ABSTRACT

Managing the wastewater produced by confined animal feeding and rearing operations is a major environmental challenge. Wastewater produced from the saltwater crocodile is uricogenic (high in ammonia estimated up to 90%) with high biochemical oxygen demand (100 mg/L), suspended solids (630 mg/L), phosphorus (6 mg/L) and nitrogen (30 mg/L). Discharge of untreated or partially treated wastewaters containing high concentrations of nitrogen into water bodies contribute to deterioration of water quality, human health problems and accelerate eutrophication. Total nitrogen and ammonia removal is achieved in general by expensive conventional wastewater treatment plants such as activated sludge and biological nutrient removal technologies which involve large capital investment and operating cost. One way of treating wastewater is the application of constructed wetlands, an easy to handle system that is considered to be relatively inexpensive. Thus constructed wetlands are gaining increased attention for treatment of non-point sources of water pollution especially from animal husbandry.

The focus of this study is to treat the wastewater generated from the rearing of saltwater crocodiles to achieve effluents that meets wildlife discharge standards ($\text{BOD}_5 < 2 \text{ mg/L}$). Hence, a performance study was carried out using vertical subsurface flow constructed wetland system, employing two macrophytes for the removal of organic and nutrient pollutants from the crocodile pond wastewater. The two different types of macrophytes (reed plants) employed in the present study were *Arundo donax* (bulrush) and
*Typha angustifolia* (cattail). The performance of the system was evaluated at different Organic Loading Rates (OLR), i.e., VSFCWs planted with *Arundo donax* was fed with OLR of 40, 80 and 120 g COD/m²/day, and *Typha angustifolia* was fed with OLR of 80 and 120 g COD/m²/day. The each OLR was studied up to 12 weeks and the physico-chemical characteristics (especially organic and nutrient contents) of the influent and effluent was monitored throughout the study period.

The results showed that the maximum removal efficiency of the system was achieved at OLR of 120 g COD/m²/day with *Typha angustifolia* (COD 78 ± 3 % and BOD 74 ± 2%) than *Arundo donax* (COD 77 ± 6% and BOD 75 ± 9%). The corresponding nutrient removal i.e., TKN and NH₄-N was 89 ± 3% and 85 ± 5% for *Typha angustifolia* and 86 ± 9% and 84 ± 12% for *Arundo donax* respectively. The nitrate and phosphate concentrations was higher in the effluent compared to that of influent of the VSFCWs planted with *Arundo donax* at different OLR studied, which indicated the absence of denitrification activity in the system. Whereas, the nitrate and phosphate concentrations were lesser in the effluent compared to that of influent of the VSFCWs planted with *Typha angustifolia* at two different OLRs studied. It implies that the system is capable of removing both organic and inorganic pollutants effectively from the wastewater. Thus VSFCWs planted with *Typha angustifolia* exhibited good quality effluent in terms of organic and nutrient removal. Further, biochemical and molecular studies showed that the soils from rhizosphere region of vertical flow constructed wetlands planted with *Typha angustifolia* were colonized predominantly by *Bacillus* and *Clostridium sps.*