IRCUWU 2024

8th International Research Conference

24th & 25th July 2024

Sustainability Nexus: Multidisciplinary Connections for a Resilient Future

Uva Wellassa University of Sri Lanka

Paper ID: IRCUWU2024-494 *Poster*

Efficiency of duckweed species in treating farm-dairy effluent for sustainable water quality management

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Duckweeds are floating macrophytes that produce a lot of biomass, are adapted to withstand diverse conditions, and have high nutrient uptake efficiency. The present study evaluated the efficiency of two major duckweed species, *Spirodela polyrhiza* and *Lemna perpusilla*, for the phytoremediation of dairy farm wastewater generated by a livestock farm, Udaperadeniya, Sri Lanka. Dairy effluent was diluted at a 1:4 ratio with distilled water to achieve the initial concentration suitable for the study. An experiment done over fourteen days at two-day intervals determined the ability of these duckweed species to remediate nitrates and phosphates and maintained Dissolved Oxygen levels (DO), pH, and Electrical Conductivity (EC) of farm-dairy effluent at desired levels. Results indicated a significant reduction in phosphate and nitrate ($P<0.05$). After the dilution, the initial concentrations were 208.3±0.7 mg/l for nitrate and 54.2±0.63 mg/l for phosphate. *L. perpusilla* had an 84% reduction in nitrate and 36.7% in phosphates, whereas *S. polyrhiza* had 64.4% and 41.5% reductions, respectively. *L. perpusilla* recorded the highest reduction of EC from the initial 559.3±4.6, to 363.2±2.45 µS/cm, in farm effluent and that indicates a 35.06% reduction of EC from the initial concentration. *S. polyrhiza* reduced EC to 412.97±5.23 µS/cm from initial the concentration and which indicates 26.1% reduction of EC. Both plant species indicated the ability to maintain dissolved oxygen levels in water. The DO level increased up to 7.62 mg/l in water treatment with *S. polyrhiza* and it was only an increase up to 6.42 mg/l from 0.44 mg/l in *L. perpusilla* treatment. These levels for EC and DO follow Maximum Permissible Levels (MPLs) and Minimum Acceptable Levels (MALs) for irrigation and agriculture. The pH level of the treated water samples fluctuated in the range between 6.5-8.3 within the regulatory limits of 6.0-9.0 and there was a significant impact on treatment to maintain pH level in farm-dairy effluent. To achieve regulatory limits for nitrates and phosphates, an extended treatment period is required. Both duckweed species have the potential to be used as sustainable options for mitigating agricultural wastewater pollution by reducing pollutants to within regulatory limits and improving overall water quality.

Keywords: Dissolved oxygen; electrical conductivity; sedimentation; wastewater

Underlined is the presenting author.