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Investigation of Anaerobic Digestion Backed by Solar-Wind System for Clean Energies in Rural Areas

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Abstract

Rural communities in Africa, Chamwino district in Tanzania inclusive, are facing discouraging challenges of sustainable supply of their energy needs and low soil fertility. Improving energy and soil nutrients accessibility in rural areas will essentially require strategies which will facilitate the utilisation of the locally available cheap and low value materials and resources, e.g. animal wastes (biomass), solar radiation and wind energy. It is argued that a hybrid system utilising of renewable energy resources (biomass, wind and solar) is suitable for energy generation in under-privileged rural areas where electricity grid connection has not reached. The optimally hybrid system provides a supplement of energy for cooking (biogas), electricity for lighting and bio-slurry/digestate for improving soil fertility. The focus of this study is to investigate the anaerobic digestion backed by solar-wind system for production of clean energies (biogas and renewable electricity) in rural areas, specifically in Chamwino district, Dodoma-Tanzania. The approach will involve a feasibility of the cheap and low cost materials and resources; then optimising, designing, and testing, modelling and conduct techno-economic analysis of intended hybrid energy system. The information collected from literature shows that semi-arid rural areas such as Chamwino have abundant wind and solar energy, estimated at 6 m s^{-1} and 4.7 $^{kWh}/_{m}2$/day, respectively annually. These areas also face a decreasing rate of fuel wood sources, which was estimated at 0.68 % per year since 2007 exceeding that of 0.23 % per year from 2001 to 2007. The expected outcome and results of this study will be to have in place an optimised hybrid anaerobic digestion-solar-wind system for producing affordable, sustainable, and clean energies for rural areas. Model for sizing in the intended hybrid anaerobic digestion-solar-wind system based on geographical location and feedstocks as well as the techno-economic analysis results of that system will also be presented .

Keywords: Anaerobic digestion, biogas, biomass, clean energies, electricity, rural areas, solar systems, wind

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