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Priyanka Khare
Govt. Holkar Science College, Indore, Madhya Pradesh, India

Dr. NK Jain
Govt. Holkar Science College, Indore, Madhya Pradesh, India

Correspondence
Priyanka Khare
Govt. Holkar Science College, Indore, Madhya Pradesh, India

Phytoremediation of waste water by constructed wetland system in government new law college, Indore

Priyanka Khare and Dr. NK Jain

Abstract
Phytoremediation is an emerging green technology which uses green plants for the treatment of pollutants or harmful materials present in the environment. The present study focuses on the investigation of phytoremediation potential of tall reed grass *Phragmites karka* in the constructed wetland system for wastewater in the college campus of Govt. New Law College. Reed bed systems are ecofriendly, self-contained, artificially engineered wetland systems. The efficiency of reed as an effective natural biological tool for waste water treatment was examined. Water samples were taken from the inlet and outlet tank and physicochemical parameters were analysed. The results confirm the phytoremediation potential of *Phragmites karka*, pH reduced from 8.122 to 7.26, Electrical conductivity decreased from 798.5 to 578.9 µ mho per cm, nitrate reduced from 7.727 to 1.231 mg/L, nitrite reduced from 0.832 to 0.194 mg/L, sulphate from 50.877 to 21.275 mg/L and phosphate from 0.198 to 0.627 mg/L. The results reveal that constructed wetland system is efficient for treatment of wastewater.

Keywords: constructed wetland system, phytoremediation, wastewater treatment, *Phragmites karka*

Introduction
Water is one of the most essential requirements for the survival of living beings. Though 70% of the earth is covered with water, 96% of it is saline water in oceans which is not drinkable. The freshwater sources such as rain moving into streams, rivers, lakes and groundwater, provide water to all the living beings. Due to increased urbanization and industrialization these freshwater sources are highly polluted and eutrophicated as domestic and municipal wastewater is added directly into it .wastewater is any water that has been used from domestic, commercial or agricultural activities. Sewage is also a wastewater originating from toilets and bathrooms, laundry, kitchen sinks, cleaners and similar dirty water, which is produced in household and public places. There is a great need for smart wastewater management to minimize pollution, improve public health and to reduce groundwater contamination. First and foremost thing is to reduce misuse of water and generation of wastewater and second thing is to capture wastewater immediately from its source and direct it for treatment. This part involves investment but it will reduce the harmful properties of wastewater before discharging it into natural resources of water or rivers. Constructed Wetland System or reed bed systems can be proved very useful in this regard. One very important factor in the success of any constructed wetland system is selection of right plant. The plant should be able to tolerate and survive in such unfavourable conditions and it should have profuse root system. Wetland plants play a vital role in the removal and retention of nutrients and help in preventing the eutrophication of wetlands. A range of wetland plants has shown their ability to assist in the breakdown of wastewater. The Common Reed *Phragmites karka* is a good example of marshy species that can effectively uptake nutrients.

Materials and Methods
Experiment site and sample collection: Site of the experiment was Government New Law College Indore. In the college campus a constructed reed bed system is constructed, the plant used for it is *Phragmites karka* tall reed.

Fig 1: Sample collection site Govt. New Law College, Indore.

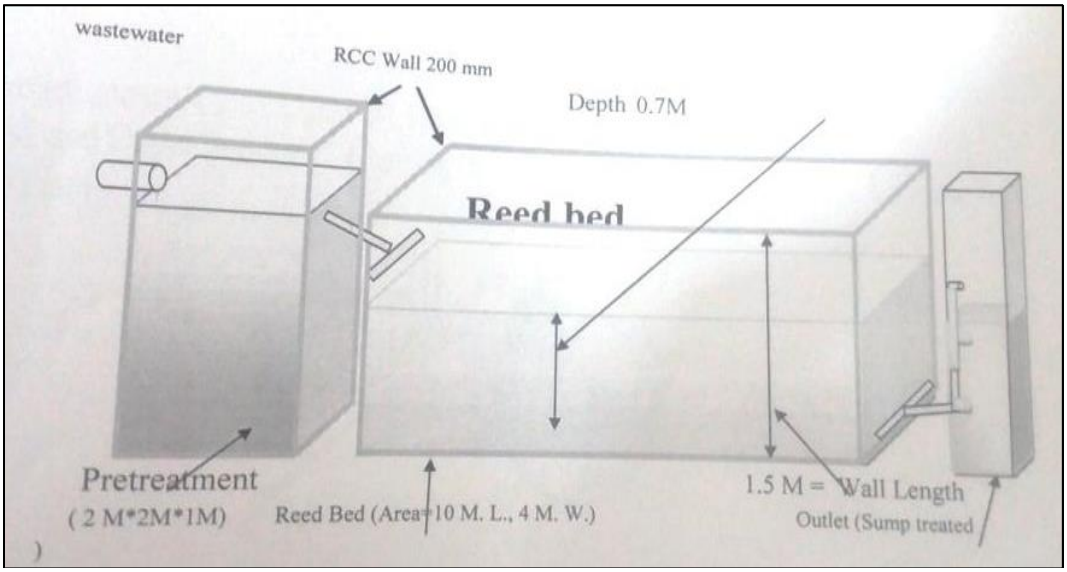

Fig 2: Outline diagram of constructed wetland system

Sampling and Analysis: Water samples were collected in clean plastic bottles from the site in the month of July and August. Immediately after collection the samples were brought to the laboratory for analysis of physicochemical parameters. pH, electrical conductivity, nitrate, nitrite, sulphate and phosphate were analysed by standard methods described in APHA, AWWA, FSIWA (2005) [1] in the laboratory of pollution control board, INDORE.

Setup Design: Setup was designed by Dr. S. K. Billore. The reedbed has 4m width, 10m length and 1.5 m depth. Total area of the reedbed is about 40 m^2. The Horizontal Gravel filter is made of reed plants and peanut size river gravel. The slope of bottom is about 1%. The flow direction is mainly horizontal. The filter is planted with *Phragmites karka* and mechanisms are biological conversion and physical filtration. Setup has three components pretreatment, main treatment body and outlet.

Pretreatment: Wastewater is pretreated in a rectangular chamber of 1.0 m depth, 2.0 m length and 2 m width. One third of the tank is filled with smooth round bolders to settle large sediments, debris, large particles etc. of the incoming raw sewage in order to avoid the clogging of gravels in the main treatment body and maintenance of proper hydraulic conductivity.

Main Treatment Body: It has 40 m^2 area of rectangular shape of 1.5 m depth and filled with river gravel 0.7 m for reed grass plantation. PVC pipe network is installed above the surface of the gravel bed and downward movement of the sewage is monitored. The main treatment body is waterproof in the bottom and laterally to control the wastewater movement which is untreated. Slope of 1% is given to easy flow of the water in gradient gravity.

Outlet: The treated water is collected in a rectangular outlet tank and can be easily pumped out in the condition of overflow and used for gardening purposes.

Results: The result represented below shows that pH was reduced significantly from 8.122 to 7.26. Electrical conductivity reduced from 798.5 to 578.9 µ mho/cm. Nitrate and Nitrite reduced from 7.727 and 0.832 to 1.1231 and 0.194

mg/l respectively. Sulphate reduced from 50.877 to 21.275 mg/l and phosphate from 0.998 to 0.627 mg/l. The range of reduction of chemicals present in the sample was 15% to 90% approximately.

Discussion

The results represented that pH was reduced significantly from 8.122 to 7.26. The reduction in pH could be attributed to the fact that nitrogen compounds are highly reduced. This is because these compounds encourage biological reaction that produce hydrogen ion hence pH drops. Electrical conductivity of the water sample decreased from 798.5 to 578.9 µ mho/cm. The electrical conductivity mostly depends on the concentration of various soluble salts and with the decrease in their concentration EC also decreases. Nitrate and nitrite concentration in the wastewater estimated 7.727 and 1.231 mg/L before treatment and 1.231 and 0.194 mg/L after treatment. Nitrates are commonly present in various forms in the wastewater and are important for plant growth. Removal of nitrogen conventionally takes place through several processes like plant uptake, ion exchange, ammonia volatilization, nitrification and denitrification (Gersberg *et al*., 1983; Vipat *et al*., 2008) [6] indicated the pathway of N-removal through the plant uptake as insignificant while Breen (1990) considered such plant uptake as a dominant mechanism for nitrogen removal. Phosphate is a main nutrient, significantly needed for the functioning of terrestrial as well as aquatic ecosystems. It is required for better plant growth and is a limiting key factor for vegetative productivity. Although, the introduction of trace amount of phosphorus into receiving waters can have negative effects on the structure and productivity of the aquatic ecosystem in the form of eutrophication (Kadlec and Wallace, 2008) [7]. The removal and recovery of phosphate from wastewaters is important to reduce eutrophication problem in the receiving water bodies. Sulphate concentration reduced from 50.877 to 21.275 mg/L. Sulphate in very high concentration becomes the limiting factor for growth of plants and hence its removal is essential during phytoremediation so that the treated wastewater can be reused for agriculture purpose.

Conclusion: The Root Zone Technology using *Phragmites karka* is suitable for the treatment of wastewater and is quite efficient for the removal of nitrate, nitrite, phosphate and sulphate from the polluted water and reduction of pH. The system acts on physical-chemical and biological processes occurring in the natural systems with incoming wastewater in Reedbed. It is very low maintenance, ecofriendly technology. Reed grass provides appearance of flower garden, minimizes odor and mosquito problem. No electricity, no additional chemicals or running cost is required and no noise pollution by the system. The treated water is used for the gardening and irrigation purpose in the campus to maintain greenery.

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Table 1: Change in characteristics of effluent before and after treatment

S. No.	parameters	Inlet	outlet	% reduction
1	pH	8.122	7.26	89.39%
2	Electrical conductivity (µ mho per cm)	798.5	578.9	72%
3	Nitrate (mg/l)	7.727	1.231	15.92%
4	Nitrite (mg/l)	0.832	0.194	23.32%
5	Sulfate (mg/l)	50.877	21.275	41.82%
6	Phosphate (mg/l)	0.998	0.627	62.83%

Fig 3: % reduction in pH before and after treatment

Fig 4: % reduction in electrical conductivity after treatment

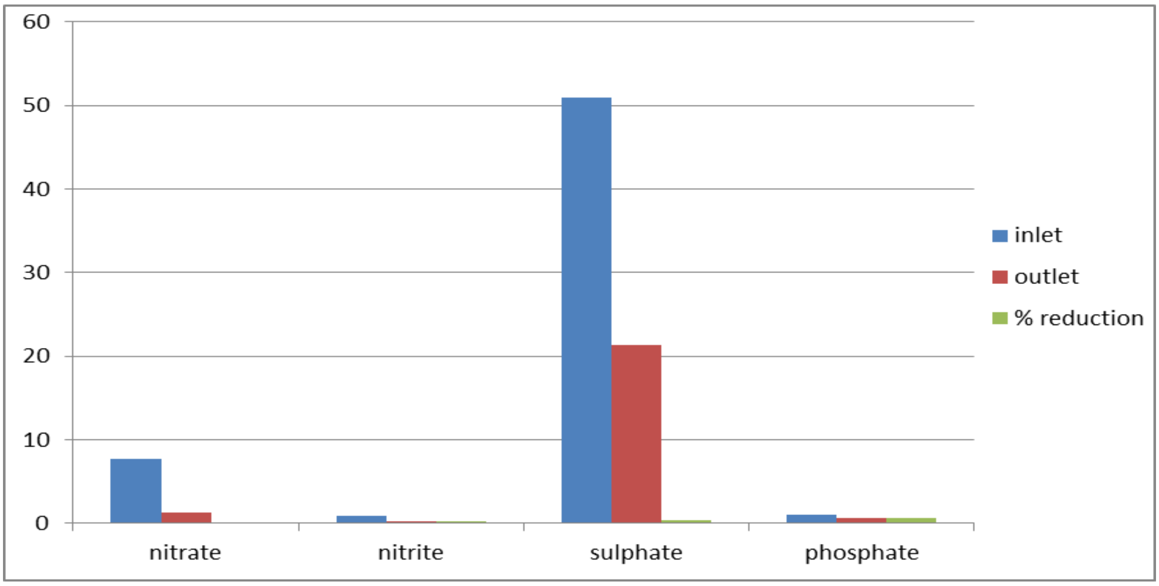

Fig 5: % reduction in concentration of nitrate, nitrite, sulphate and phosphate after treatment

References

1. APHA, AWWA, FSIWA. Standard Methods for the Examination of Water and Wastewater. 21st Edn., American Public Health Association, Washington, DC, 2005.
2. Chavan BL, Sonawane NS, Mule MB, Dhulap VP, Ustad IR, Sonje NP. Response of *Phragmites karka* to nitrogen and phosphorous in National conference on Recent Trends in Bio resources and Bio-Science Murum, Osmanabad. (M.H.) India, 2009.
3. Billore SK, Singh N, Sharma JK, Dass P, Nelson RM. Horizontal subsurface flow gravel bed constructed wetland with *Phargmites karka* in central India. Wat. Sci. Tech. 1999; 40(3):163-171.
4. Dar SH, Kumawat DM., Singh N, Wani KA. Sewage treatment potential of water hyacinth (*Eichornia crassipes*). Research Journal of Environmental Sciences. 2011; 5(4):377-385.
5. Hanieh F, Mokshapathy S. Determination of pH, dissoved oxygen, sulphate, phosphate and total hardness as of some physicochemical parameters of water pollution in Kukkarahalli lake in Mysore city –India.
6. Gersberg RM, Elkins BV, Goldman CR. Nitrogen removal in artificial wetland. Wat. Res. 1983; 17(19)1009-1014.
7. Kadlec RH, Wallace S. Treatment Wetlands, CRC Press, Lewis Publishers., Florida, USA, 2008.
8. Saxena S. Effects of *Phragmites karka* plant in constructed wetland system. International Journal of Research Granthalayah [Social issues and environmental problems], 2015, 3(9).