20

Application of Upflow Anaerobic Sludge Blanket (UASB) Reactor Technology for Wastewater Treatment: Technical, Environmental and Socio-Economic Assessment in Developing Countries

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Wastewater management is one of the major challenges faced by most developing countries in Sub-Sahara Africa. Population growth and urbanization have led to the generation of large volumes of wastewater, which are discharged into the environment without treatment due to inadequate infrastructure. Wastewater contains contaminants and pathogens that are harmful to public health and the receiving ecosystems. Wastewater is however rich in organic matter and nutrients which can be harnessed into useful resources. Conventional wastewater treatment technologies implemented in high-income countries are usually not suitable for low-income countries due to high installation and operational costs. Thus the need for an efficient and economically feasible wastewater treatment technology in developing countries cannot be overlooked. The Upflow Anaerobic Sludge Blanket (UASB) reactor technology which requires low energy consumption, produces less sludge and generates biogas as bi-product may be an appropriate alternative for developing countries.

Sustainable wastewater management is one that does not only focus on eliminating water pollution but also seeks to minimize environmental burdens and potential impacts from wastewater treatment systems, preserve human health and recover nutrients from wastewater. As the global community shifts towards attaining sustainability, several research works have been carried out to assess the sustainability of wastewater treatment systems in developed countries, these studies consequently lacking in the context of developing countries. This case-study based research is thus intended to evaluate the sustainability of the Mudor Wastewater Treatment Plant (MWWTP) located in Accra, the capital city of Ghana. The MWWTP employs the UASB reactor technology with post-treatment units to treat municipal wastewater generated in various suburbs of Accra.

The first objective of this study is to assess the performance of the treatment plant by determining the pollutant removal efficiency of parameters of interest. Secondly, the life cycle analysis (LCA) technique will be employed to evaluate the environmental burdens and potential impacts associated with the various unit processes during operations of MWWTP. Finally a socio-economic assessment will be conducted. The cost-benefit analysis approach will be employed to determine the total cost of running the plant (Capital and Operational Expenditure). The corresponding benefits from bi-products such as biogas and sludge with energy recovery potentials, sludge as fertilizer and nutrient-rich reclaimed water for irrigation practices will also be evaluated. The socio-cultural implications regarding public perception and acceptance of wastewater sludge for agricultural purposes, irrigation with treated wastewater and consumption of food crops cultivated with this waste stream will also be assessed. Methodology for the study objectives has been conceptualised in the chart below (Figure 1):

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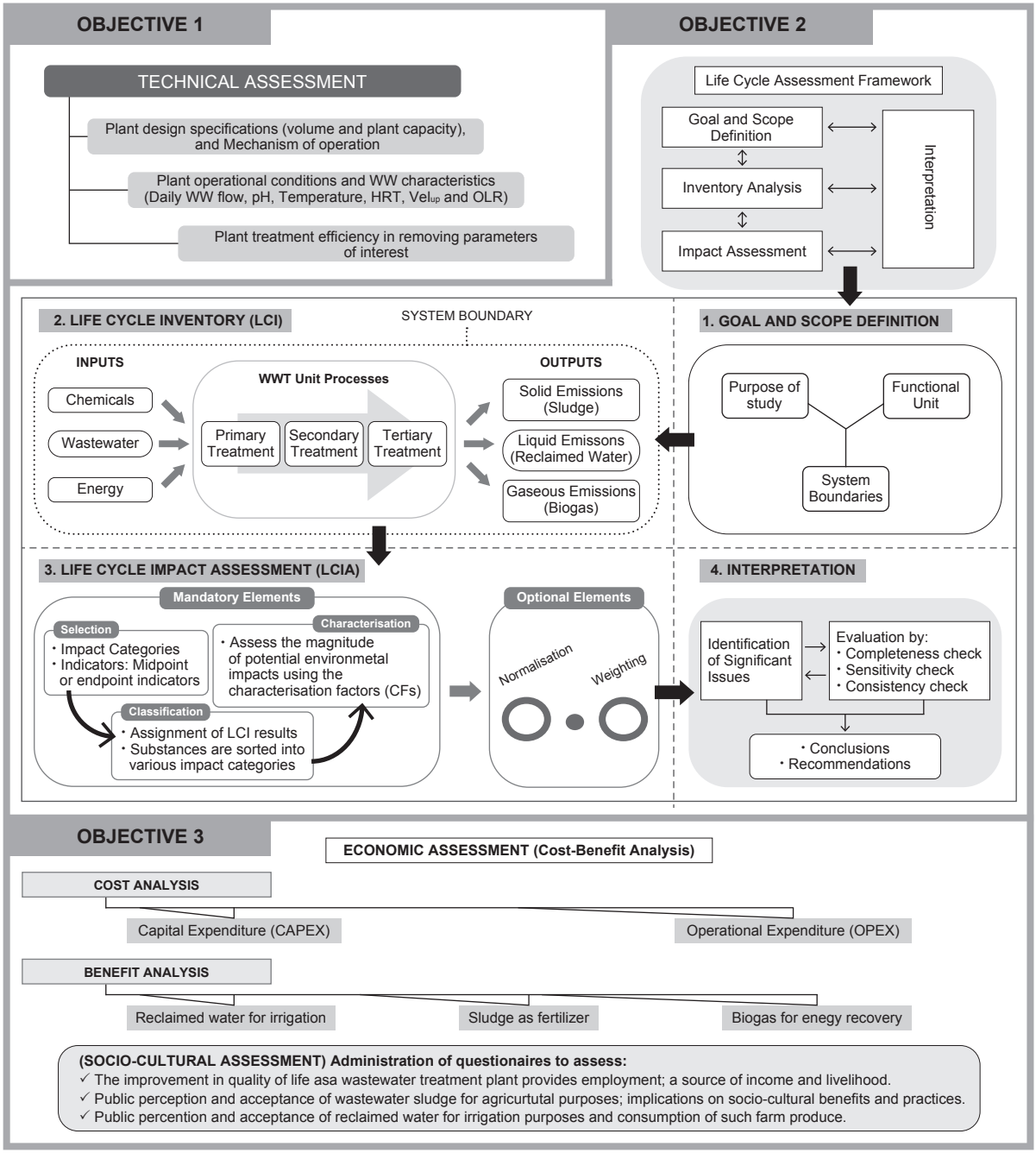

Figure 1. Research Methodology.

From the study, the following results will be expected to be achieved:

- Establishment of the performance and pollutant removal efficiency of the municipal-scale UASB reactor coupled with the post-treatment by Trickling Filter.
- Identification of environmental hot spots in the Mudor WWTP system operations with significant environmental burdens that requires consideration for improvement.
- Establishment of the socio-economic impacts of the Mudor WWTP.