POLICY ADVANCEMENTS FOR INTEGRATING INDIGENOUS KNOWLEDGE AND BIOGAS -BASED CLEAN COOKING IN UGANDA: A PATHWAY TO CLIMATE RESILIENCE

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Overview of the Study

The need for energy security and sustainability are driving a major shift in the global energy scene. Approximately 2.5 billion people still cook their meals using firewood and readily available biomass as their main energy sources (IEA, 2023; WHO, 2022; Ghimire, 2013). Consuming firewood for cooking is a long-standing societal custom embedded within local communities as Indigenous knowledge which was passed down through the generations (Mastrangelo et al., 2019). solid fuels like firewood and charcoal causes indoor air pollution, which puts women and children at the highest risk of being among the 3.7 million premature deaths that occur each year (IEA, 2023; WHO, 2016) and also leads to deforestation, forest degradation, emits carbon dioxide hence accelerating climate change (Jetter et al., 2012; Zhao et al., 2018; Batchelor et al., 2019; Shilenje et al., 2022; Kyayesimire et al., 2021; Benti et al., 2021; GIZ, 2014). Transitioning to biogas energy technology with integration of indigenous knowledge presents a viable solution to these challenges (Kabeyi et al., 2022; Asfaw et al., 2022; Rufis et al., 2021). According to the IEA 2017; 2022; IRENA,2022b; Climate Analytics, 2022, about 588 and 783 million people in Africa, respectively have no clean energy access. The condition in Uganda is appalling, since about 94% of the population depend on firewood and charcoal for cooking, with biofuels constituting 87% of the energy supply (MEMD, 2023; IEA, 2020; Nzabona et al., 2021; Bamwesigye et al., 2020). Expanding the usage of biogas based clean cooking not only addresses environmental and health concerns but leads to broader objectives, such as reducing carbon emissions, curbing deforestation, and enhancing household productivity (Mukisa et al., 2022; Kabeyi et al., 2022). Empirical research and policy discussions about Indigenous communities' transition to clean cooking have recently increased. However, there are knowledge gaps between Indigenous people, rural development strategies and biogas energy technology diffusion (OECD, 2019). Indigenous researchers and expertise are also essential, yet they are under represented in energy research particularly biogas energy technology (Stefanelli et al., 2019, Barau et al., 2016). Consequently, integration of biogas energy technology with indigenous knowledge in Uganda is affected by various obstacles, such as low awareness, high upfront costs, and insufficient policy frameworks, despite the potential benefits (Mukisa e al., 2022; Nevzorova et al., 2019; Lwiza et al., 2017). Therefore, uutilizing indigenous knowledge, policymakers can create culturally and socially appropriate measures that increase community acceptance and diffusion of biogas – based clean cooking which is obtained from organic matter by the anaerobic digestion process (Rasimphi et al., 2024; Nahwani et al., 2024; Izuoma,2022; Rebeka & Muhammad, 2018; Mafongoya et al., 2017; Dawson et al., 2021).

Methodology

This study used an empirical methodology (qualitative and quantitative data) to examine data obtained from community surveys, Government players and Non-government organizations like SNV and GIZ as well as Uganda Bureau of Statistics (UBOS) from which request was made and permission granted. The data covered the previous seven (7) years (January 2018 to December 2024. Data analysis was done using STATA and R statistical packages to conduct a time series analysis using a co-integration. According to conventional economic theory, there may be a short-term drift in some variables and relationships with one another and thus have a long-term relationship. Consequently, it is crucial to test whether there is a cointegrating relationship between the research variables. Therefore, the Autoregressive Distributed Lag (ARDL) bounds test by Pesaran, Shin, and Smith (2001) is mainly used method for testing cointegration in the study**.** In addition, a pilot study was conducted to gather study insights. Data was collected using a questionnaire created with an online survey tool called All Counted, and 50 respondents were reached using a non-probability technique termed as referral sampling. For variables that were thought to be significant to the study, descriptive statistics were obtained through data analysis and presented inform of frequency tables and percentages.

Results of the Study

From the findings, 96% of respondents were aware of biogas energy technology, but only 50% had formal training or information on its benefits, highlighting a significant knowledge gap. 88% of respondents acknowledged the relevance of indigenous knowledge in promoting the dissemination of biogas energy technology, emphasizing its vital role in improving the diffusion and sustainability of biogas systems thus mitigating climate change. Majority of the respondents (70%) stated that biogas-based cooking had reduced deforestation, improved waste management techniques (52%), improved air quality (90%) and reduced dependency on firewood and charcoal, among other environmental benefits. Since household air pollution leads to premature deaths, respiratory diseases and toxic air pollutants, it is widely known

that acceptance and long-term usage of clean cooking fuels improve environmental quality (Balakrishnan et al., 2002, 2011). Biogas has a lot of promise to advance environmentally conscious practices, enhance energy accessibility, and encourage sustainable development in rural areas (Sawyerr et al., 2019). Barriers like high upfront costs, technological difficulties, and cultural opposition, however, still prevented broader implementation and diffusion of biogas systems (Mukisa e al., 2022).

Conclusion

Biogas energy technology is a promising endeavor worldwide due to the availability of proven feedstocks and production technologies together with exciting new ones. Utilizing biogas based clean cooking with indigenous knowledge perspectives protects the environment, reduces household air pollution, improves people's incomes through bio slurry, increases agricultural productivity and mitigates climate change**.** Notwithstanding several initiatives to promote the spread of clean energy alternatives, solid fuels inform of charcoal and firewood remained the most widely used cooking fuels in Uganda, thus utilization of biogas as a cooking energy source is still relatively small, even though inexpensive feedstocks are widely available. Given this slow shift, it is significant that evidence- integrated based policies should be created, executed, and then reviewed to promote a faster shift to cooking using cleaner fuels, hence mitigating climate change, the achievement of SDG 13 and 7. Therefore, in order to improve the successful integration of biogas based clean cooking in Ugandan communities, the paper suggests policy frameworks such as integrated indigenous customs for community acceptance and participation, focused training programs, awareness campaigns, and financial incentives. This research adds to the conversation on climate resilience and sustainable energy development by highlighting the interaction between indigenous practices and contemporary energy solutions. It also promotes cooperation between stakeholders, local communities, and the government in order to effectively utilize local knowledge for climate action and sustainable development in Uganda.

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