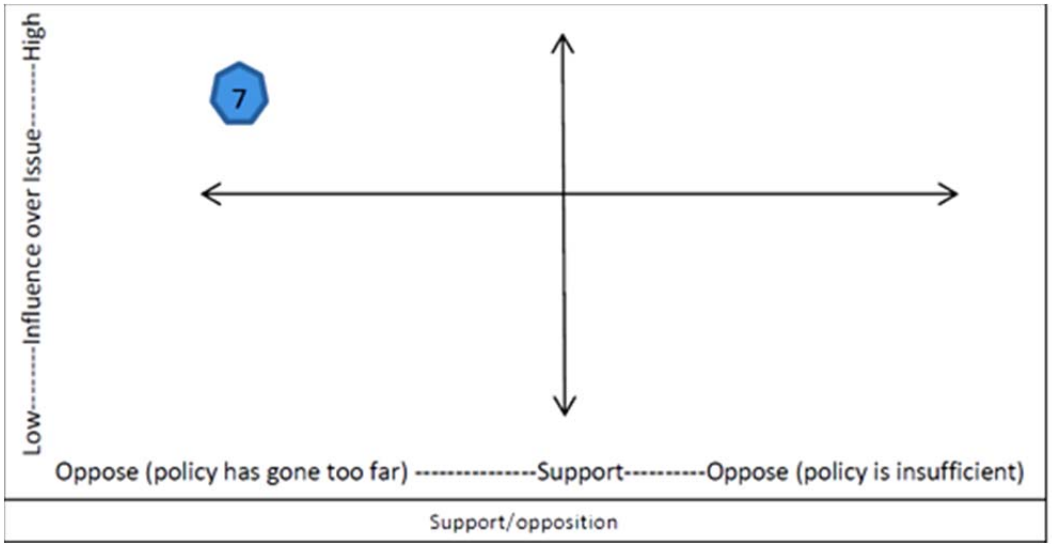

**Figure 6: Stakeholder Influence over Implementation**



*Micro-political Mapping*

While stakeholder analyses matrices provide valuable information on the level of support or opposition, it would be helpful to understand why a stakeholder may oppose policy reform and how they would react to any changes in the policy design (Holland, 2007). One tool useful in understanding why a stakeholders opposes is micro political mapping discussed by Brinkerhoff and Crosby (2002). A micro-political map organizes the opposition based on whether they think the policy has gone too far or, because they think the policy is insufficient. While Brinkerhoff and Crosby (2002) use a different format for displaying micro-political data, this paper suggests using the same format used in Stakeholder Analysis Matrices discussed above. On the X axis close to the origin would be "Oppose: the policy has gone too far." The center of the X axis would represent supporters, while the left would again represent those opposed but in this case they are opposed to the policy because it is insufficient (see figure 8.2.3). In the example below (figure 8.2.3), stakeholder number 7 is highly influential but opposes the policy because the policy has gone too far. Knowing why a stakeholder opposes policy is valuable information that can guide optimal changes to the policy reform. This information is useful for a policy practitioner because it does not assume that opposing stakeholders disagree for the same reasons and can, in fact oppose for opposing reasons, thus this map allows practitioners to understand the overall nature of the opposition.

**Figure 7: Micro-Political Map Example (Source: Adapted from Holland, 2007)**




*Value Chain Analyses*

Another important analysis includes market chain actors and their linkages in the value chain. This section will briefly introduce the concept of value-chain analysis as a tool used to explore market chain actors and weaknesses in the value chain that hinder wider dissemination of a technology in a country or region (Nyagabona & Olomi, 2009). A value chain is defined as the series of activities that a firm engages in to deliver a good or service to the market (Kaplinsky & Morris, 2001). Like Power Analysis, and Participatory Rural Appraisals, Value Chain Analysis is a tool to identify blockages and missing links in the dissemination of biogas technology. For example, in the social network map displayed earlier (figure 3) it may have raised a flag that many NGO biogas projects are disconnected from any partnerships with other institutions.

The specific objectives of the value chain analysis are:

- Identifying actors, processes and links in the value chain for biogas
- Examining critical links, strengths and weaknesses among the links as basis for recommending action to improve the value chain for sustainability
- Assessing policy and regulatory framework in terms of their appropriateness for development of the biogas value chain
- Examining the adequacy of the support environment including Business Development Services and Finance along the biogas value chain. (Nyagabona & Olomi, 2009, pp.7)

There are three levels in a value chain analysis (VCA); *market chain actors and their linkages, the business environment,* and, *Business Development Service (BDS) Providers*. The market chain actors are economic actors who own a product as it moves from the primary producer to the end user (Nyagabona & Olomi, 2009). Actors in the business environment are at the macro level and are responsible for infrastructure, policies, laws, institutions and processes that shape the market system. Business Development Service (BDS) Providers are actors that support the market chain operation. It was mentioned previously in this paper that the Ugandan Government has identified the need to move beyond a grassroots implementation toward a thriving market chain. As the government moves forward, a VCA can provide information on the current value chain and where linkages are missing.

Conducting a VCA should utilize a holistic approach including literature reviews, interviews, process observation. Information should be gleaned from both the actors in the value chain as well as the end users (Nyagabona & Olomi, 2009). A VCA is suggested to be an important tool in this paper not only to improve the policy process but as a tool to improve the technology itself. While policies to support the production and distribution of biogas are important, so are

policies which support the research and development of biogas technology. The specific methodological approach used to conduct a VCA must be rigorous and chosen carefully. There are a number of 'how to' manuals available online. For example, the World Food Program (2010, September) produced *How to Conduct a Food Commodity Value Chain Analysis?*

## Discussion

This paper outlines potential methods for an improved policy-making process that may help the government reach its biogas uptake goals. A participatory policy process is suggested primarily as a means for improving horizontal and vertical communication and addressing the cultural stigma associated with the use of biogas for cooking. Active rather than passive engagement with citizens may be necessary therefore Participatory Rural Appraisals is suggested as an effective method of not only sensitizing citizens toward the use of biogas but also eliciting their support for biogas technology. Additionally, citizen engagement can also be used to improve the overall design of the policy resulting in better uptake.

Furthermore, to improve the uptake of biogas, this paper suggests that various analyses are conducted to gain a better understanding of the stokeholds that are crucial to the uptake of biogas. A power analysis can be used to determine a stakeholder's level of influence and this information can be used to more effectively elicit the support of influential stakeholders. Two dimensional stakeholder analysis matrices plot a stakeholder's level of support and their level of influence providing information on support or opposition trends among stakeholders, and to what level these trends can influence either the decision or, implementation process. In general, this information can be used to determine the sphere of influence of the opponents or

supporters. A Social Network analysis which maps inter-stakeholder connectivity has also been suggested because it can identify stakeholders with high connectivity. Since greater connectivity can be correlated with greater influence, a social network map can be used to identify influential stakeholders. This information can be used to prioritize stakeholders who should be approached first and who will play an important role in championing policy.

A policy-making process which leads to the creation of a national biogas framework and mitigates cultural barriers should result in a significant uptake of biogas technology in Uganda, as has been the case in Nepal, a country with a similar population and GDP but with national biogas framework that has fostered the uptake of over 260,000 biogas units resulting in 11,000 jobs and reducing wood use by an estimated 500,000 tonnes per year and CO2 emissions by 750,000 tonnes (U.S Aid, n.d; Rai, 2005). Relatively moderate effort is required for implementing the methods outlined in this paper. Holland (2007) estimates that a power analysis should take 2-6 months and cost approximately $50,000 USDs, a stakeholder analysis matrices should take 1-3 weeks and cost between $10-25,000 USDs, while a social network analyses when combined with previous analyses should take a week and cost $10,000. The time and resources required for citizen participation will depend on the particular Participatory Rural Appraisal method chosen but usually consist of a local workshop administered by a small team of practitioners. In the case where the target of 100,000 units is realized the benefits to Ugandans will far outweigh the cost both in terms of the quality of life and livelihoods for Ugandans and their following generations.

## Conclusion

The Government of Uganda has endorsed biogas technology as a means for improving the quality of life and livelihoods of Ugandans. The benefits of biogas technology include improvements in sanitation, clean energy use, and increased food availability. Biogas technology also improves livelihoods through improved crop productivity and a sustainable energy supply. For theses reasons, the Ministry of Energy and Development set a goal in 2007 to increase biogas units to 100,000 by 2017. To date around 2500 units have been installed prompting a need to investigate the factors which are prohibiting biogas uptake.

The purpose of this paper has been to identify methods to improve the policy making process for a national biogas framework in Uganda. This purpose was established as necessary after research to determine the factors prohibiting the uptake of biogas technology in Uganda identified the need for a national biogas framework. This paper fills a gap in the literature by identifying methods to improve a policy making process for a national biogas framework in Uganda. Stakeholder collaboration was identified as a method which should result in an improved policy making process. Furthermore, tools which should result in an improved stakeholder collaboration process were also suggested. These tools included Participatory Rural Appraisals, Power Analysis, Social Network Analyses, Stakeholder Analysis Matrices, Micro-political mapping, and Value Chain Analysis. Combined, these tools can be used to improve stakeholder collaboration, which can be used to improve the policy making process, which can be used to establish a national biogas framework, which can be used to establish a biogas sector, which can be used to increase biogas technology, which can then be used to improve the quality of life and livelihoods of Ugandans. There are many steps between an improved

policy process and improved quality of life and livelihoods of Ugandans. To begin with, methodology for other required solutions to issues such as micro-financing and digester designed flaws have yet to be outlined. Furthermore, the benefits of biogas technology have not been exhausted. For example, eco-tourism can be augmented along with the dissemination of biogas technology to further improve the livelihoods of Ugandans. However, first things first, the next step toward the goal of improved quality of life and livelihoods for Ugandans is policy for a national biogas framework.

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