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ASSESSING THE PERFORMANCE OF FREE WATER SURFACE **CONSTRUCTED WETLANDS** IN TREATING DOMESTIC WASTEWATER: A POTENTIAL ALTERNATIVE FOR IRRIGATION

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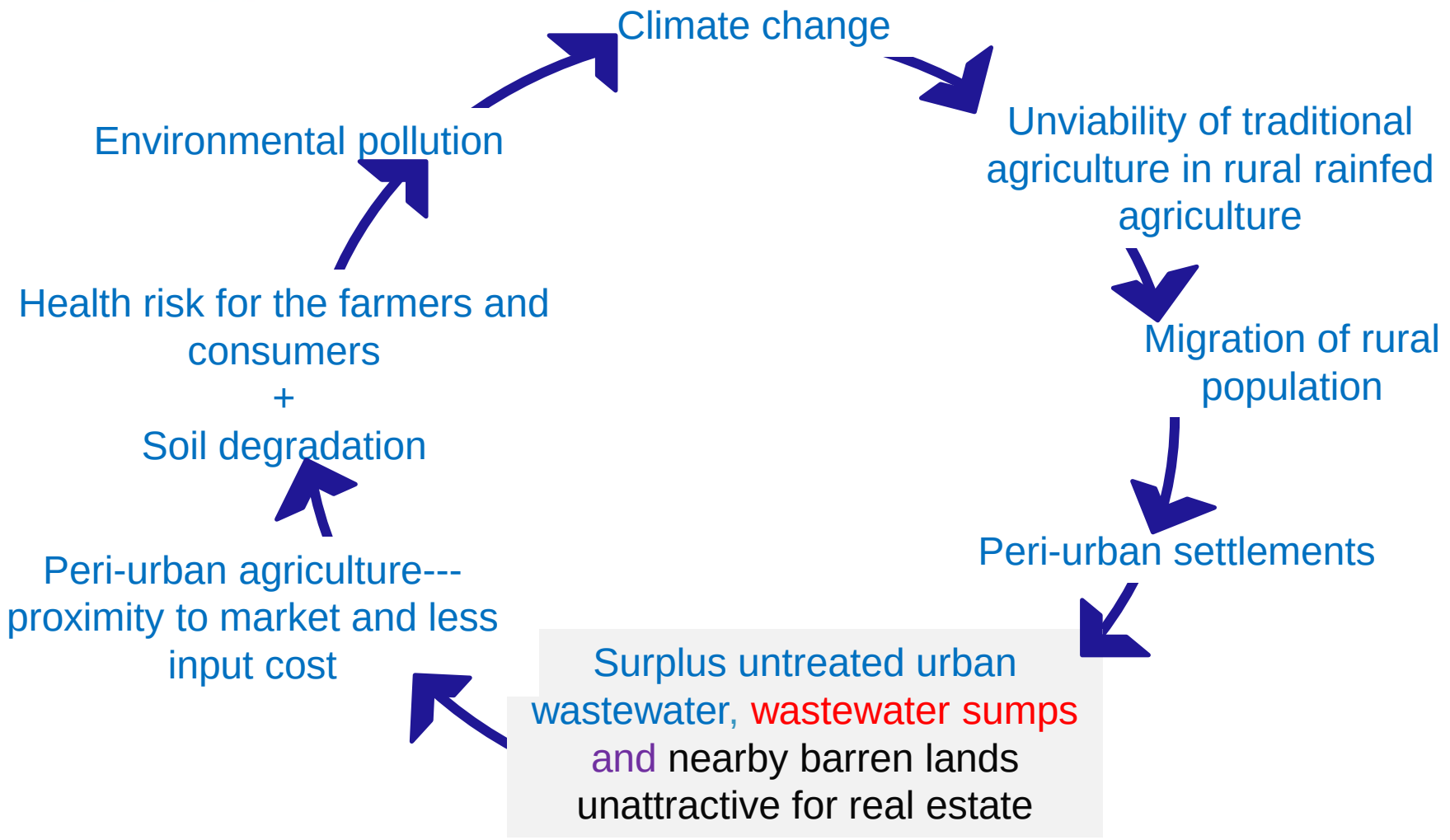
ICRISAT
Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

WHY?


Climate change
Unviability of traditional agriculture in rural rainfed agriculture
Migration of rural population
Peri-urban settlements
Surplus untreated urban wastewater, wastewater sumps and nearby barren lands unattractive for real estate
Peri-urban agriculture--- proximity to market and less input cost
Health risk for the farmers and consumers
+
Soil degradation
Environmental pollution

WHY?

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Peri-urban agriculture using sewage : Sustainable Solution

Fasalwadi, Telengana, India

Madhya Pradesh's order to destroy crops cultivated using sewage has triggered a debate over the age old practice of using wastewater for irrigation

73,000 ha of peri-urban agriculture in India depends on wastewater
(People in Centre Consulting, India)

20 million ha in 50 countries irrigated with raw or treated wastewater in 2000
(Institute for Global Environmental Strategies, Japan)

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HOW ?

Wastewater treatment and reuse

as

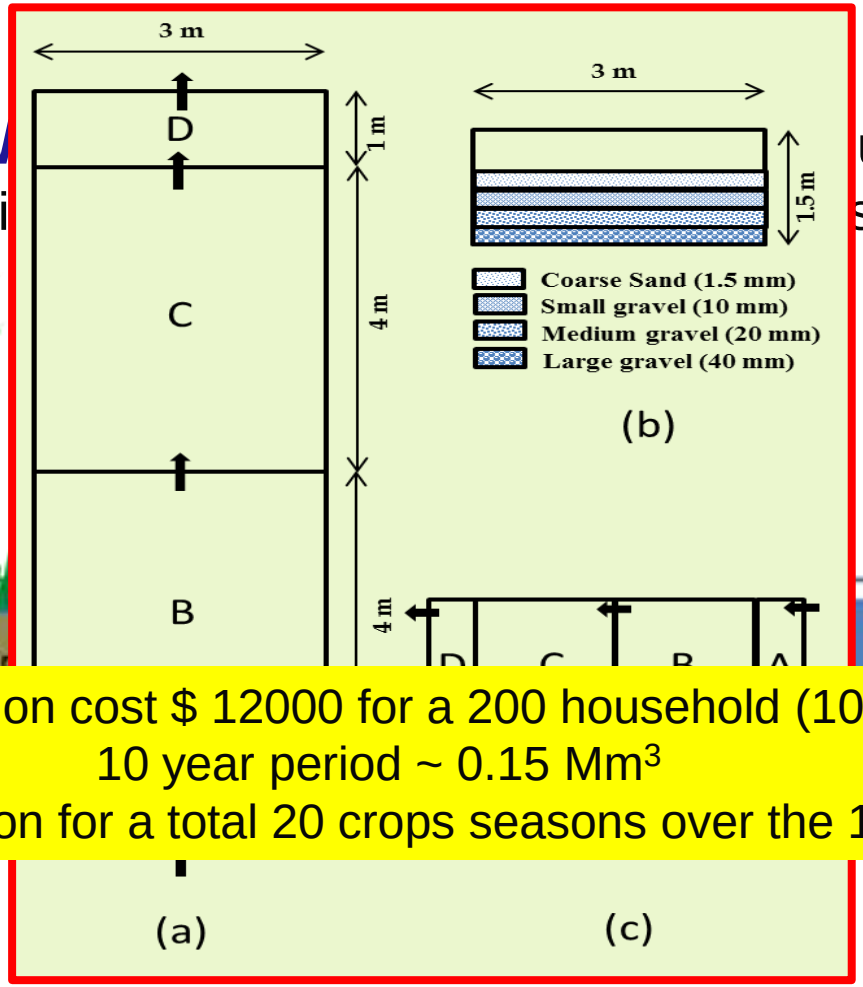
integrated water resources management

Safer wastewater irrigation and better rural hygiène

Kothapally village, Telengana, India

Constructed wetlands

- **Constructed W** uilt to remove pollutants present i se systems.



One time construction cost $ 12000 for a 200 household (1000 population)
10 year period ~ 0.15 Mm^3
4 ha fertigation for a total 20 crops seasons over the 10 years

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Factors affecting Phytoremediation

- ✓ identification of efficient aquatic plant
- ✓ estimation of plant uptake by the growing plants
- ✓ optimization of harvesting schedule
- ✓ investigation of beneficial use of the plant biomass

water hyacinth
water lettuce
Typha

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Inlet wastewater characteristics

(Average for July 2014 to Aug 2015)

Sl. No.	Parameters	Concentrations	Sl. No.	Parameters	Concentrations
1	Arsenic (mg/L)	0.02	16	Ammoniacal nitrogen (mg/L)	61.81
2	Boron (mg/L)	0.04	17	Nickel (mg/L)	BDL
3	Cadmium (mg/L)	BDL	18	Nitrate nitrogen (mg/L)	2.65
4	Calcium (mg/L)	75.48	19	pH	7.68
5	Chlorides (mg/L)	59.75	20	Phosphates (mg/L)	14.72
6	Chromium (mg/L)	0.01	21	Potassium (mg/L)	18.49
7	Cobalt (mg/L)	0.02	22	Sodium (mg/L)	78.51
8	Chemical oxygen demand (mg/L)	176	23	Sulfates (mg/L)	24.83
9	Copper (mg/L)	0.02	24	Sulfur (mg/L)	8.54
10	Detergents (mg/L)	1.59	25	Total dissolved solids (mg/L)	1214
11	Electrical Conductivity (ms)	2.43	26	Total Alkalinity (mg/L)	294
12	Fluorides (mg/L)	1.70	27	Total Hardness (mg/L as CaCO3)	370
13	Lead (mg/L)	BDL	28	Total iron (mg/L)	0.15
14	Magnesium (mg/L)	32.75	29	Total suspended solids (mg/L)	44
15	Manganese (mg/L)	0.04	30	Zinc (mg/L)	BDL

General concerns for wastewate Fertigation

- Heavy metals and risk of bio-accumulation
- Risk from pathogens *farmers and consumers*
- Salt accumulation in soil
- Clogging due to suspended solids
- Excess N, P and K

20 mg/L of Nitrogen concentration => **10 kg / ha** nitrogen addition per irrigation

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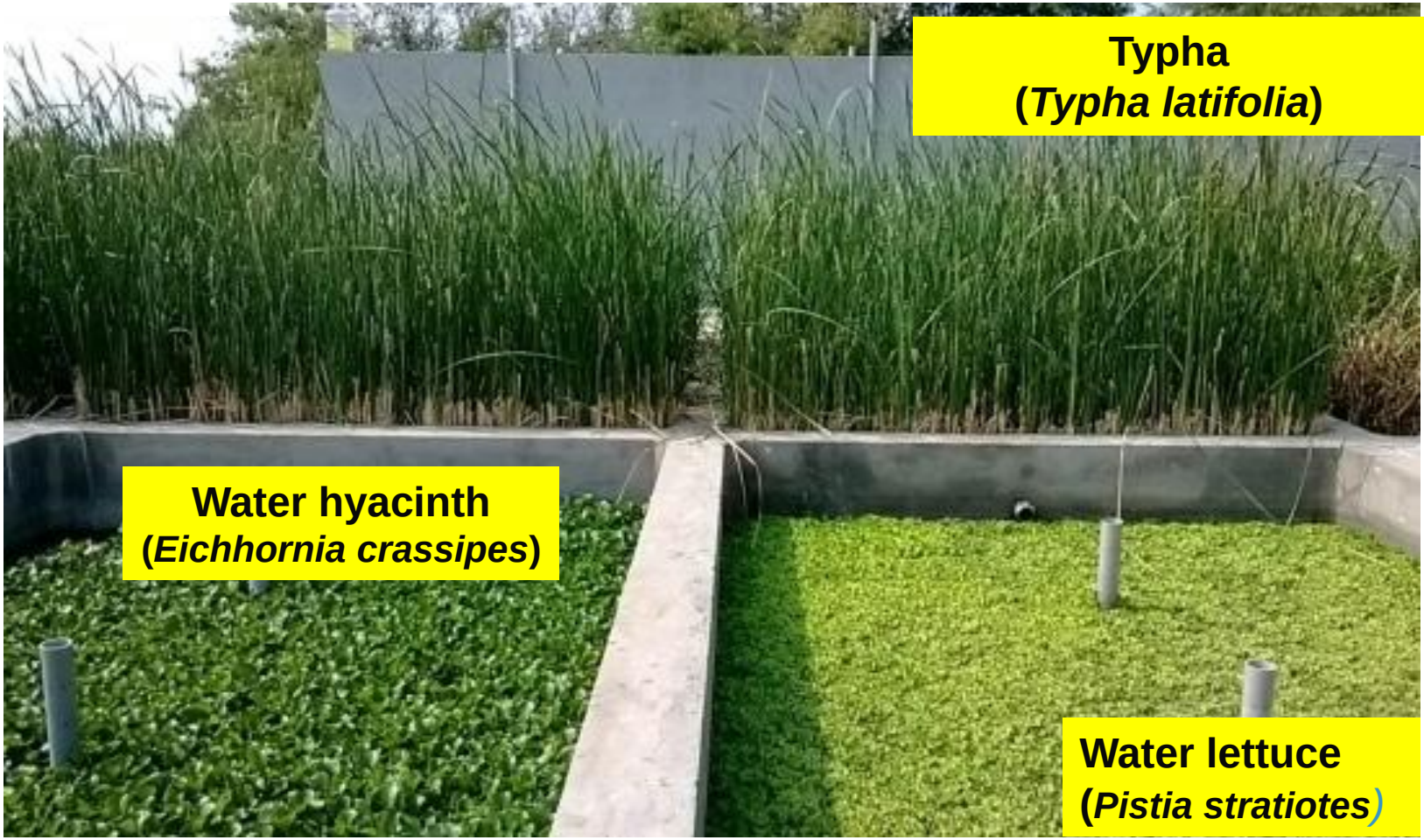
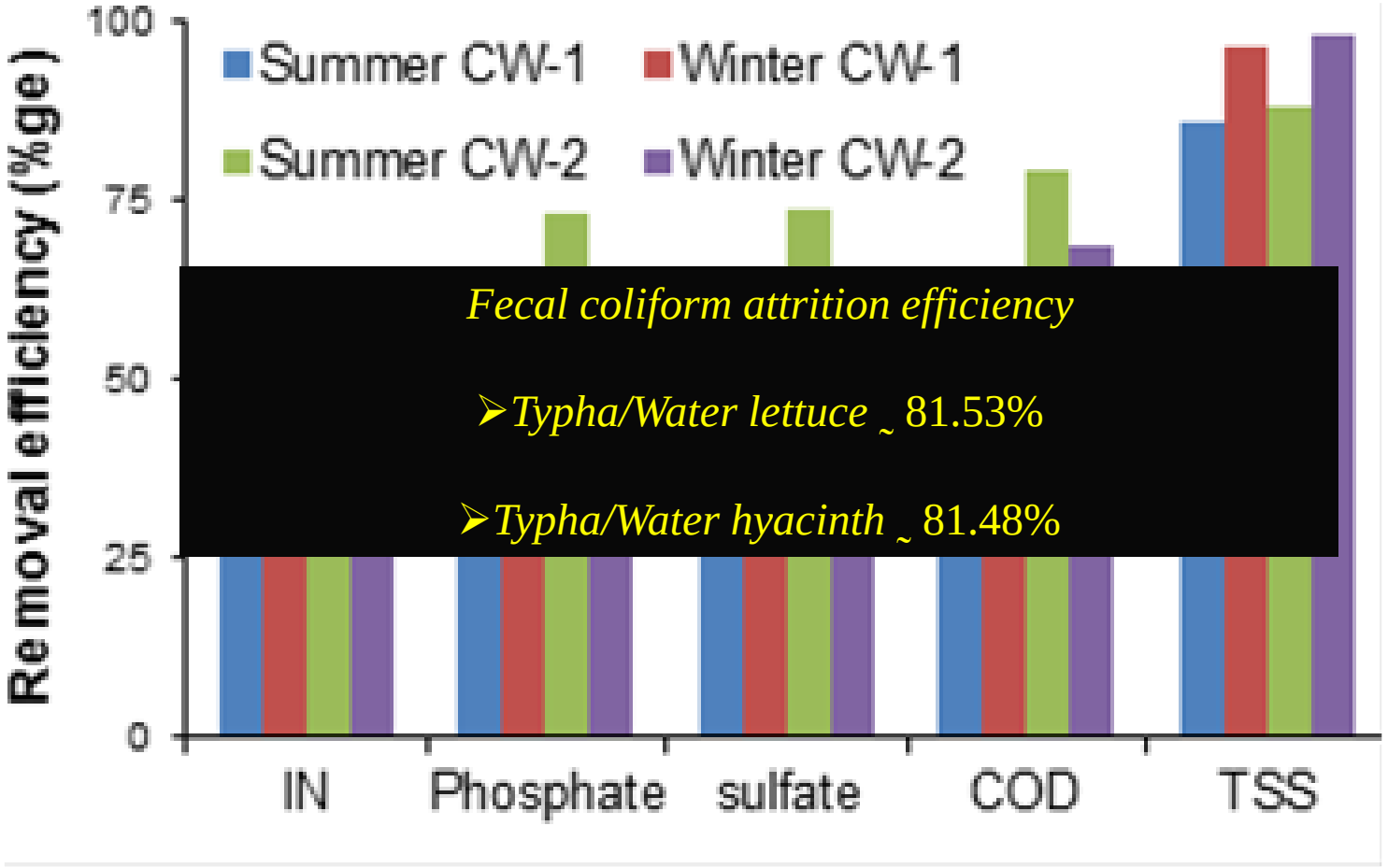
Field scale free surface CWs



Wastewater treatment efficiencies



Fecal coliform attrition efficiency

- *Typha/Water lettuce ~ 81.53%*
- *Typha/Water hyacinth ~ 81.48%*

CW-1 :: Typha+ Water Hyacinth
CW-2 :: Typha+ Water Lettuce

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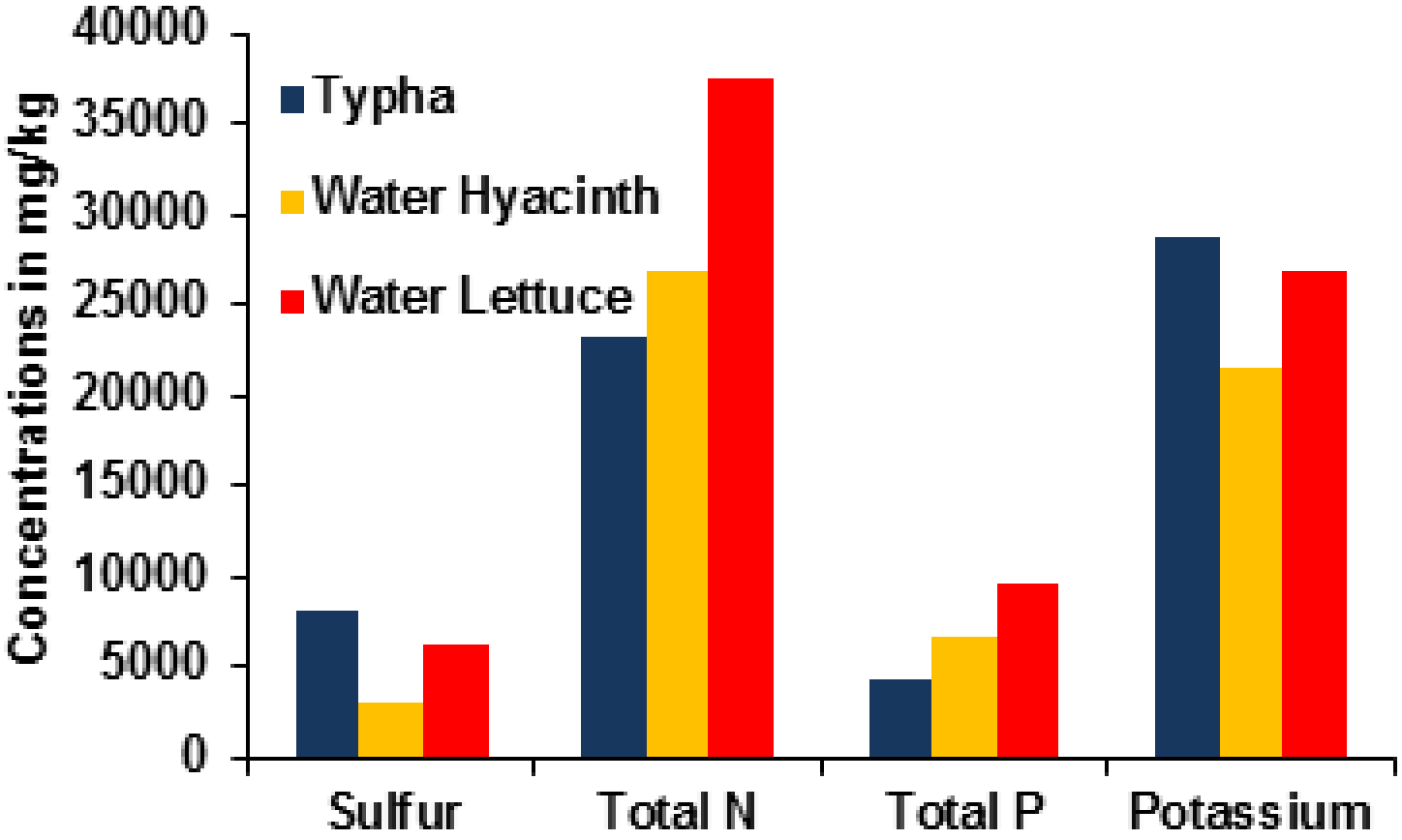
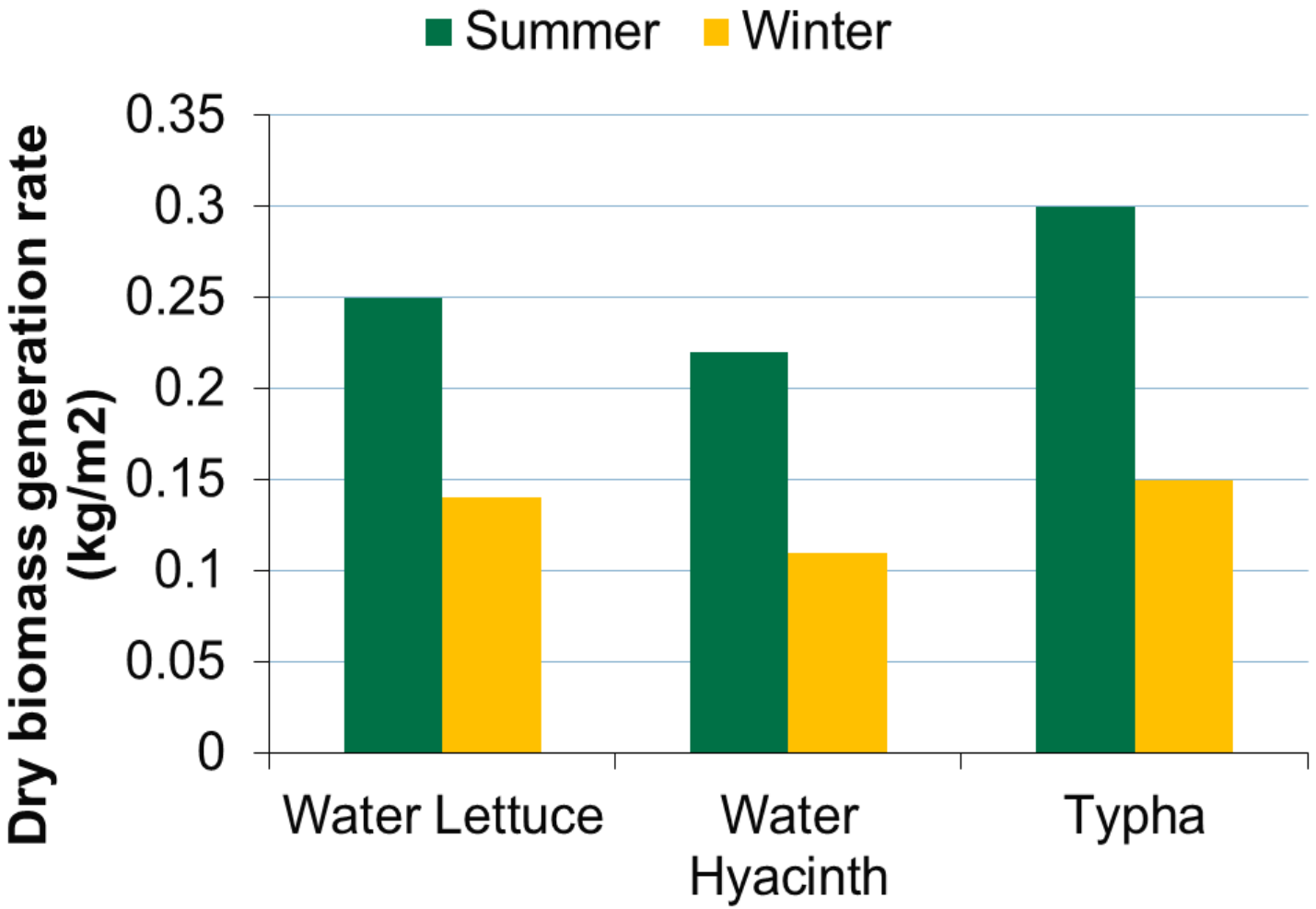
Plant nutrient uptake



Optimized harvesting period



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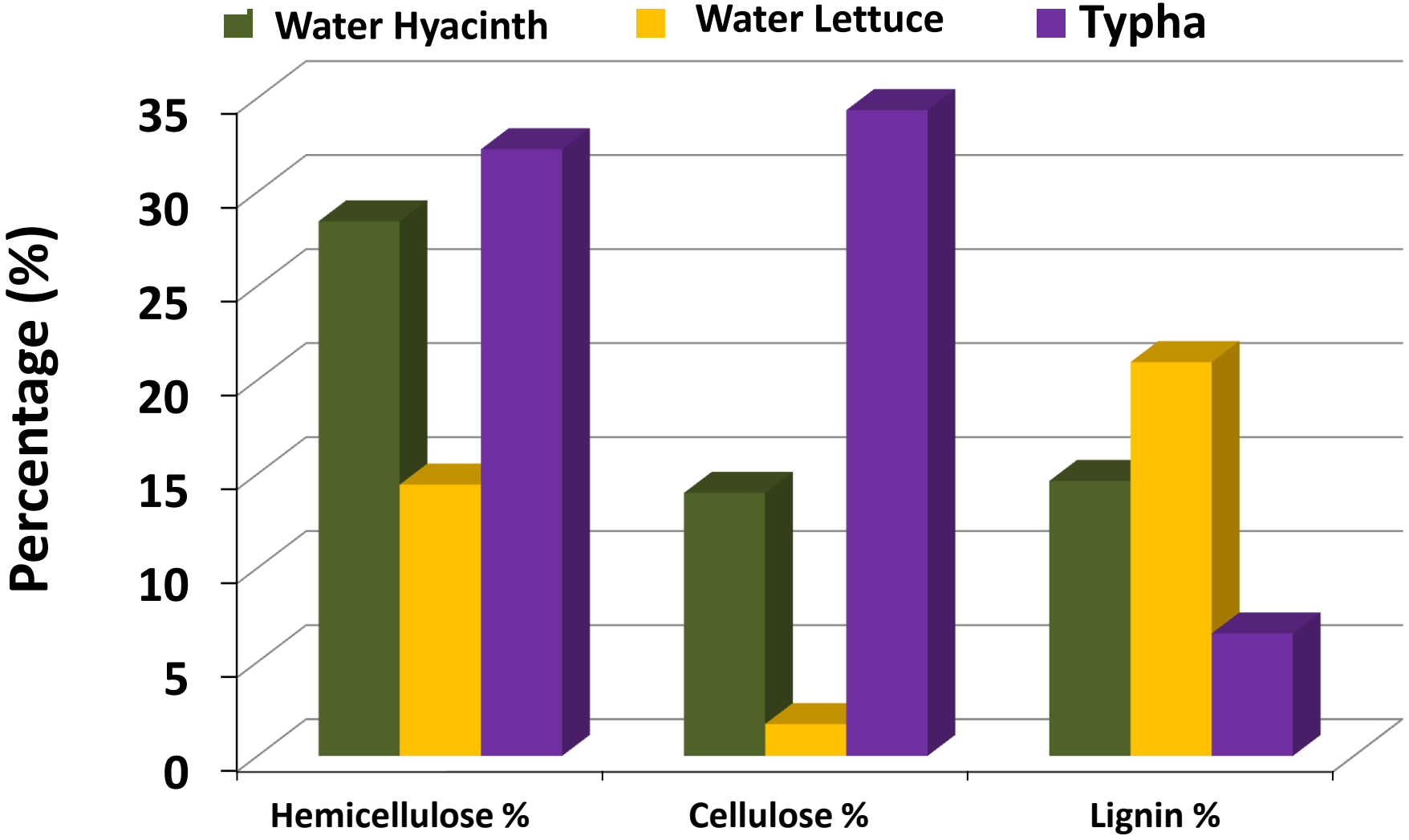
Comparison of fiber content



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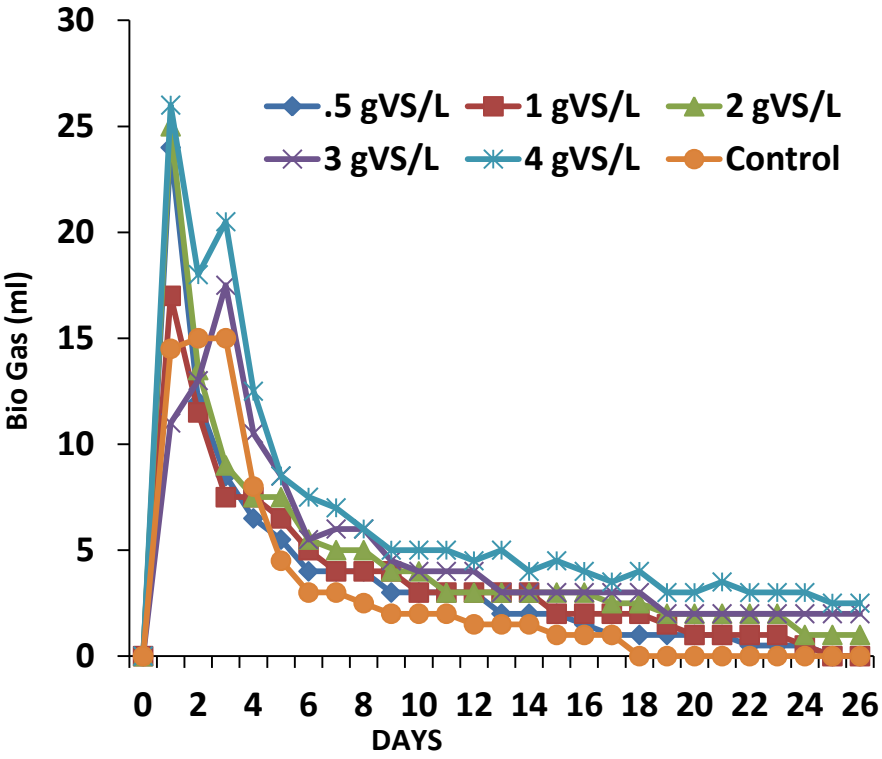
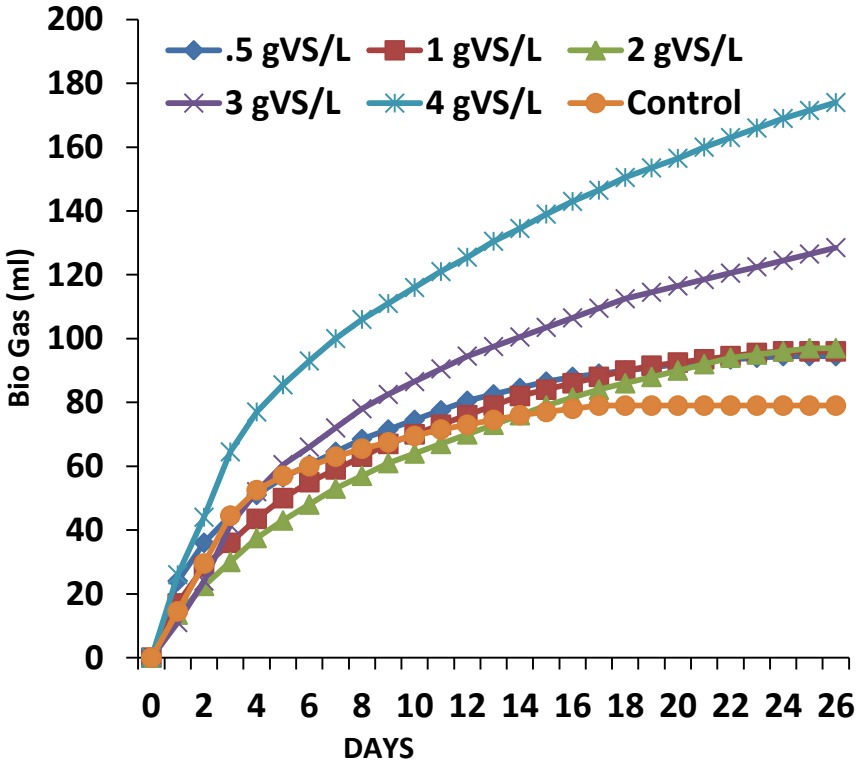
BMP of Water hyacinth

Daily BMP Graph



Cumulative BMP Grarph



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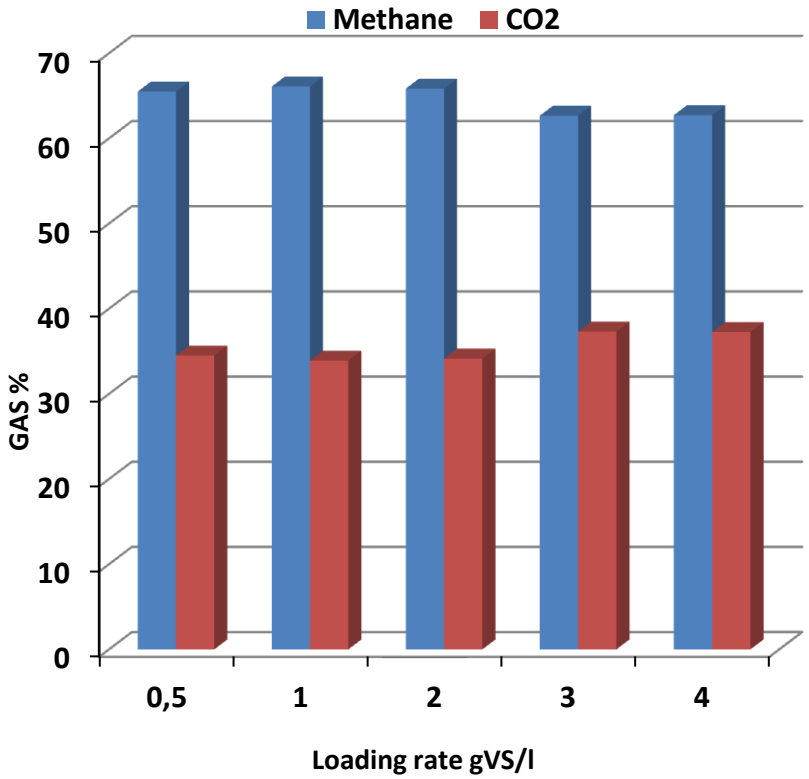
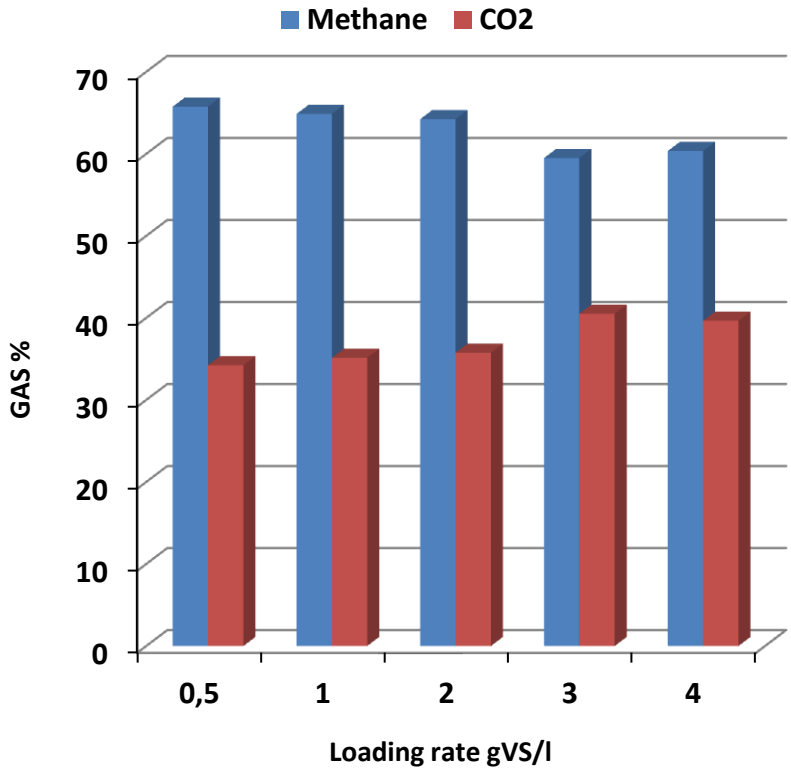
GC of Water hyacinth

After 8 days

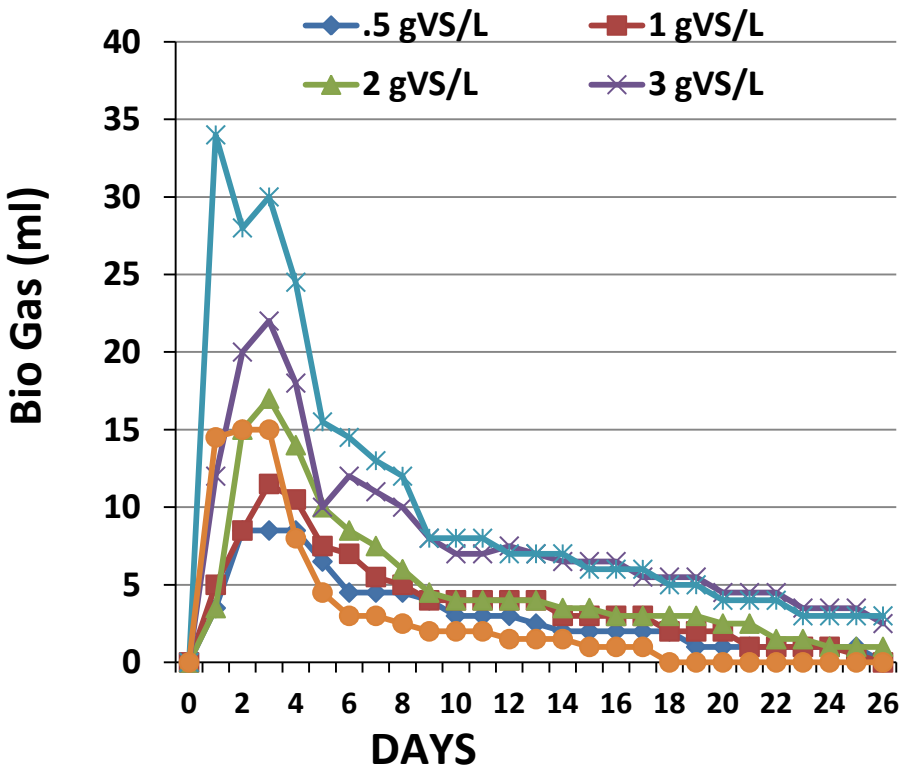


After 10 days

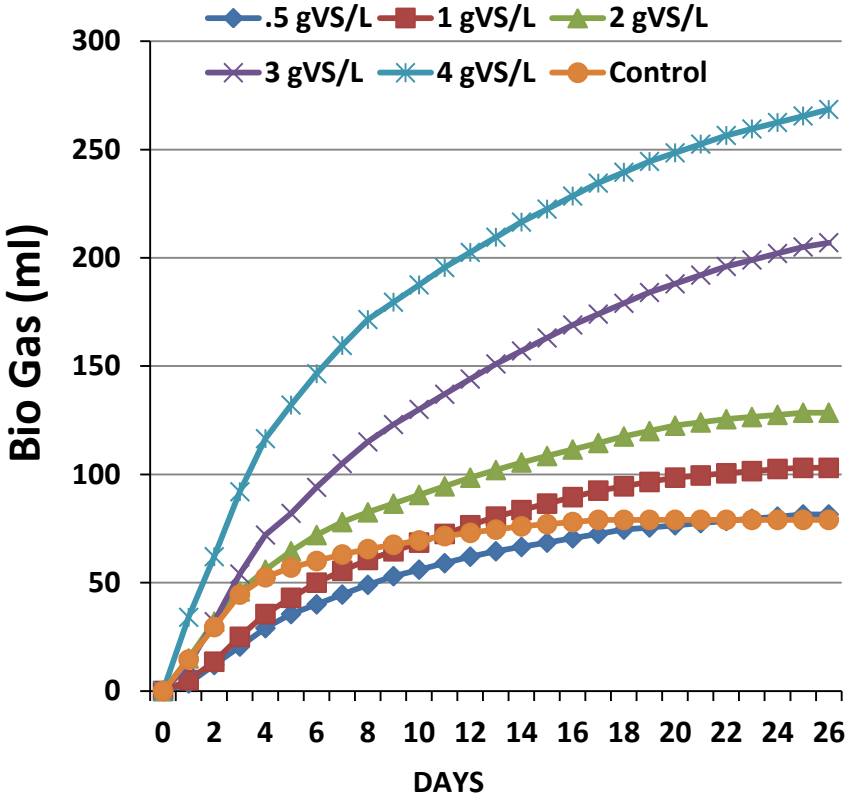


BMP of Water Lettuce

Daily BMP Graph



Cumulative BMP Grarph



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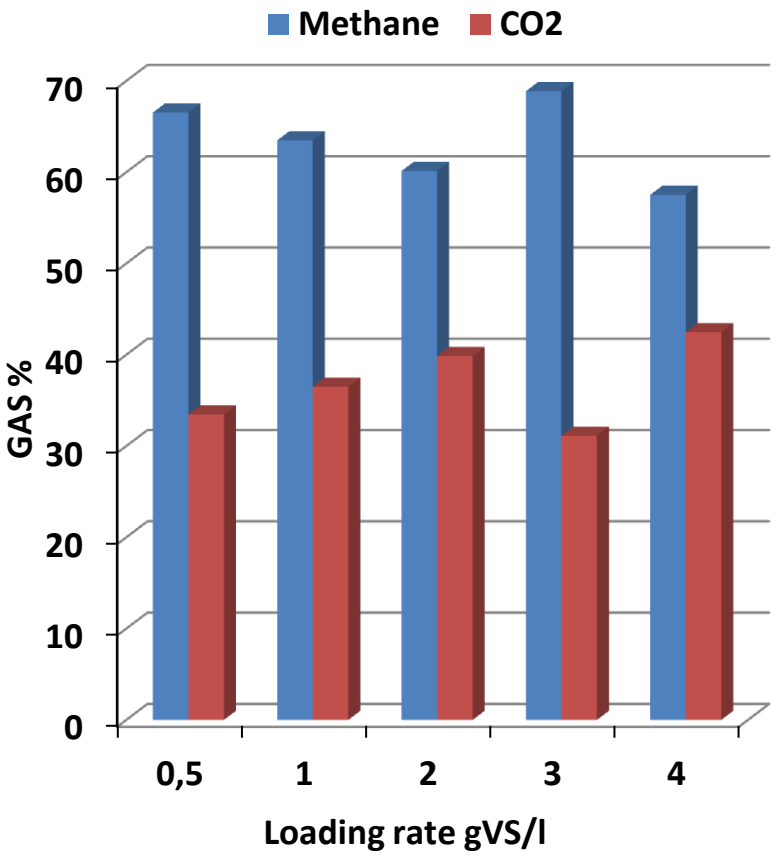
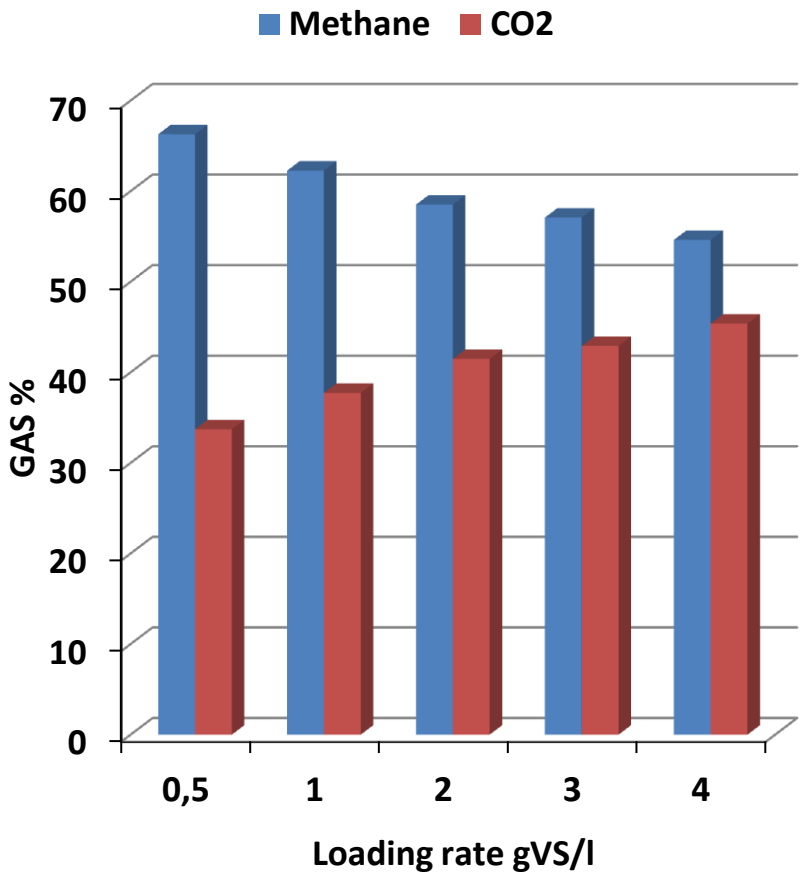
GC of Water Lettuce Biogas

After 8 Days

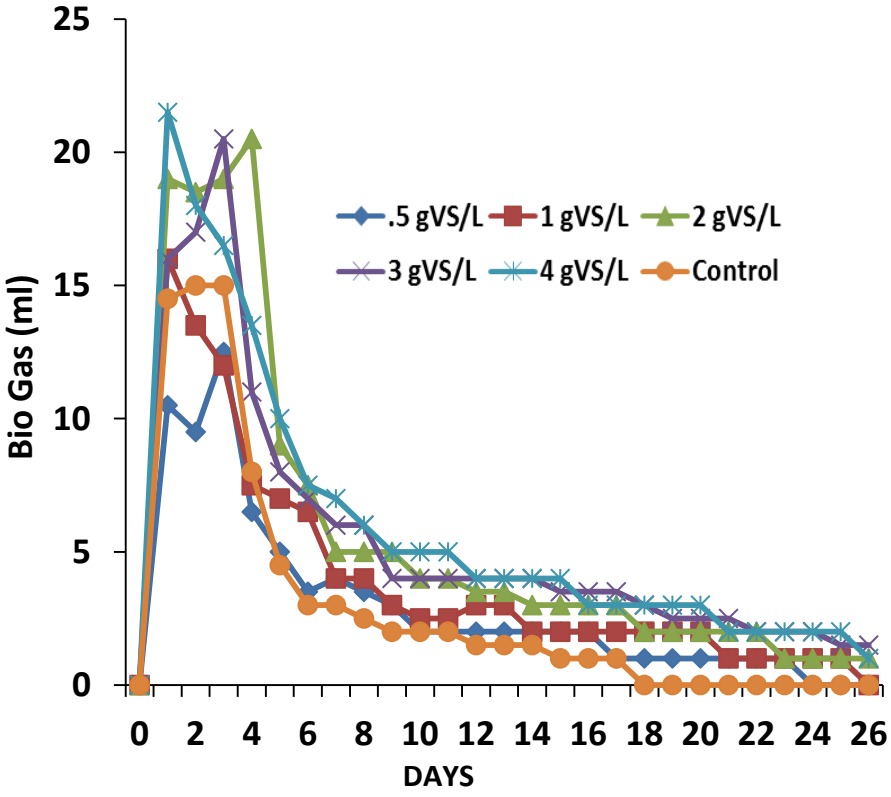


After 20 Days

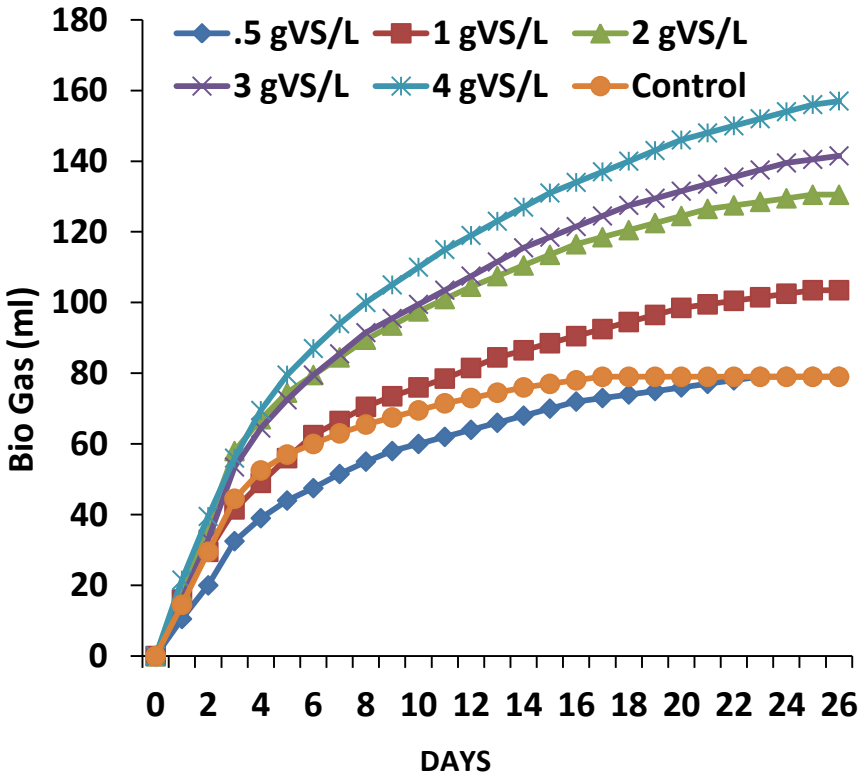


BMP of Typha

Daily BMP Graph



Cumulative BMP Graph



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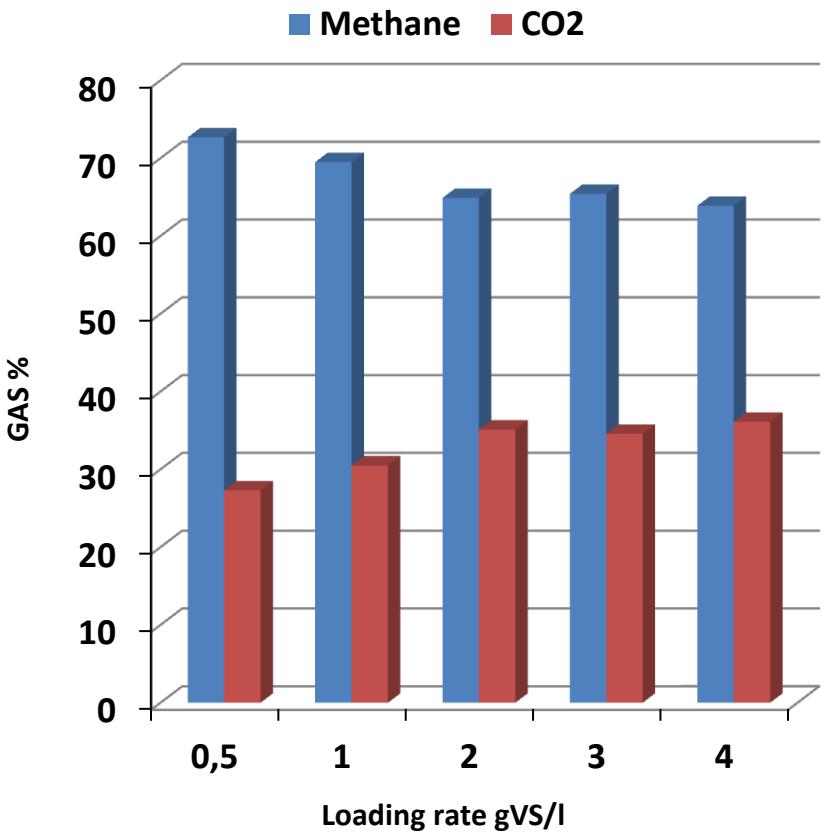
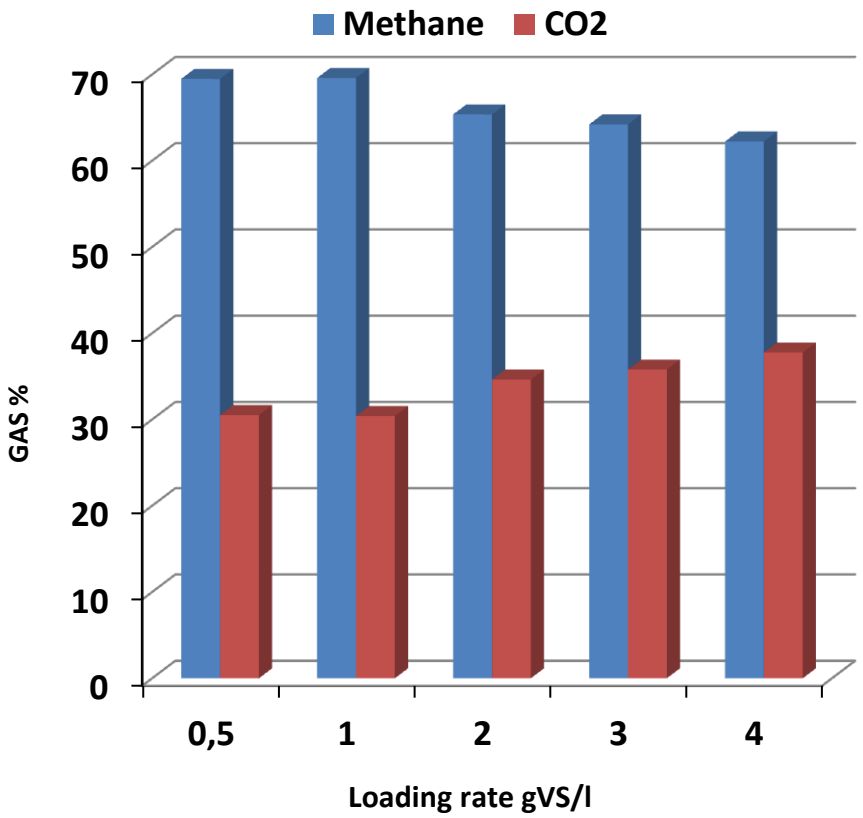
GC of Typha Biogas

After 8 Days



After 20 days



Conclusion

- Sulphur **uptake**….Typha and WL higher than WH
- Overall plant uptake …. WL higher than WH
- WL….. **mosquito** breeding nuisance
- **Solution:** small fishes

WL = Water Lettuce
WH = Water Hyacinth

Acknowledgement

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UF UNIVERSITY of FLORIDA

Water4Crops

सत्यमेव जयते

Department of Biotechnology
Govt. of India

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