Abstract

A commercial scale novel AD plant is examined in terms of feedstock economics, substrate availability and energy generation outputs. The study features a novel lagoon based multidigester anaerobic digestion plant at Sky Power (Pvt.) Ltd at Lahore, Pakistan. The plant has previously been used for biogas production from cow dung as an alternative to LPG. The data for MPW feeds tock generation is collected from different broiler and layer farms in district Lahore followed by pilot-plant testing for respective energy outputs. Then the data modeling tools; Life Cycle Assessment, financial indicators and Life Cycle Costing have been applied to check overall sustainability of the plant. Poultry-based organic waste total of 75488 tons/ month and 2516.74 tons/day is being generated from broiler-based poultry farms. Meanwhile, a total production of 1452.42 tons /month and 48.41tons/day of MPW generation is estimated for layer farms within the premises of Lahore. The monitoring of bioenergy yield from plant operations for eight months provided an average biogas production of 2890.27 m3/month and 96.34 m3/day respectively. Such bioenergy outputs over the study period are a proof to operational productivity of the pilot plant to sustainably process mixed poultry based feed stocks. The coupling of such bioenergy production with net present value of 1.19 million US$ provided the internal rate of return as 39%. A comprehensive list of environmental impact categories is selected for biogas production from poultry litter in comparison to CHP by natural gas and the recent electricity and heat at country level. The impact value for selected LCIA categories showed lowest results for anaerobic digestion of MPW. The impact score for MPW slurry provided significant values of 88, 42, 30.1 and 24 for MDP, TAP, HTPc and GWP respectively. The calculations for LCC Cost-heads indicated monetary inputs of 10.77, 0.11, 0.53 and 0.41 million $ for capital cost, material extraction, operation & maintenance and utility costs. The cumulative results for LCC provided life-time cost of 12.47 million $. The calculations of MPW feedstock availability within the Lahore premises, financial indicator scores and resultant full-time life cycle cost have portrayed it as a feasible option to obtain renewable energy. The inclusive policy-formation, implementation around agro-waste production and increased percentage of energy recovery can play a role to address power shortages and energy sector gap between supply and demand.