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Objective To make clear the contribution of vegetation to water purification performance in constructed wetlands, the annual removal performances of BOD, TKN, TN and TP in planted and unplanted wetland for the first three years of operation were compared.

Methods A five-stage vertical flow constructed wetland system treating milking parlor wastewater derived from 30 milking cows was used in this study. The total area of constructed wetland was 111m². Average influent concentration of BOD, total nitrogen (TN), total Kjeldahl nitrogen (TKN) and total phosphorus (TP) during three years of operation was 1490, 93, 93 and 19.7mg/l, respectively. Cumulative hydraulic loading during three years operation reached 2430m³, resulting in the average daily hydraulic loading of 2.15m³/d. The location of the constructed wetland has snowfall from December to March. The lowest daily average atmosphere temperature was below -6 °C and the maximum snow lay was over 60cm deep. Even under such cold-climate conditions, the treatment had never stopped without any problems except 58 days of pause when the earthquake on March 11, 2011 made operation of the wetland impossible.

Results Removal performance of BOD, TN, TKN and TP in planted and unplanted wetland was compared in Fig.1, Fig.2, Fig.3 and Fig.4, respectively. It was common for both planted and unplanted wetland in which the removal performance was improved in the 2nd year. There was no significant difference in BOD removal performances between planted and unplanted wetland. Difference in TN removal was, however, significant in the 2nd year, while that in the 3rd year was not. On the other hand, the effect of vegetation became significant in the 3rd year for TKN and TP removal. These differences in removal performance of TKN, TN and TP between planted and unplanted wetland were proved by statistical significant levels ($P < 0.05$). The results of this study confirmed that presence of vegetation leads to a positive effect on TKN, TN and TP removal in constructed wetland even without plant harvesting process.

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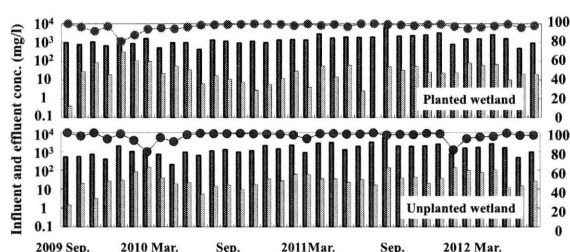


Fig.1 BOD removal performance for 3 years in planted and unplanted wetland.

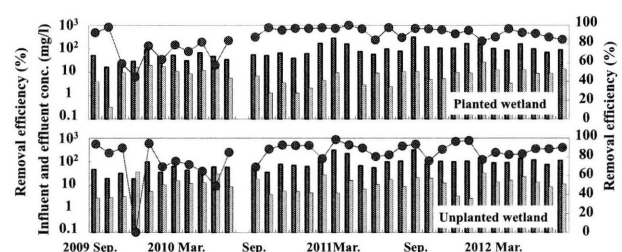


Fig.2 TN removal performance for 3 years in planted and unplanted wetland.

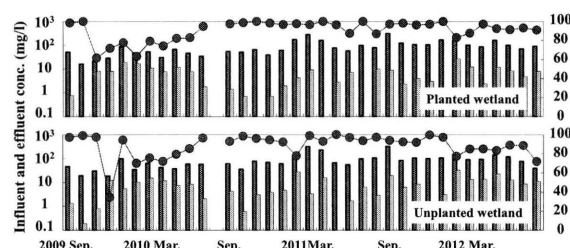


Fig.3 TKN removal performance for 3 years in planted and unplanted wetland.

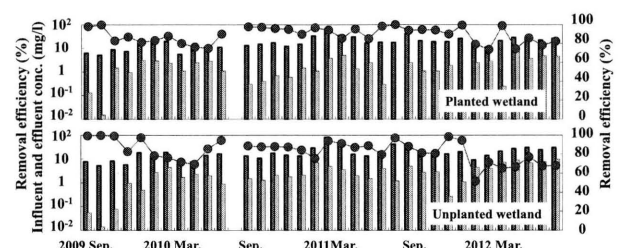


Fig.4 TP removal performance for 3 years in planted and unplanted wetland.