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Criteria for Assessment of Different Designs of Small-scale Biogas Technology

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Abstract

Biogas technology is capable of improving the living standards of rural households in developing countries and jointly reduce their environmental impacts. These potential benefits are often not fully achieved due to different technical or non-technical constraints related to specific local conditions and various aspects of different designs of biogas plants. Despite the addressing of the advantages and disadvantages of biogas in rural areas in many studies, the implementation of biogas technology has not been assessed in a holistic way. Therefore, the aim of this study is to develop a holistic assessment technique, which can be used for a comprehensive assessment of available designs of small-scale biogas systems. In addition, a decision-making tool for use by both researchers and technology implementers in the sustainable development of small-scale biogas plants will be designed. The research methodology is based on a multi-criteria sustainability assessment framework (SAF) involving four dimensional aspects - environmental, technical, economic and social - applied to evaluate different constraints of designs ensuring their suitability for use in selected target areas. The framework integrating multi criteria analysis principles use also the sub-criteria capturing the fundamental aspects of the sustainability dimensions, based on a critical examination of scientific literature (Technical: process efficiency, energy payback, operational reliability; social: health and sanitation, gender equality, cultural perception of biogas technology; economic: total investment costs, payback period; environmental: life-cycle analysis, global warming potential). Obtained secondary data will be further analysed in the evaluation matrix, using weights to indicate relative significance of each sub-criterion. The results presented in the study will provide suitable criteria for development of a decision-making tool, which will be available for researchers and practitioners in favour to implement the biogas technology according to the local conditions, while favouring the rural households and reducing their environmental impact.

Keywords: Anaerobic digestion, biogas, developing countries, small-scale biogas plants, sustainable development goals, waste management