Field Scale Constructed Wetlands (CWs)

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Introduction and Background

Fresh water scarcity and wastewater a valuable resource

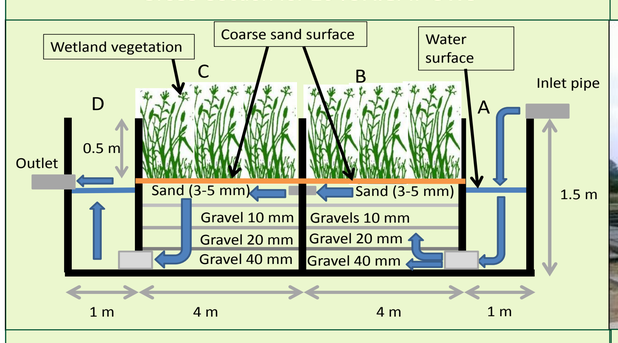
- Severe limitation of fresh water in India-projected to be water stressed by year 2020.
- Wastewater generated in urban cities and rural villages of India is a perennial water source.
- However usage of untreated wastewater can pose health hazards to humans and animals.
- There is greater need for a effective, low cost and minimal maintenance system for wastewater treatment.
- Constructed wetlands (CWs) are human made engineered systems consisting of wetland plant species, microbial populations and coarse sand media which remove excessive nutrients by physical, chemical and biological process operating simultaneously.

Objectives

- Quantify the wastewater treatment efficiency (inlet and outlet concentrations, nutrient accumulations in coarse sand and wetland plant species) of 10 field scale CWs located in International Crops Research Institute for Semi-Arid Tropics (ICRISAT) campus receiving domestic wastewater from a nearby urban colony.
- Quantify the nitrogen, phosphorus and sulphur uptake of Billygoat-weed (*Ageratum conyzoides)* in ICRISAT CW.
- Determine the plant species having maximum nitrogen, phosphorus and sulphur removals.

ICRISAT Constructed Wetland (CW) and Introduction of Billygoat-weed *(Ageratum conyzoides)* in CW

Cross-section for 10 ICRISAT CWs



Field view of 10 ICRISAT CWs

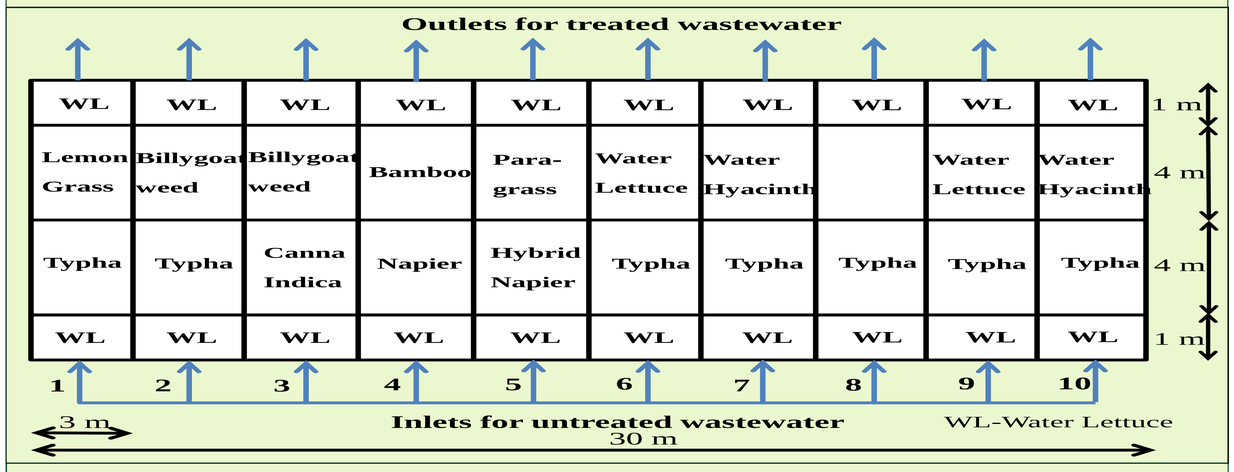
Roots of Billygoat-weed *(Ageratum conyzoides)*

Billygoat-weed *(Ageratum conyzoides)* in ICRISAT CW

Materials and methods

- Total treatment capacity of 10 CWs is 50 m^3/day and wastewater inflow rate in each CW is 2 L/min having hydraulic retention time (HRT) of 5 days.
- Five CWs (1-5) having subsurface flow regime while remaining 5 CWs (6-10) having free water surface flow.
- Untreated wastewater is collected in chamber A and treated wastewater in chamber D. Both chambers have *Pistia stratiotes* (Water lettuce).
- Treatment chambers B and C in each CW have 3 gravel types, coarse sand and single wetland plant.
- Nine months of field scale data (July 2014-April 2015) is reported in this poster.
- Wastewater inlet and outlet monitoring-every week each month.
- Nutrient accumulation in coarse sand and wetlands plant-twice each month.

Lay-out of the ICRISAT constructed wetland (CW)



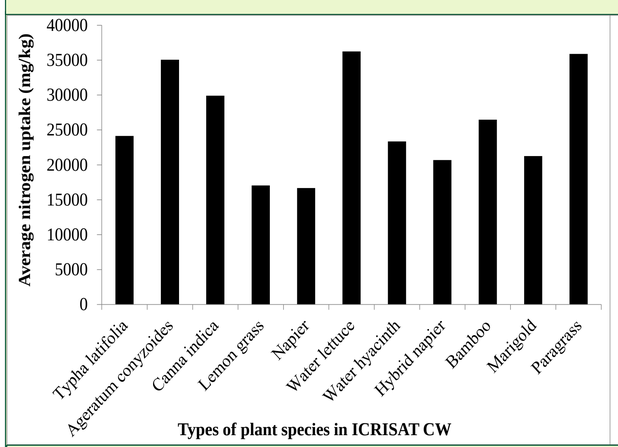
Inlet (untreated) and outlet (treated) wastewater characteristics of ICRISAT CW (July 2014-April 2015)

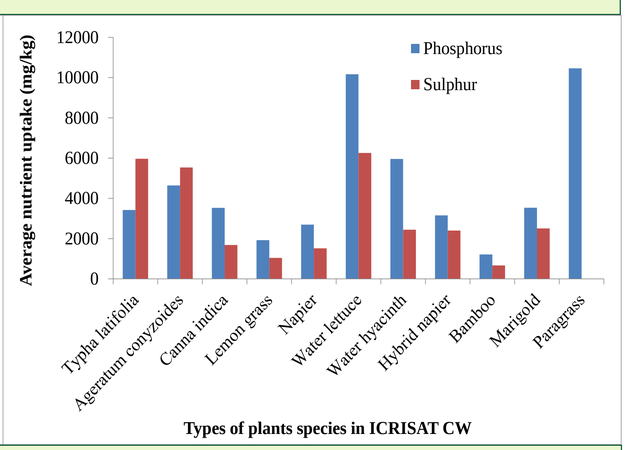
Parameters	Average Inlet	CW-1 outlet	CW-2 Outlet	CW-3 Outlet	CW-4 Outlet	CW-5 Outlet	CW-6 Outlet	CW-7 Outlet	CW-8 Outlet	CW-9 Outlet	CW-10 Outlet
NH_4-N (mg/L)	62	20	28	23	30	22	42	49	41	47	39
NO_3-N (mg/L)	2.65	5	1.88	1.71	1.95	2.14	1.41	1.45	1.41	1.72	1.93
Phosphate (mg/L)	15	9	5.7	4.5	8.24	4.45	3.52	5.17	4.92	3.89	3.93
COD (mg/L)	176	96	96	64	128	64	64	96	64	96	96

Results (July 2014-April 2015).

- Optimum treatment efficiency (%) of CW for the parameters listed below:
  - NH_4-N removal-CW-1(68%), CW-5 (65%) and CW-3 (63%).
  - NO_3-N removal-CW-6 (48 %), CW-8 (48 %) and CW-7 (45%).
  - Phosphate removal-CW-6 (76.5%), CW-9 (74%), CW-5 (70.3%) and CW-3 (70%).
- Wetland plants having optimum removals for parameters listed below:
  - Nitrogen-Water lettuce, Paragrass, and Billygoat-weed (*Ageratum conyzoides)*.
  - Phosphorus- Paragrass, Water lettuce, and Water hyacinth.
  - Sulphur-Water lettuce, *Typha latifolia* and Billygoat-weed (*Ageratum conyzoides)*.
- Based on the nitrogen and phosphorus uptake, the Billygoat-weed (*Ageratum conyzoides)* have shown a promising growth potential in CWs.

Average above-ground nitrogen, phosphorus and sulphur uptake of wetland plants (July 2014-April 2015)





Average total nutrient accumulation in coarse sand (July 2014-April 2015)

Average nutrient accumulation in coarse sand media	Subsurface treatments (1-5)	Free water surface (FWS) (6-10)
Total nitrogen (mg/kg)	242	229
Total phosphate (mg/kg)	138	144
Total sulphur (mg/kg)	7.4	33
Available phosphate (mg/kg)	9.0	9.1