

## ABSTRACT

Biogas plant can efficiently utilize organic waste as substrate and recover energy from dairy waste. Present study focused on evaluation of energy and power generation potential from farm-based biogas reactor. A fixed dome biogas plant was designed and constructed with 6.25 m<sup>3</sup> volume having 0.618 Kg VS m<sup>3</sup> day<sup>-1</sup> organic loading rate. About 0.2 m<sup>3</sup> volume of substrate was added per day from 25 cows. An amount of 8.115m<sup>3</sup> per day biogas produced with 63% methane yield. The COD concentration was decreased at the end of anaerobic process and TS and VS increased which indicating the presence of food. The power generation potential was calculated as 348.75 KWh day<sup>-1</sup>, this amount supplies approximately 4 to 5 households. A questionnaire-based analysis was conducted to determine the adopters and non-adopter perception about this biogas production and utilization. Adopters and non-adopters have an average 2.3 and 1.5 acres farms which showed the land availability for biogas plant. According to 48% respondents, energy expenditure saved and 22% perceived that less workload is attributed to biogas utilization. 82% respondents reported that the social status was enhanced due to biogas adoption. When respondent was asked about plant performance, 88% respondents highlighted that plant is working efficiently while only 12% respondents have given negative response. The agricultural applicability of biogas digestate from cattle manure is based upon its effects on soil fertility and content of different elements in the grown crop. The aim of this study was to evaluate digestate characteristics obtained from cattle manure and its application on soil fertility and growth of crops (*Sorghum*, *Saccharum officinarum*, *Gossypium hirsutum* L., *Zea mays* L., *Triticum aestivum* L.) in field scale experimentation. Samples of liquid digestate, soil and crops were collected and analyzed according to standard methods. Afterwards, accumulation factor (AF), SAR, MAR and health risk index (HRI) were determined. The results showed that macro and micronutrients (N, P, K, Fe, Zn, Cu, Pb) in liquid digestate were below the permissible limits and also has irrigational value (SAR > 10) as compared to control. Available P and K contents were high in digestate irrigated soil and crop as compared to control. The correlation coefficient was found from soil to crops and showed that digestate irrigated crops has strong correlation with high r<sup>2</sup> values (0.90).

Accumulation factor was found highest in Gossypium hirsutum L. (1.48) in Fe. Health risk index value in adult was within the permissible limit (HRI >1) but the value in children was near to threshold level in Triticum aestivum L. crop as compared to control. Anaerobic digestion technology is progressively utilized to instantaneously handle solid and liquid fractions of organic waste to decrease the harmful effects of contaminated composites in the treatment process, and to also enhance the biogas production. This paper presented the economic and financial feasibility study of biogas plant by exploiting the dairy waste to evaluate the success of the investment. The underground fixed dome digester allows a continuous mixing and anaerobic digestion mechanism. This is the first pilot scale bioenergy plant in remote area of Bahawalpur Pakistan, which is providing biogas (243.45m<sup>3</sup>/month) and electricity (486.69 KWh/month). The capital cost of the plant was 2451 US\$ with the net present value (NPV)

US\$ and internal rate of return (IRR) is 17.96%. The procedures and strategies used in this feasibility study i.e. design description, production and cost analysis allow the replication of the taken analysis to ultimately initiate pilot-scale biogas production plant consuming organic waste in other situations with comparable circumstances. According to the results of the current study, it can be concluded that at both household and communal levels, this biogas plant at village scale is economically sound investments. This system can also guarantee that the household stands above the poverty edge. It may be concluded that the use of liquid digestate will proof as value addition in enhancement of soil fertility and crop growth. The potential of pilot-scale biogas systems in rural region is reinforced with the sufficient feedstock availability as well as people's awareness towards the biogas technology adoption and their significant advantages.