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Africa Biogas Partnership Program: A review of clean cooking implementation through market development in East Africa

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ABSTRACT

This paper analyses the Africa Biogas Partnership Program (ABPP) in Kenya, Tanzania and Uganda. ABPP was established in 2009 to promote adoption of biodigesters by rural households in sub-Saharan Africa. We use the RE-AIM framework (Reach, Effectiveness, Implementation, Adoption, Maintenance) with information from literature, internal documents, primary data from user surveys and interviews with sector stakeholders.

ABPP was implemented with the primary objective of establishing viable biodigester markets. By 2017, Kenya made most progress toward commercial viability, evidenced by market entry of companies offering prefabricated digesters and establishment of 22 marketing hubs, which link rural organizations with local construction enterprises and finance institutions. In Uganda 5 marketing hubs were established and in Tanzania 7. Between 2009 and 2017 over 27,000 households installed a biodigester, half of them in Kenya. Additional objectives include improving agricultural productivity by using bio-slurry, improving health, reducing deforestation, and improving livelihoods.

Households perceive higher crop yields (84%–91% of users), reduced fuel consumption (84%–94% of users), reduced eye problems and respiratory symptoms (45%–91% of users). Benefits most appreciated are "easy cooking" and "saving time and money". Fuel consumption tests show households with biodigesters use 2.1 to 3.3 fewer tons of wood per year than similar households without biodigesters.

The ABPP case study suggests that the program has created a nascent biodigester market in East Africa. The country programs have been dynamic and adaptive, moving along the cycle of market development; however, many challenges remain. For example, while half of the adopters in Kenya exclusively use biogas for cooking, in Uganda and Tanzania fuel stacking is more prevalent, making it more difficult to achieve health and environmental objectives. In addition, high upfront cost, limited access to credit, and lack of maintenance present challenges. In 2016, 27% of biodigesters constructed between 2009 and 2013 were not working. In response, ABPP implemented call centers and launched campaigns to repair non-functioning plants. To ensure long-term viability and increase the likelihood of achieving environmental and health goals, we suggest deeper engagement with governmental and non-governmental stakeholders and a targeted campaign promoting exclusive use.

Introduction

Throughout East Africa, households rely heavily on solid biomass for cooking. This is particularly true in rural areas, where over 95% of households report using solid fuels as primary source of energy (ICF International, 2015). Biogas is an alternative option for households for households that have access to sufficient suitable organic feedstock (IRENA, 2017). Globally, roughly 50 million biogas systems have been installed to produce gas for cooking. The majority of these systems are in Asia, particularly China (Chen, Zhao, Ren, & Wang, 2012; Putti, Tsan, Mehta, & Kammila, 2015; Wang et al., 2016; Zuzhang, 2013) and India (IRENA, 2017; Putti et al, 2015). Approximately 300,000 biodigesters are installed in Nepal (Bajgain & Shakya, 2005; Saroj, 2012) and another 300,000 in Vietnam, Bangladesh, Cambodia, Indonesia and Pakistan (IRENA, 2017). Dissemination in Africa is still very limited. Most of the literature about use of biogas in Africa discusses its potential contribution to the well-being of its population, economic development and environmental protection, or the challenges for large-scale uptake of the technology (Amigun, Parawira, Musango, Aboyade, & Badmos, 2012; Lwiza, Mugisha, Walekhwa, Smith, & Balana, 2017; Mulinda, Hu, & Pan, 2013; Mwirigi et al., 2014; Nhete & Kellner, 2007;

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Roopnarain & Adeleke, 2017; Smith et al., 2011). This study describes the implementation of national biogas programs in three East African countries (Kenya, Tanzania and Uganda) and reviews its effectiveness and adoption and sustained use of biogas over a period of eight years (2009–2017).

Household energy in East Africa

Throughout East Africa, biomass dominates residential energy supply; large majorities use wood and charcoal as their primary cooking fuel (ICF International, 2015).[1] Fuels like LPG, ethanol, biogas, and pellet fuels burned in advanced stoves emit less pollution than unprocessed wood or charcoal.[2] Some of these fuels are gradually becoming more accessible in East Africa, particularly in urban settings. Access to electricity is increasing in East Africa: rapidly in Kenya and more gradually in Uganda and Tanzania. In all three countries, urban electrification rates have exceeded 50%; however, rural access remains quite low (ICF International, 2015). In some African countries, electricity is popular for cooking. For example, in Namibia and Zimbabwe over 50% of urban households cook mainly with electricity (ICF International, 2015). However, it is rare in East Africa, where less than 1% of urban households use electricity as primary source for cooking. Clean fuels like ethanol, pellets coupled with advanced gasifier stoves, and solar cookers are even less common. All have all been introduced in Kenya, Tanzania and Uganda; however, they have limited distribution and very low adoption.

Domestic biogas in Africa

According to a study in 2007 conducted by SNV-the Netherlands Development Organization and the International Institute of Tropical Agriculture, cooking with biogas is technically feasible for 18.5 million households in 24 African countries, based on livestock ownership, water availability, fuelwood scarcity, population density and climate (Heegde & Sonder, 2007). The three countries we assess here showed some of the highest potentials: Tanzania - 1.8 million households, Uganda - 1.3 million households; and Kenya - 1.3 million households. Actual dissemination and use of biodigesters in Africa contrast with number of systems disseminated in Asia and high technical potential for use in Africa. By 2005, Tanzania was the only country with >1000 biogas plants installed (Laramee & Davis, 2013; Nhete & Kellner, 2007).

Initial investment is a constraint for biodigester dissemination in Africa. The most common design in East Africa is based on the Chinese fixed dome digester (Mulinda et al., 2013). Because of high upfront cost, some argue that flexible balloon models should be promoted instead of fixed-dome digesters (Richter, 2014; Rota & Sehgal, 2015; Smith et al., 2011). Others argue that adoption depends on the program strategy. Household level adoption can be enhanced by an integrated program approach, including technology standardization, quality control, and integrated farming using biogas and bio-slurry (Mwirigi et al., 2014).

The "sector development" model developed by SNV in Nepal and replicated in Asia was introduced in Africa (SNV, 2009). The model's core principle is that large-scale dissemination is driven by user-satisfaction, and product credibility, which create a feedback loop: "service-quality - user satisfaction - promotion - sector development". To create a new market, coordinated effort is needed to build supply, demand, and an enabling policy environment. The model pursues a balance between market forces and program-enforced quality management (Ghimire, 2013; SNV, 2009). Functions should be undertaken by multiple rather than single stakeholders allowing competition on the supply side, which benefits users. Additionally, successful programs quickly grow too large and complex to be run efficiently by a single actor. Lastly, coordination is needed through proper institutional arrangements.

The aforementioned studies about biogas potential in Africa and contrasting low numbers of actual dissemination and use (Heegde & Sonder, 2007; Nhete & Kellner, 2007) were discussed at the "Biogas for Better Life An African Initiative" Conference in 2007. The Initiative also discussed a number of guidelines aimed at sector development respecting market principles (Nes & Nhete, 2007). Within each country, national governments are expected to provide policy, legal and institutional frameworks while NGOs and private sector players would act as implementing agencies. A business plan presented by the Initiative concluded that with the right approach and sufficient funding, two million African households could access biogas for cooking and lighting in 10–14 years (Biogas Team, 2007). They estimated USD 1050 million would be needed to complement farmer investments and microcredit (assuming each unit requires USD 130–330 in subsidies and USD 200 for marketing and management). Notably, the Investment cost is nearly double the average cost in Asia (USD 530 compared with USD 300) due to higher cost of labor, raw materials, and appliances (Biogas Team, 2007).

The first national program in Africa following guidelines discussed at the Conference was launched in Rwanda. Through this program over 2400 digesters were installed between 2007 and 2011 (Bedi, Pellegrini, & Tasciotti, 2015; Landi, Sovacool, & Eidsness, 2013), increasing to 9850 by March 2018 (personal communication[3]). Subsequently, in 2009, the Netherlands' Directorate-General for International Cooperation (DGIS), part of the Ministry of Foreign Affairs, approved funding for national programs in 6 countries coordinated by the Africa Biogas Partnership Program (ABPP).

The national biogas programs in Kenya, Tanzania and Uganda function under the umbrella of the ABPP. "The overall objective of the ABPP is to contribute to the achievement of the Millennium Development Goals through the dissemination of domestic biodigesters as a local, sustainable energy source aiming at the development of a commercial, market oriented sector in selected African countries" (DGIS, Hivos, & SNV, 2008). It was established by the Ministry of Foreign Affairs of the Netherlands, providing funding, and two Dutch NGOs: the Netherlands Development Organization, SNV, providing technical assistance, and Hivos, taking care of fund management and coordination. The first phase of ABPP ran from 2009 to 2013; a second phase began in 2014 and will run through 2019.

This study describes the implementation of ABPP in the countries mentioned and reviews its effectiveness and adoption and sustained use of biogas using the RE-AIM framework (Glasgow, Vogt, & Boles, 1999) (Quinn et al., in this issue). Methods, sources and approach describes research methods. In the following two sections we analyze the program implementation strategy, program effectiveness and describe household adoption and sustained use of biogas in the three case-study countries, using parameters from the RE-AIM framework. Discussion and Conclusion present some lessons learnt.

Methods, sources and approach

We used the RE-AIM framework tailored by the United States National Institutes of Health Implementation Science Network (NIH-ISN) to evaluate clean cooking interventions (See Appendix A), which integrates five factors i.e. Reach, Effectiveness, Implementation, Adoption, Maintenance, to analyze the implementation of ABPP in

[1] Many households use multiple fuels, but most nationally representative surveys only collect information about primary fuels.

[2] The WHO discourages the use of kerosene as a household fuel because pollution emissions lead to potentially harmful exposures. Therefore we omit kerosene from this list of "modern" fuels (World Health Organization, 2014).

[3] data provided by Anaclet Ndahimana, SNV Rwanda RE Sector Leader on 25 April 2018

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