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Reed- *Phragmitis Karka* based constructed wetland for the treatment of domestic wastewater in Ujjain city of central India

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Abstract- Constructed wetland with horizontal subsurface flow have been used wastewater treatment in India more than 35 years. Water scarcity is likely to become more geometrical proposition in the near future due to rapid population growth, increasing per capita water consumption and geographical disparities or inequalities between centers of population growth and availability of water CWS after an effective mean of integrating wastewater treatment and resources enhancement, often at competitive cost in comparison to conventional wastewater treatments, with additional benefit of green urban landscaping and wildlife habitat. In present research work various pollutants have been removed from domestic wastewater like TS, TSS, TDS, DO, TKN, NH_4^+-N, COD and BOD by 78%, 80%, 76.48%, 135.41%, 69.53%, 69%, 78.64% and 69.54%. The constructed wetland system is located in upstream of wastewater nullah on MR-II road site in Mahankal Commercial Area at Ujjain city with (23°12'N latitude, 75°42'E longitude) mean sea level 515.45 m in the central part of India. *Phragmites Karka* the tropical emergent grass over 60 cm depth peanut size gravel bed planted. The system specially designed for domestic wastewater treatment. The treatment system covered effective surface area of 900 m^2 (length 100m x width 9m), retention capacity $75m^{3/}$day. *Phragmites Karka* the indigenous tropical emergent grass cosmopolitan species found in north America, Mexico, Great britain, Euresia, India, Africa, Newzealand and Australia. In India species is a distributed widely in the north and indo Gangetic plain of humid area. *Phragmites Karka* (Reed Grass) play important role in removing pollutant when strategically planted in eco engineered system.

Keywords : *Phragmites Karka, Gravel bed, TS, TKN, Wastewater and Filtration.*

I. INTRODUCTION

The water scarcity is increasing day by day due to lots of reasons. This may be social, economic, geological, precipitation deficiency; more depend on ground water for increasing land area of Agricultural and Aquaculture.

The domestic wastewater in Ujjain city is characterized by high concentration of total solid, biological oxygen demand and total nitrogen (Particularly the $NH_{4-}^{+}N$) [1, 2, 3]. At Ujjain the nutrient rich sewage, agricultural runoff and storm water sewerage directly merges into the river Kshipra passing through wastewater channels having horizontal subsurface constructed wetland at MR-11, Road side in Mahankal Commercial Area, Ujjain of Central India [4]. Constructed wetland are essentially inspired by natural processes in naturally occurring wetland use of constructed wetlands (CWS) is now recognized as an accepted low cast biotechnology, especially beneficial to small town that cannot afford expensive conventional systems [5, 1]. The CW system can also promote subsurface flow through a shallow parable substratum in which aquatic plants are established (subsurface flow, SF) [6].

The rest of the paper is organized as follows. Secton I- Introduction, Secton II- Related work, Secton III- Methodology, Section IV- Result and Discussion and Section V- Conclusion and Future scope.

II. RELATED WORK

There are currently thousands of constructed and natural wetland world-wide receiving and treating a variety of municipal, industrial and urban runoff wastewater [7]. subsurface flow wetland have received a measure of popularity in Northern Europe and the USA. The attraction of subsurface systems when compared to free water surface and overland flow systems, has been in part the perception of decreased risk of nuisance from and odour and great efficiency in terms of land usage [8]. Old treatment systems are engineered systems designed and constructed priority for wastewater treatment; they mimic natural processes within a more controlled environment [9].

In Central India the field scale application of CW for wastewater treatment started around the late 1990s [10]. The very first full scale pilot system of Central India (Ujjain District Headquarters) was established in 1997 for treating domestic wastewater emanating from the staff quarter of Vikram University campus. The installed treatment capacity was 18000 day serving a community of 50 households. Later SSPCWS of varying designs were installed at Ujjain (1998 and 2007), Barwaha (1989) and Bhopal (2001), Dahod and Rajpora for treating domestic wastewater, industrial wastewater and a mix of domestic and storm wastewater respectively. The SSFCW of Ravindra Nagar, Ujjain (1998), and Ekant Park Bhopal (2001) were receiving the mix of domestic and wastewater and storm water.

III. METHODOLOGY: THE STUDY SITE AND SAMPLING

The presents study site is located in a wastewater channels (Nullah) of which receive a sizable amount of wastewater emanating from the different locality of Ujjain city supporting a population of around 1 lakh. In a wastewater channels constructed wetland has been installed size (100 m x 9 m = 900 m^2). It supports dense vegetation of *Phragmites Karka* (Reed given) Over a peanut size gravel bed. The system is specially designed for the domestic wastewater treatment in upstream of wastewater nullah on MR-11, road in 2007. The site in Mahankal Commercial Area at Ujjain city with (23°12'N latitude, 75°42'E longitude, mean sea level 515.45 m). The Ujjain city is located in the central part of India in the Madhya Pradesh state. The climate of the area is typically monsoon receiving 1032 mm. rains annual, confined exclusive during July to September, the rainy seasons. The Annual maximum and mean temperatures were 31.4 and 15.5°C respectively. The gravel bed system already existed in the wastewater channel was selected for the present study and been coded as site no. 1.

The treatments performance of constructed wetland evaluated by comparing the water quality characteristics (Physical, Chemical and Biological contact) at two sampling point. The sampling point 1 (SP I) located 100 m. apart from gravel bed constructed wetland in the upstreams receiving the input from different locality areas and sampling point 2 (SP2) lying below the end of gravel bed constructed wetlands. Grab sample were brought from June 2008 to May 2010 in plastic containing canes except during the rainy season which causes and swift flow in river water (July to September). Monthly sample of June 2008 to May 2010 were collected from upstream of constructed wetland at inlet (SP-1) and outlet (SP-2) for the two year study period. These collected samples were analysed for TS, TSS, TDS, pH, DO, TKN, NH_4-+N, COD and BOD. Parameter applying standard method in order to estimate the performance of constructed wetland system in reduction of the mentioned water quality parameters.

IV. RESULTS AND DISCUSSION

All water quality characteristics of physical, chemical and biological were analyzed for inlets (Untreated-domestic wastewater) and outlets (Treated domestic wastewater) of constructed wetland points. The water sample from this system were analysed monthly and presented as average values of the total values recorded in the consecutive two years i.e. from June 2008 to May 2010. The results one analysed and data are expressed by table and figure. (Table No. 1). The results have been also statistical analysed which shown as standard deviation (Sd) and 't' values.

In treated water controls paints the dissolved oxgyen got increased. It was notes that the DO was increased to 135% in treated value of constructed wetland systems. (Table no. 1 and Figure 1). Wetland plant species typically display parenchyma (tissue air space) development in their tissues. Which facilitates oxygen diffusion to the roots and may also reduce the amount of living, respiring tissue in roots relative to root volume [11].

Do increase in wastewater, reflects to purity. It occurred due to removal of various organic matter and releasing oxygen in root/rhizomes in the soil by the existing plants species [12, 13, 10, 14]

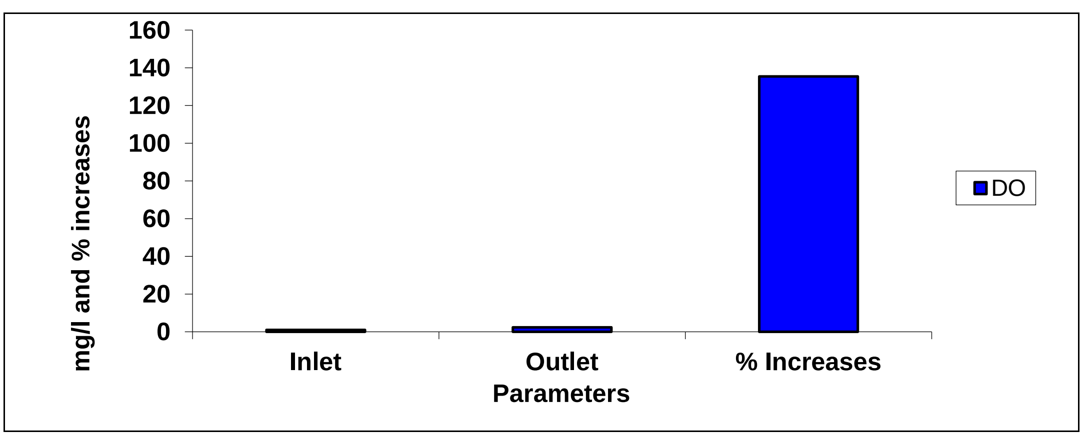

Figure 1. Increases DO by constructed wetland during June 2008 to May 2010.

The constructed wetland caused following reduction in the concentration of solid at gravel bolder site - TS 78%, TSS 80%, TDS 76%. The results were also statistically tested by using student 't' test as 5% and 10% level. These removals are the end of results of complicated set of internal processes including the production of transportable solids by wetland biota, low water velocity coupled with the presence of vegetation or gravel substrate (sediments) which promote fall out and filtration of different solid materials. This transfer of SS from water to sediment bed has important results both for quality of water and properties and function of the wetland system as also expressed earlier by [7].The removal zone by gravity sedimentation in the quiescent water beneath. Plants seem to constitute a substratum for the fixation of decomposing microorganism that act as filter for the dissolve organic matter. Thus the present work is in accordance with earlier findings [15, 8]. The average reduction show in table 1 and figure 2.

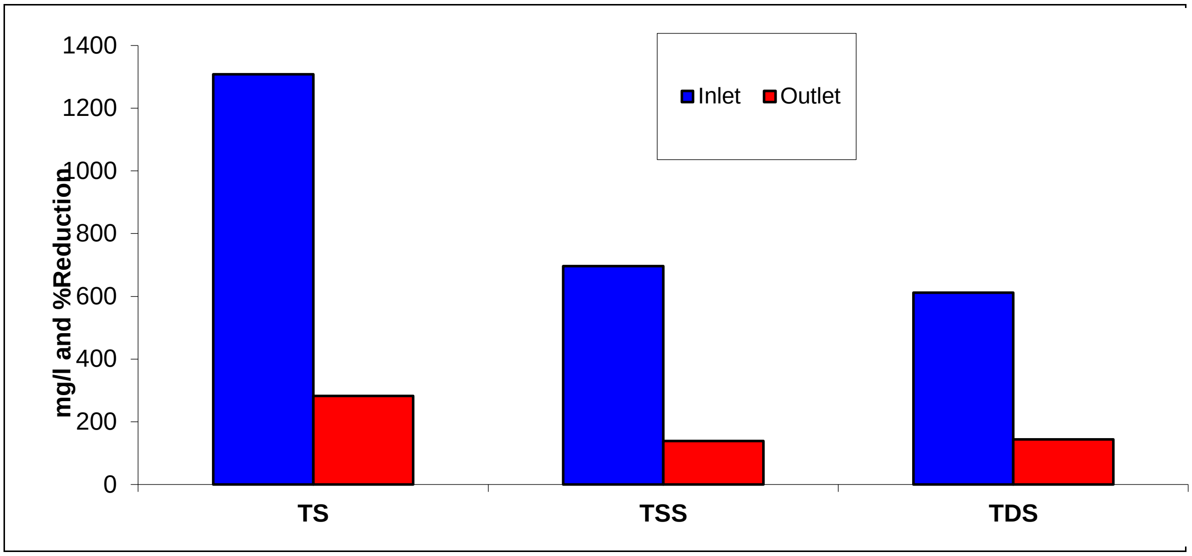

Figure 2. Removal of TS ,TSS and TDS by constructed wetland during June 2008 to May 2010.

The dominant removal mechanism for N has been reported as (i) Plants adsorption, uptakes and retention, (ii) ammonia volatilization, (iii) Nitrification (due to preserve of aerobic pocket) and (iv) Ammonification [7, 16, 17, 18]. Although, in situ nitrificaiton in the rhizosphere of aerenchyma tons plants has indirectly demonstrated a stimulation of the nitrification process by oxygen release [12, 19]. Nitrogen removal efficiency of constructed wetland presented in Table 1 and Figure 3). In constructed wetland the average % reduction of NH_4^+-N and TKN are 63% and 69.5%.

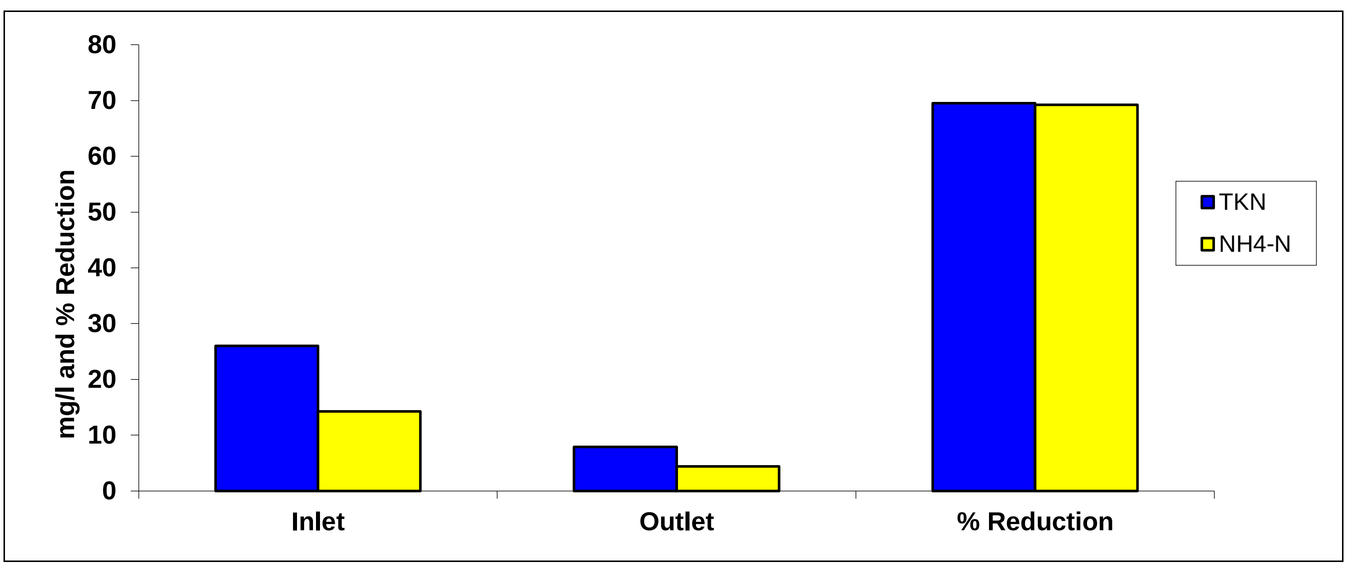

Figure 3. Average removal of Nitrogen by constructed wetland during June 2008 to May 2010.

Considering COD, significantly lowered/reduced amount in outlet treated water as compared to inlet wastewater of this CW system was recorded. The removal of COD by these wetland system was primarily a function of the mount component. The processes involved are probably filtration, sedimentation, oxidation, adsorption and biological degradation. The significant man removal efficiency of COD in constructed wetland observed was 78.64%. It is due to decomposition of organic matter and developing aerobic condition in wetland beds [10, 14]. Plants and Microbilogical rhizosphere are supposed to be the major players in the reduction of BOD. Plants enhance BOD removal by transporting O_2 from the atmosphere into the root zone, there by creating an oxidized rhizosphere beds [20]. Treatment of polluted water by CW plants is accomplished because of the ability of wetland plants to bleed or leak oxygen from its root system into the surrounding water thereby supporting bacteria calories which ingest and feed upon the nutrient and solid in the water stream. Annually BOD reduction in experiment Reed based wetland bed in 69.54% A. Colloidal and dissolved from continues to be removed as wastewater comes in contact with attached microbial growth in the system [8]. The average percentage reduction by COD and BOD show in table 1 and figure 4.

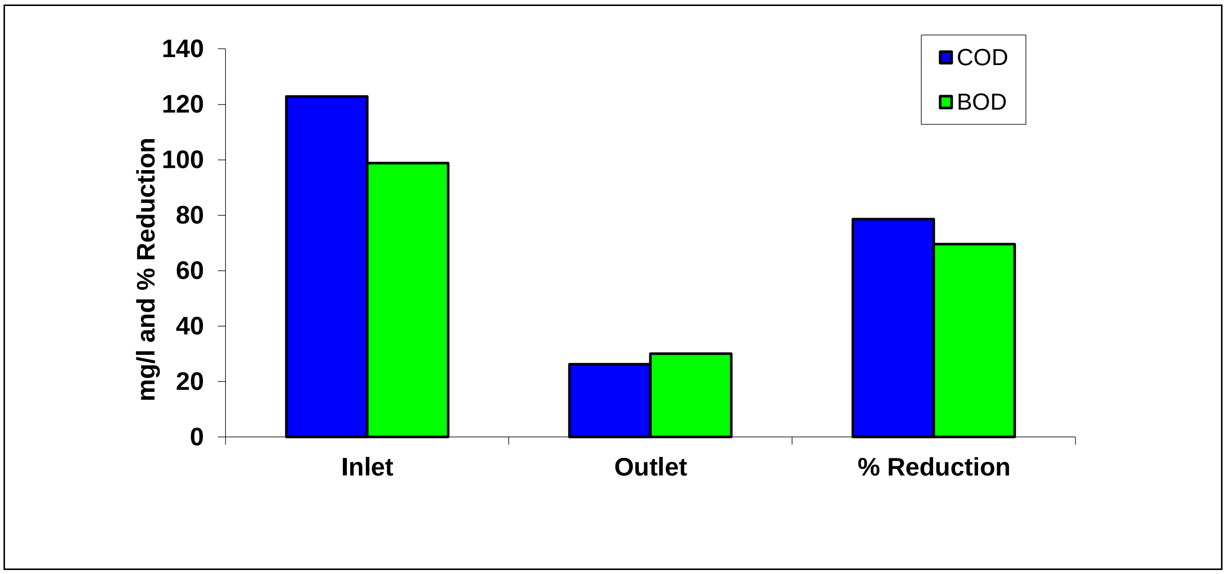

Figure 4. Average removal of COD and BOD by constructed wetland during June 2008 to May 2010.

Table-1 The average value of concentration reduction in Mahankal Commercial area MR-11 by constructed gravel bed wetland systems. (June 2008 to May 2010).

	PARAMETERS							
	TS (mg/l)	TSS (mg/l)	TDS (mg/l)	DO (mg/l)	TKN (mg/l)	NH_4-N (mg/l)	COD (mg/l)	BOD (mg/l)
INLET**-** Untreated wastewater (Sd-value)	1308.44 (40.53)	696.38 (56.62)	612.05 (38.49)	0.96 (0.37)	26 (10.94)	14.27 (3.28)	122.83 (16.81)	98.77 (25.93)
OUTLET-Treated wastewater (Sd-value)	282.55 (18.61)	138.16 (20.29)	143.94 (26.25)	2.26 (1.18)	7.92 (3.62)	4.39 (1.28)	26.23 (5.67)	30.08 (6.13)
% REDUCTION	78.40	80.16	76.48	135.41	69.53	69.23	78.64	69.54

V. CONCLUSION AND FUTURE SCOPE:

Horizontal subsurface technology are low cost, nature based ecotechnology, seems to be long term and sustainable option for overall treatment of domestic wastewater. The CWs are Reed based eco- engineering technology used for treatment of Municipal wastewater with respect to reduction in solids, BOD, TKN, NH_4^+-N, COD and increase DO in the sewage. Contaminated water the constructed wetland that offer great potential for the restoration and management of the stagnant and slowly flowing water bodies. This CW system receiving attention in several countries for water purification, land scape development and birds habitat. This technology more accepted in developing countries like India has been limited by the lack of scientific base on the concept, design criteria and function suitable installation process, monitoring and maintenance.

Cws are very dynamic and diverse system were a lot of complex process on running and influencing each other. This shows that constructed wetlands are close to natural system and can remove and transform nutrient and pathogen on an efficient performance level

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