Assessment of Seasonal Variations in the Treatment Efficiency of Constructed Wetlands

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Abstract

Unlike conventional treatment technologies, the performance of nature-based facilities were susceptible to seasonal changes and climatological variabilities. This study evaluated the effects of seasonal variables on the treatment performance of constructed wetlands (CWs). Two CWs treating runoff and discharge from agricultural and livestock areas were monitored to determine the efficiency of the systems in reducing particulates, organics, and nutrients in the influent. For all four seasons, the mean effluent suspended solids concentration in the agricultural CW (ACW) increased by -2% to -39%. The occurrence of algal blooms in the system during summer and fall seasons resulted to the greatest increase in the amount of suspended materials in the overlying water. unlike ACW, the livestock CW (LCW) performed efficiently throughout the year, with mean suspended solids removal amounting to 61% to 68%. Algal blooms were still present in LCW seasonally; however, the constant inflow in the system limited the proliferation of phytoplankton through continuous flushing. The total nitrogen (TN) and total phosphorus (TP) removal efficiencies in ACW were higher during the summer (21% to 25%) and fall (8% to 21%) seasons since phytoplankton utilize nitrogen and phosphorus during the early stages of phytoplankton blooms. In the case of LCW, the most efficient reduction in TN (24%) and TP (54%) concentrations were also noted in summer, which can be attributed to the favorable environmental conditions for microbial activities. The mean removal of organics in ACW was lowest during summer season (-52% to 35%), wherein the onset of algal decay triggered a relative increase in organic matter and stimulate bacterial growth. The removal of organics in LCW was highest (54 % to 55%) during the fall and winter seasons since low water temperatures may limit the persistence of various algal species. Variations in environmental conditions due to seasonal changes can greatly affect the performance of CW systems. This study effectively established the contributory factors affecting the feasibility of utilizing CW systems for treating agricultural and livestock discharges and runoff.

Keywords : Constructed wetland, Low impact development, Nature-based solutions

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