Phytoremediation Mats

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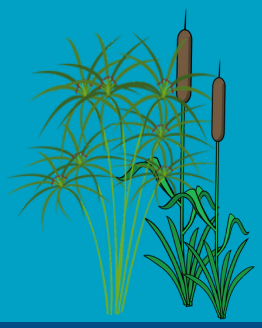
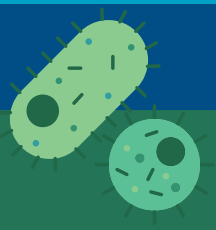
Team 21



Water is a human right

In the face of climate change induced calamities and large-scale water waste, the demand for clean fresh water is increasing and the supply is ever dwindling. Finding ways to improve water quality is a vital step in making clean water accessible to all, improving biodiversity of aquatic life, and fighting the impacts of pollution on the environment.

People do not have access to clean water



Common Water Pollutants We Aim To Address

Phosphates & Nitrates — Phosphates and Nitrates are common agricultural pollutants that can lead to eutrophication, degrading water quality, decreasing biodiversity, and introducing toxins into the water.

Heavy Metals — Heavy Metals in water are often toxic and consumption can lead to various, serious negative health effects.

Bacteria — Bacteria in water can lead to infection by deadly diseases.

Suspended Solids — Large particles that degrades water quality and lead to increased bacteria growth.

Our Solution

A surefire way to combat water pollution is to simply **remove harmful pollutants from the water.** We propose phytoremediation—the use of plants to remove or contain pollutants from the environment— as an inexpensive yet effective solution to the much larger problem at hand.

We propose **a modular, floating phytoremediation mat system to treat polluted, still water.** We recommend using *Cyperus Papyrus* (Papyrus), *Phragmites Australis* (Common Reed), and *Typha spp.* (Cattails) as the phytoremediators due to their ability to survive in water, proven efficiency, fast growth rate, replicability, and widespread native range. However, because of the versatility of the design, any plant species can be used with the mats.

We also hope to **promote sustainable use** with our solution. The mats will be partially constructed from reused textiles, which is a prevalent waste type in developing countries. Furthermore, the biomass of the floating mats can be regularly harvested for other uses, such as for construction materials, food, biofuel, and mat substrate.

Our Solution

1 Efficiency

The efficacy of phytoremediation in constructed wetlands has already been shown through extensive research, but we hope to implement it in new, increasingly effective ways. The simple, self-replicating design of the mat system makes it easy and inexpensive to implement in developing countries, where it is the most needed. Additionally, we hope to implement the design in heavily polluted lakes, lagoons, and municipal wastewater.

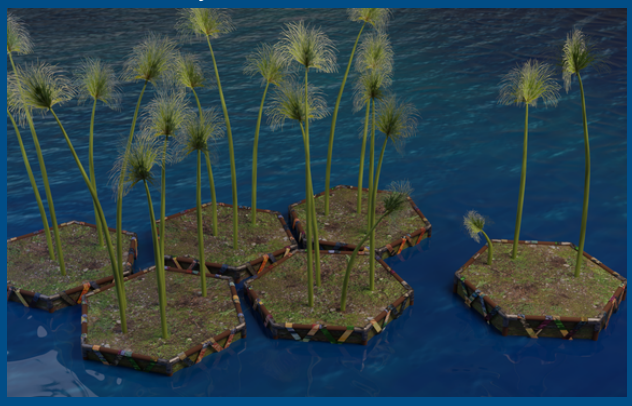
2 Replicability & Scalability

The replicability and scalability of the design is a key component to efficiency of the solution. By designing the mats using accessible materials and components produced from existing mats, the cost of many components becomes negligible and construction of future mats becomes easier as time goes on.

3 Multifaceted Uses

Outside of addressing water pollution, our design provides additional benefits including serving as a natural habitat & food source for native species and the incorporated plants being able to sequester carbon from the atmosphere.

Renders Courtesy of Peter Nardulli



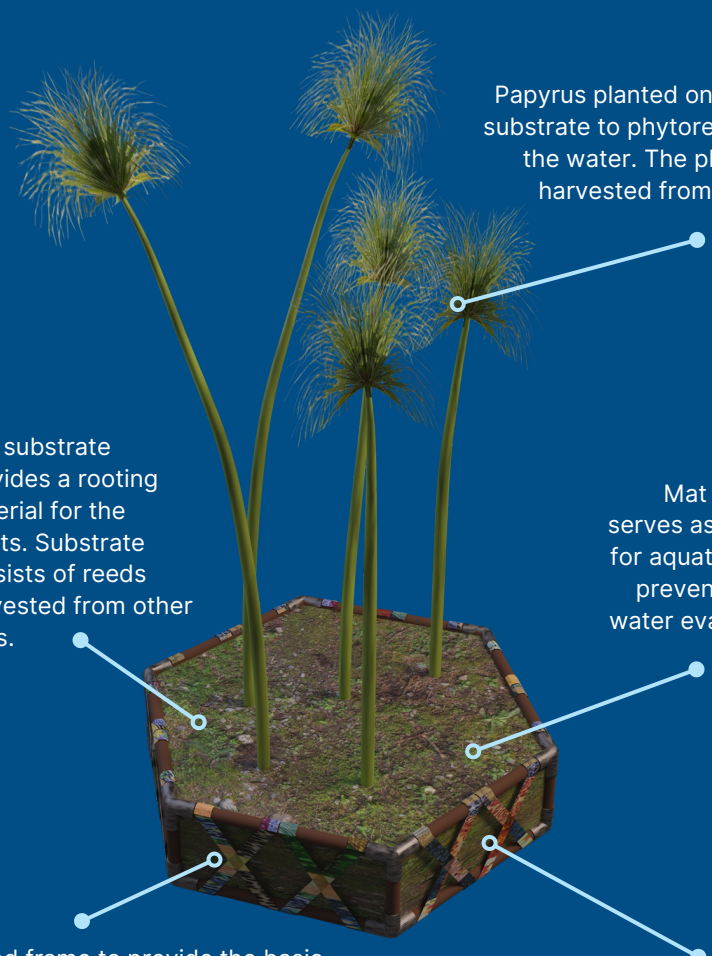
Representation of mat implementation. Ideally, hundreds to thousands of mats would be implemented on large bodies of water, cleaning large volumes of water and creating many plants to be harvested

Projected pollutant removal rates of *Cyperus Papyrus & Phragmites Australis*. High pollutant removal rate of the mats will make even the most polluted water safer to use.

Pollutants	Papyrus	Common Reed
Suspended Solids	32.46%	62.85%
Phosphorus	50.00 %	49.38%
Coliforms (Bacteria)	98.08%	96.02%
Heavy Metals*	~ 40 - 90%	~ 40 - 90%

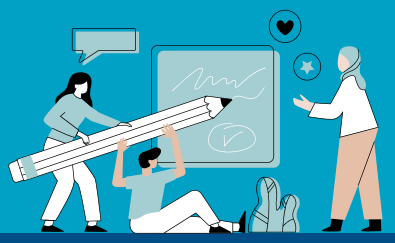
Breakdown of projected cost per unit. The relatively cheap price per unit will enable cost-effective implementation of numerous mats for one body of water.

Material	Cost (USD)**
Wood Frame	~$15
Textiles	Negligible
Substrate	Negligible
Plants	Negligible
Construction Cost	~$20



*Previous research has shown that the removal rate ranges from 40 - 90% depending on the specific heavy metal
**All costs are rough estimates. Wood cost is estimated based on ~$.5 per ft of wood. Construction cost is estimated based on a $40 hourly wage, and operating cost of ~20%. All other materials are assumed to be easily accessible and cost negligible.

Implementation

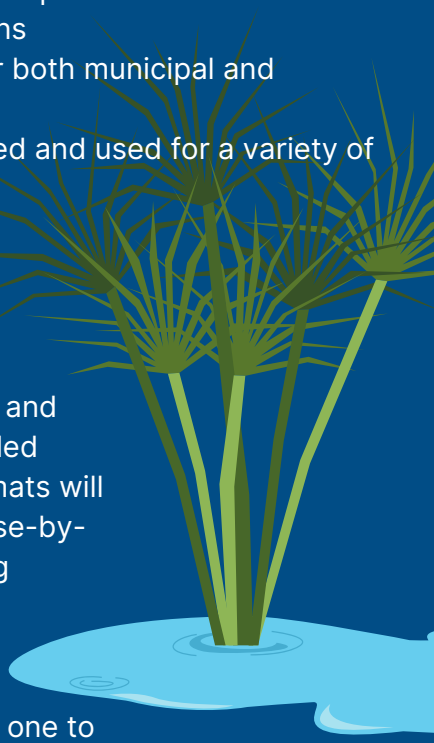


Partnerships

For large scale applications, there will need to be a large effort to assemble, maintain, and harvest the mats.
Thus, partnering with world governments and private water corporations will be beneficial for both the funds and maintenance required to implement the solution.

Why Invest?

- Access to clean water is a human right
- Cheaper and easier to implement than formal water treatment options
- Water is necessary for both municipal and industrial applications
- Plants can be harvested and used for a variety of other purposes



Future Considerations

Our proposed solution needs further vetting and testing to confirm the feasibility and effectiveness of implementation, which can be done through preliminary, controlled experiments. A majority of the obstacles facing effective implementation of the mats will be the ongoing costs and design improvements, which can be addressed in a case-by-case basis. Different implementations should also be considered, such as farming foodstuff with the mats or designing them as a landscape art installation.

This is ultimately a short-term solution for a much larger problem; we project implementation in any given area will last a few months and will remain active for one to three years, during which effectiveness will be measured with water tests to track the amounts of the key pollutants we are targeting.

Water Pollution Relation to SDGs

Creating and making clean water more accessible for human consumption around the globe

Finding new ways to use common textile waste and biomatter for sustainable purposes

Increasing biodiversity of aquatic life by preventing eutrophication, increasing the quality of the water, and creating new habitats

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