

VETIVER PHYTOREMEDIATION TECHNOLOGY FOR TREATMENT OF SEWAGE EFFLUENT IN INDIA



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INTRODUCTION

A GLOBAL PROBLEM: UNTREATED WASTEWATER DISCHARGE

According to WHO/UNICEF's 2010 Joint Monitoring Program untreated sewage from 4.3 billion people is being discharged, resulting in contamination of public water supplies. Unregulated effluent discharges by industry and agriculture further exacerbate the problem.

If contaminated water was properly treated, the spread of water-borne pathogens and human mortality could be greatly reduced. These pathogens – including bacteria, fungus and algae – require nutrients to multiply so the removal of these (particularly N and P) from wastewater would greatly restrict pathogen propagation.

CURRENT SOLUTIONS

There are two main methods of treating wastewater:

- **The traditional method involving activated sludge and chemical nutrient removal technologies that are costly, require electricity and skilled personnel and, often impractical or unsuitable for poorer countries or decentralized, small-scale application.**
- **The biological method (phytoremediation):**
 - **Commonly based on constructed wetlands using Phragmites and other wetland species or**
 - **Hydroponic system using Water Hyacinth.**
 - **All these plants are invasive, and Phragmites only grows under wetland conditions.**
- ***The Need:* Generic, sustainable, efficient, easy to design and install, low cost solutions with wide applicability to the poorest, most marginalized and impacted segments of global society, such as Indian rural communities.**

CURRENT SITUATION

In 2012 World Health Organisation (WHO) reported that:

- **More than one third (37%) of the global population does not have access to adequate sanitation.**
- **Sanitation is considered the greatest medical advancement attributed to almost doubling life expectancy**
- **It is estimated that access to adequate sanitation can reduce infant mortality**
- **750,000 childhood deaths annually attributed to lack of sanitation.**
- **The majority of those without access to improved sanitation are in rural areas and the poorest.**

WHO (2012) also reported:

- **In sub-Saharan Africa and South Asia, it is estimated that 72% of those who do not have access to improved sanitation live in rural areas**
- **For example, in South Asia staggering 93% of the poorest fifth of the population do not have access to improved sanitation**
- **The poorest people are also the most affected.**

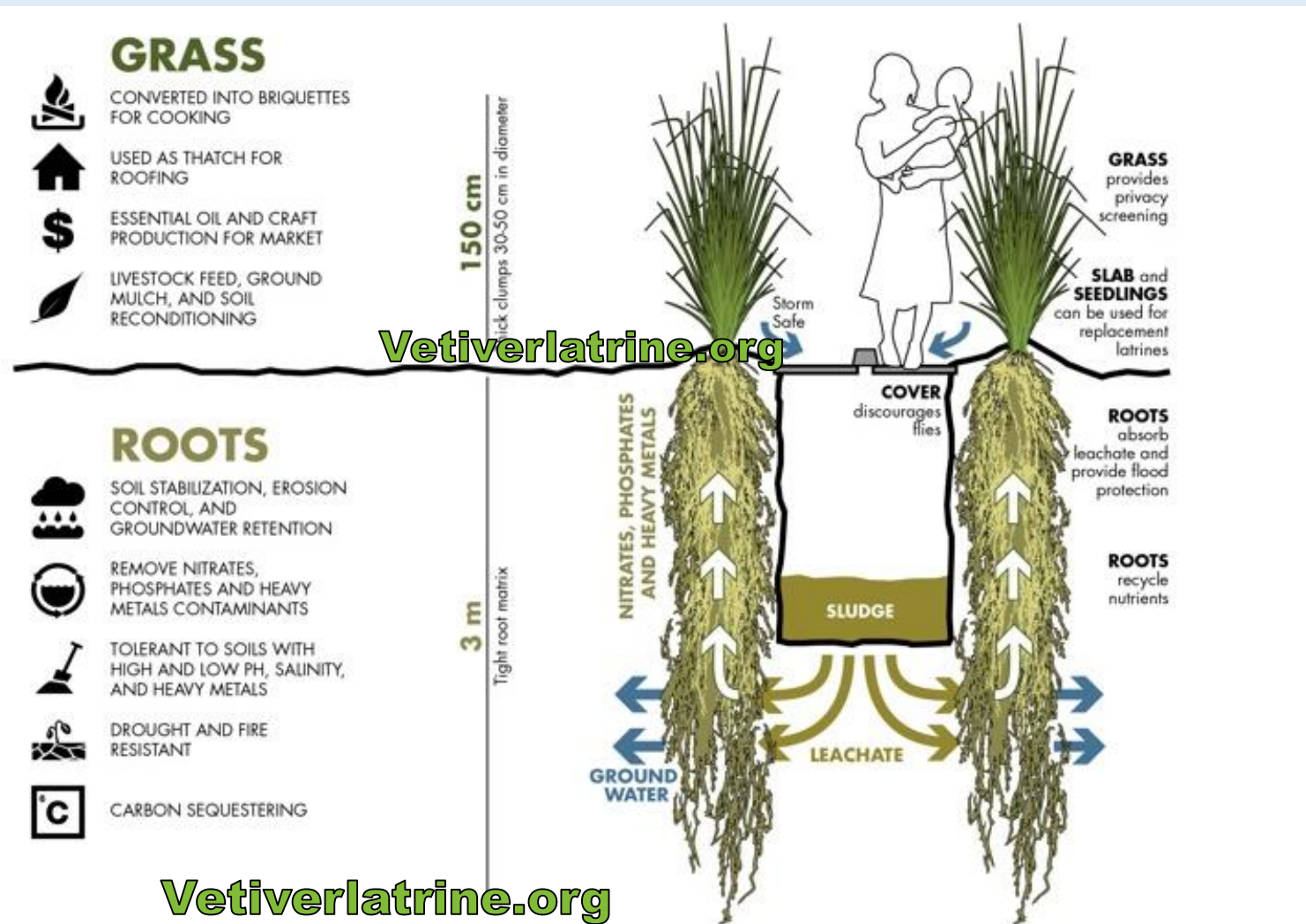
THE INDIAN SITUATION

In India the need for wastewater treatment, particularly sewage effluent is most urgent as:

- Local population's lack of acceptance of the need for improved sanitation, partly due to the Indian "Open Defecation" preference attitude**
- High cost of materials and skilled labour.**
- Concern of current open pit latrines may contaminate the ground water**

VETIVER TOILET IN HAITI

Applying the Vetiver Phytoremediation Technology, Owen Lee (Vetiverlatrine.org) developed the Vetiver Latrine for Haiti, where 88% of rural Haiti does not have access to improved sanitation (2006 UNICEF survey)



VETIVER PHYTOREMEDIATION TECHNOLOGY (VPT)

- **Vetiver thrives under wet and dry land conditions, most soil types and sand.**
- **The low-tech VPT has low establishment, operating and maintenance costs, is very robust, and has few climatic and geographic limitations.**
- **Vetiver grass was first recognised in 1995 in Australia for having “super absorbent” characteristics suited for wastewater disposal.**
- **During the last 15 years VPT has come to be widely used in Africa, Asia, Latin America, USA, and Australia as a proven solution for treating sewage effluent and landfill leachate.**

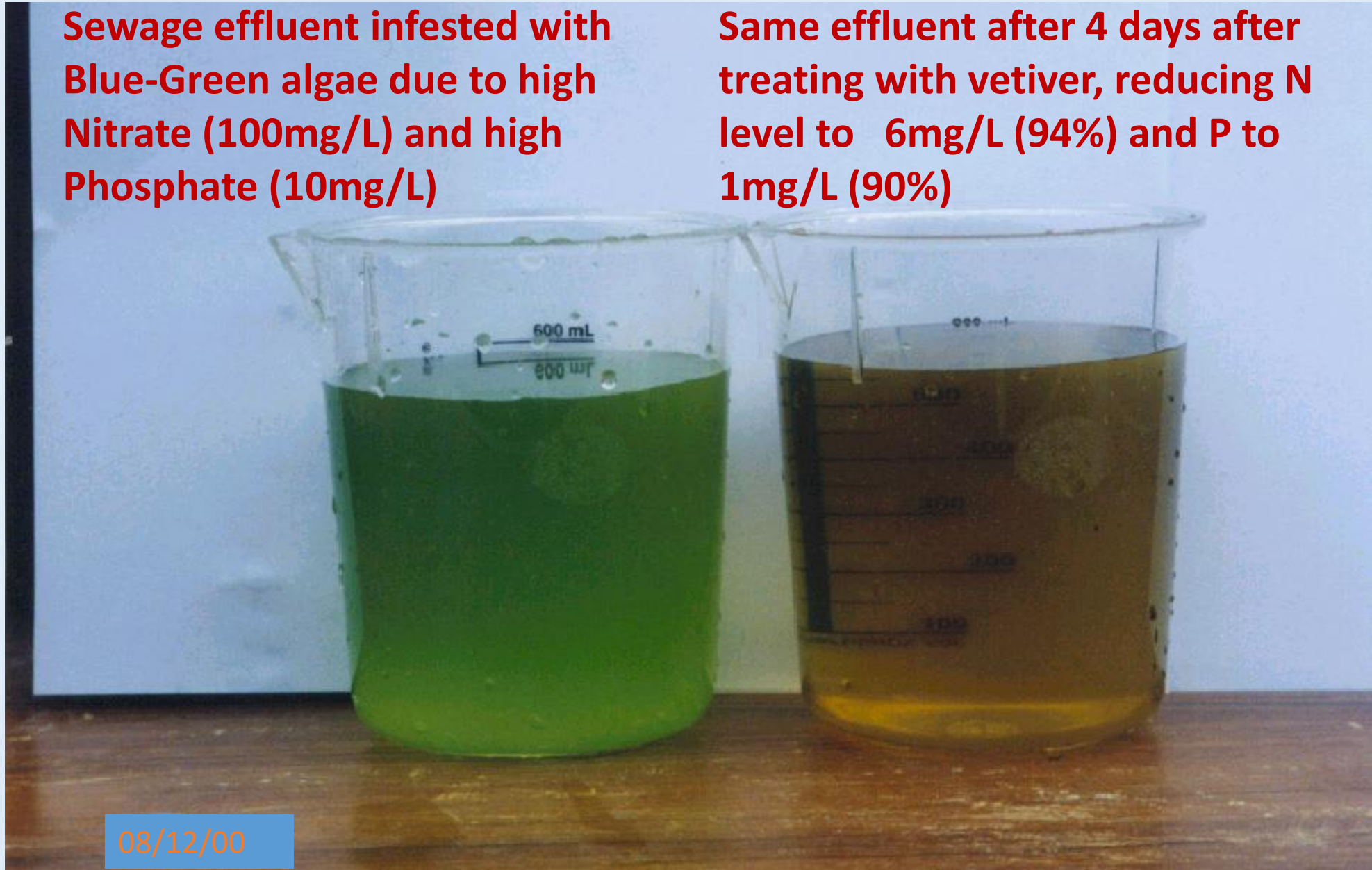
Vetiver Special Attributes Suitable For Sewage Effluent Disposal

- **Dense growth, forming porous barriers that trap coarse and fine sediments**
- **Extensive root system that reduces/prevents deep drainage.**
- **Great longevity and highly resistant to pests, diseases and fire**
- **Tolerates adverse conditions, including:**
 - **Extreme climatic variation**
 - **High acidity, alkalinity, salinity, sodicity and heavy metals**
- **Highly efficient absorption of nutrients and heavy metals in polluted water.**
- **Demonstrated non-invasive.**
- **Significant reductions of N and P in sewage and landfill leachate:**
 - **94% and 90%, respectively in hydroponic systems**
 - **94% and 95%, respectively in land treatment (irrigation) systems**
 - **91% and 80%, respectively in constructed wetland treatment systems**
 - **Virtually 100% of faecal coliforms (from more than 8000/mL to less than 10).**

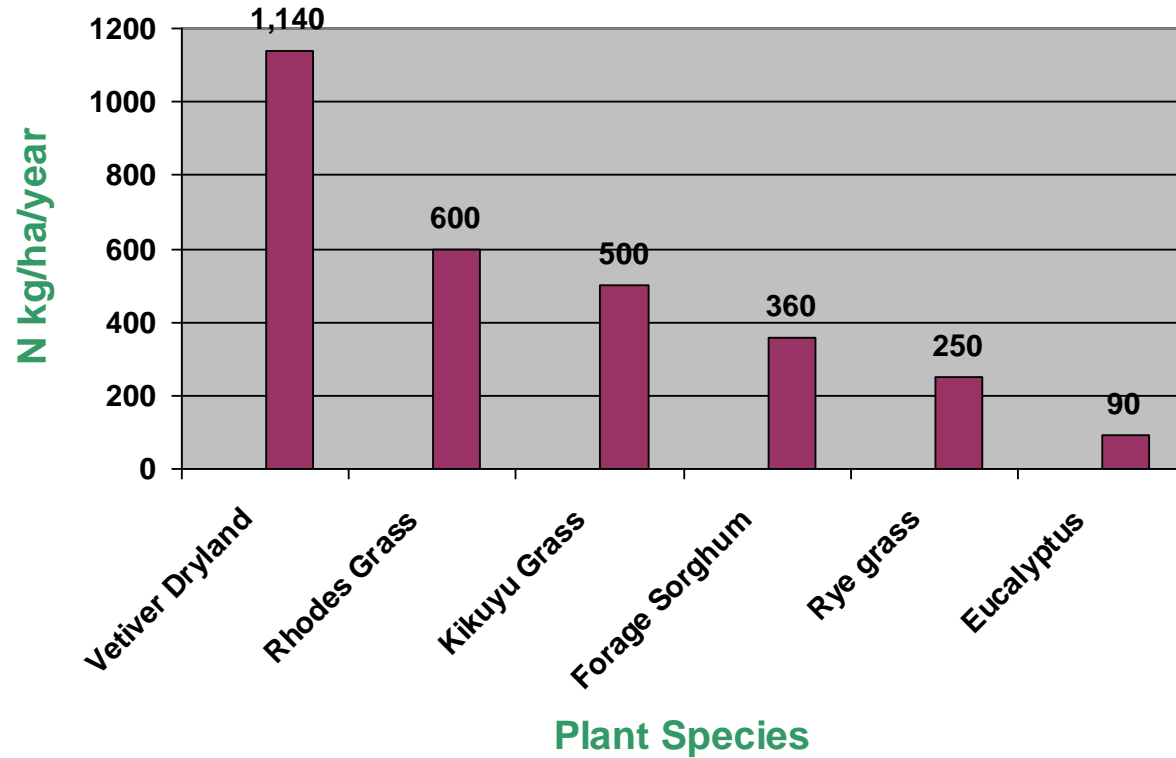
Vetiver grass has very high capacity of removing N and P in polluted water, vetiver cleaned up blue green algae in 4 days

Sewage effluent infested with Blue-Green algae due to high Nitrate (100mg/L) and high Phosphate (10mg/L)

Same effluent after 4 days after treating with vetiver, reducing N level to 6mg/L (94%) and P to 1mg/L (90%)

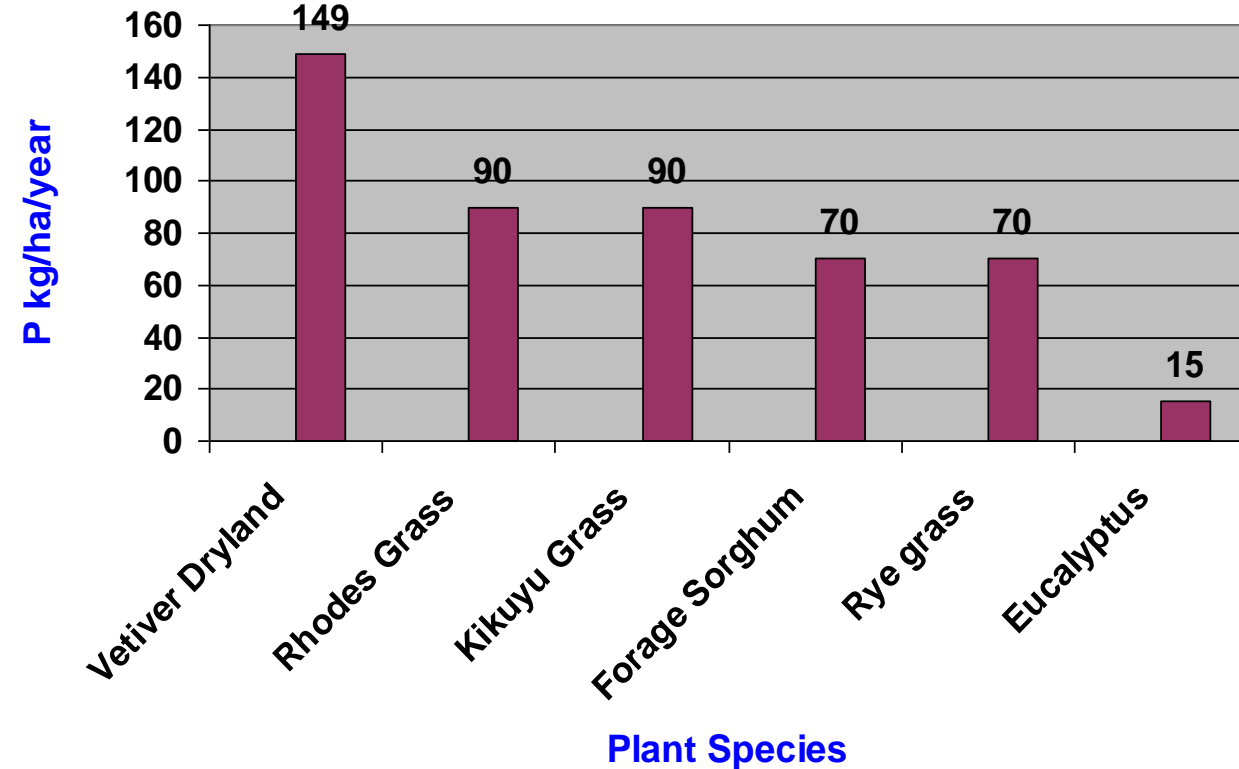


NITROGEN UPTAKE



Vetiver grass has very high capacity of removing N and P in polluted water

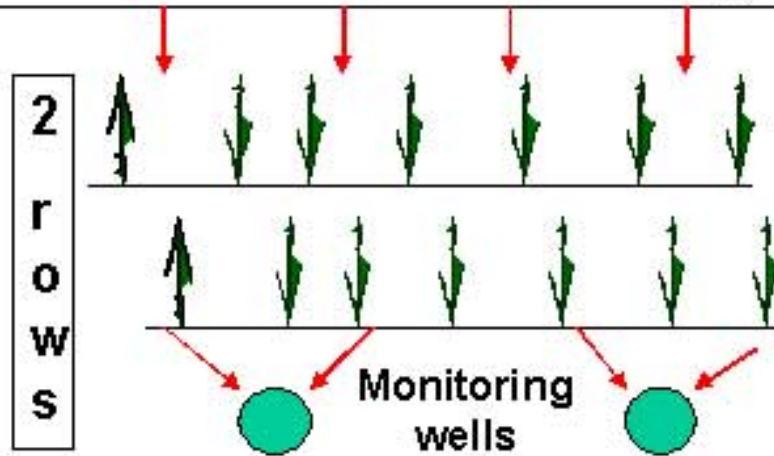
PHOSPHORUS UPTAKE



High capacity for N absorption in domestic sewage in Australia

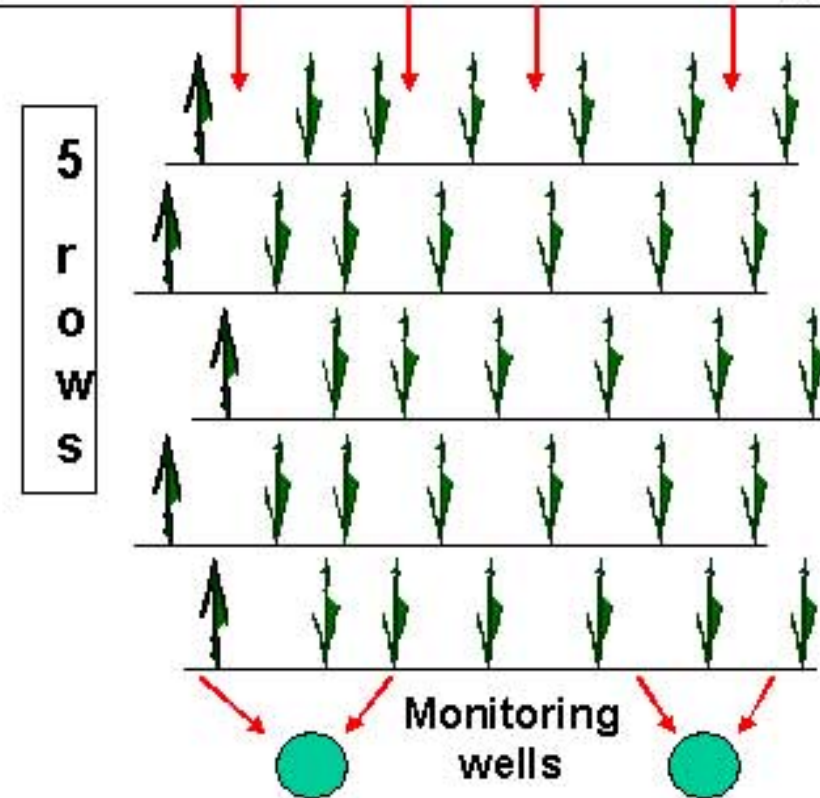
Effectiveness of Vetiver in Reducing N in domestic sewage

ENTRY: Total N level at 95.2mg/L



**EXIT: Total N level at 16mg/L
or a reduction of 83%**

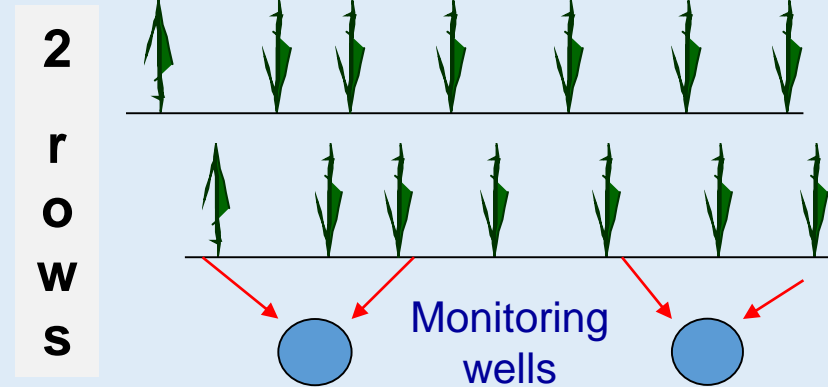
ENTRY: Total N level at 95.2mg/L



**EXIT Total N level at 1.2mg/L
or a reduction of 99%**

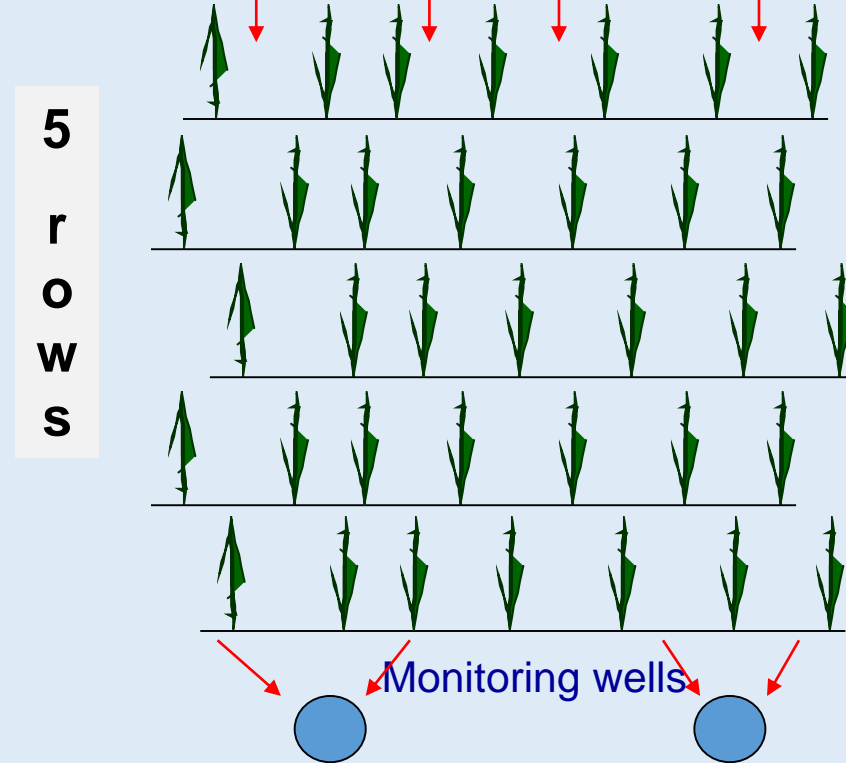
High capacity for P absorption in domestic sewage in Australia

Entry: Total P level at 1.3mg/L



Exit: Total P level at 0.24mg/L
or a reduction of 82%

Entry: Total P level at 1.3mg/L



Exit: Total P level at 0.20mg/L
or a reduction of 85%

VETIVER TOILET IN HAITI



Reference: Owen Lee (2013). Vetiver Latrine for HAITI. Proceedings, Second Latin America International Conference, Medellin, Colombia.

A Vetiver toilet is :

- ***Simple:*** Vetiver grass slips planted around a small concrete slab above the pit.
- ***Affordable:*** A vetiver toilet is approximately 1/20 of the price of a traditional toilet
- ***Sustainable:*** The Vetiver toilet can transform what was once considered waste into a useful commodity. Since there is no direct contact between the fecal matter in the toilet and the harvested grass, there is very little risk of contamination. The harvested vetiver has many economic, agricultural and health supportive applications for families



A Vetiver toilet is simply Vetiver grass slips planted around a small concrete slab above the pit. Instead of bricks and mortar the long roots of the grass stabilize the pit and even remove environmental contaminants.

The design is simple enough for the household to construct themselves with some basic training. Once the toilet is filled, the slab and Vetiver slips can be transferred over to the next pit location.

Importantly, Vetiver hedges provide *PRIVACY* to the users



PRIVACY and SECURITY

Most importantly, Vetiver tall and thick screen provides privacy and security to users day and night.



Thank you