WETLANDS

The Lost Ecosystem

In the past 200 years, the world's population has increased from around 1 billion to almost 8 billion people. Each day, we use 11 billion cubic meters of freshwater worldwide. As an increasing population uses more resources, develops more technology and industry, and expands, people will continue to levy an undue burden on the environments in which we live. Destruction of forests, pollution of water streams, and unhealthy waste disposal are just some examples of human-caused environmental degradation. Animals, plants, and ecosystems are vanishing rapidly, natural resources are becoming scarcer, drinking water is being increasingly contaminated, and climate change is exacerbating many of our already-existing problems.

One distinct natural ecological system highly affected by human activities is known as a wetland. According to the US Environmental Protection Agency (EPA), wetlands are "areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season." Wetlands can function to enrich groundwater, control floods, and treat contaminants in water through microbes. They also support an immense number of species, such as insects, birds, and even mammals.

Constructed Wetlands

Urbanization, pollution, over-abstraction, and mismanagement of resources has led to the disappearance of many wetlands globally. Engineers and environmentalists have worked to create "constructed wetlands," which are man-made and intended to function in the same manner as a natural wetland. Constructed Wetlands (CWs) hold great potential as developments in environmental engineering.

In 1953, research and development of constructed wetlands began in the Max-Planck Institute in Germany, where botanist Dr. Käthe Seidel proposed the possibility of using plants, specifically the bulrush, to "allow the contaminated waters to be capable of supporting life once more." This research led to the development and implementation of the first constructed wetland technology in the 1960's in Europe. Constructed Wetland technology has substantially improved in the time since the first prototypes.

Purpose of Constructed Wetlands

Constructed wetlands can serve multiple purposes, including

Habitat Creation: as wetlands provide habitats for birds, insects, and other animals, CWs produces an appropriate habitat for these animals to thrive.

Flood Control: Wetlands or CWs might receive runoff and may even help recycle storm/flood water.

Wastewater Treatment: CWs are able to clean domestic wastewater for industrial and agricultural reuse. An example of this would be the Green Filter CW at the Jordan EcoPark, where insects, frogs, birds, and other species have returned due to a created habitat.

CWs are considerably smaller than other conventional treatment plants, lending themselves to a decentralized approach to wastewater. While large, centralized facilities process large amounts of sewage and service many, sewer networks and distribution associated with those plants can be costly and time consuming, and would require trained personnel for operation and maintenance. CWs, due to their simplicity and small size, can service rural and remote communities much more effectively.

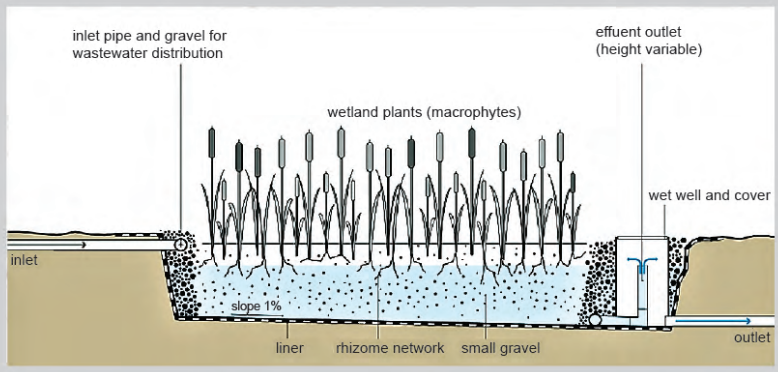
Classification of CWs

There are multiple types of constructed wetlands,including Free-Surface Constructed Wetlands, Sub-Surface Flow Constructed Wetlands, and Floating Wetlands. Within Sub-Surface Flow, there are Horizontal and Vertical Subsurface Flow systems.

Free Water Surface Constructed Wetlands

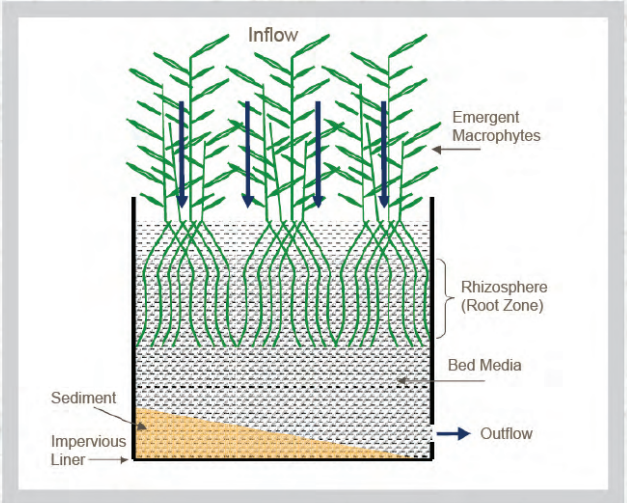
Structure	Construction	Plants Supported (non-exhaustive)	Macrophyte Classification
Water is exposed to the atmosphere above, and there is a layer of soil underneath the water.	Soil underneath plants	Common reeds, bulrush, cattails, herbs	Emergent Macrophyte

Sub-Surface Flow Constructed Wetlands: Horizontal



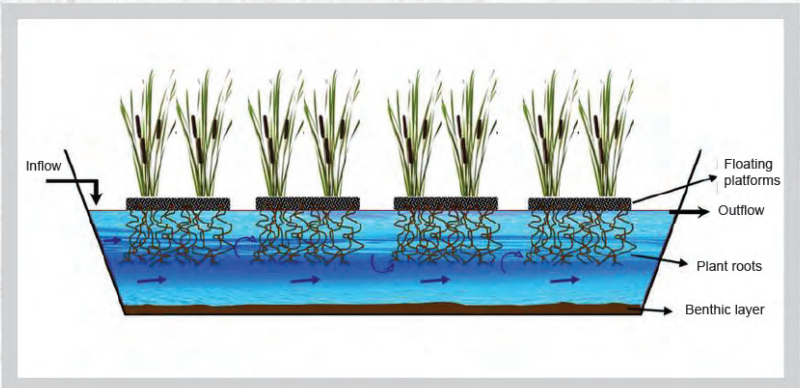
Structure	Construction	Plants Supported (non-exhaustive)	Macrophyte Classification
Plants are grown in a gravel and sand-filled basin, with water underneath.	Gravel & water soil underneath plants	Common reeds, typha (including bulrush and lavender), and scirpus (including water lily)	Emergent Macrophyte

Sub-Surface Flow Constructed Wetlands: Vertical



Definition / Structure	Construction	Plants Supported (non-exhaustive)	Macrophyte Classification
Plants are grown in a gravel and sand-filled basin, with water underneath and a vertical gradation under the water to allow seepage	Gravel and sand underneath plants; gradation vertically	Phragmites, Typha, etc.	Emergent Macrophyte

Floating Treatment Constructed Wetlands



Definition / Structure	Construction	Plants Supported (non-exhaustive)	Macrophyte Classification
Plants are attached to a floating apparatus, somewhat like a raft, and move around a lake or river.	Floating element over body of unsanitary water	Phragmites, Typha, etc.	Emergent Macrophyte

Emergent v. Submerged v. Floating Macrophyte: An Explanation

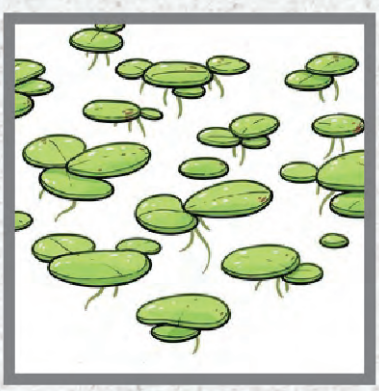
A macrophyte is an "aquatic plant growing in or near the surface," typically visible by the naked eye. There are three different types of Macrophytes: Emergent, Submerged, and Floating.

Emergent: The roots and rhizome systems of emergent macrophytes are attached to the soil (substrate) (an anaerobic area, or area without Oxygen), but their reproductive organs rise above the water level (in an aerobic area, or area with Oxygen). They prefer a depth of about 1-1.5 meters. They include genera such as Typha (such as a bulrush plant) and Hydrocotyle (water pennywort).

Submerged: Also known as submersed, submerged macrophytes are completely underwater. They often have "elongated, ribbon-like or dissected leaves, and aerial, floating or (rarely) submersed reproductive organs." Their depth is limited to around 10 meters. Common genera include Chara (algaes), Elodea (a type of water weed), and Cabomba (a genus often seen in aquaria.

Floating-leaved: Floating-leaved macrophytes are plants that float freely on the water; they have long petioles, or stalks, and their leaves are adapted toward mechanical stress. They enjoy water depths between 0.5 and 3 meters. Floating-leaved macrophytes include such genera as Nymphaea and Victoria (genera of water lilies), Brasenia and Floating-leaved duckweed.

Duckweed



Cattail

Chara (Algaes)

Environmental Benefits of CWs in the Jordan Valley

CWs helps control pollution. In the Jordan Valley, households use cesspits to store domestic wastewater runoff. This untreated water seeps into the ground and pollutes groundwater. Additionally, during winter this wastewater occasionally overflows and pollutes homes, streets as well as nearby wadis (or streams), causing a health risk, destroying the infrastructure, and contaminating the Jordan River. CWs prevent wastewater seepage into the groundwater and are flood resistant, curbing pollution into groundwater and the Jordan River.

CWs lead to the reuse of water. In the Jordan Valley, wastewater in cesspits lies dormant and unused. Wastewater is often not pumped and removed from cesspits, as septic trucks services are relatively expensive for the locals. If wastewater is pumped and removed, septic tank trucks may dump the water in a nearby wadi rather than deliver it to the wastewater treatment plant. Because CWs are decentralized, cost-effective, and easier to access, they will increase the amount of reused water by the locals, and allow it to be discharged safely back to nature.

CWs use considerably less energy than other types of wastewater treatment plants. Researchers found that CWs use significantly less energy than classical activated sludge and extended aeration plants. This is not to say that CWs should be the only solution for wastewater treatment, but their remarkably lower energy consumption compared to other technologies makes them the optimal solution for domestic wastewater challenges in rural and remote areas. Using less power means expending less fossil fuels, helping to mitigate the effects of climate change in Jordan.

Conclusion

Several issues threaten wetlands today, including unsustainable development projects, pollution from wastewater, invasive species, climate change, and water diversion for agricultural, industrial, or domestic use. Over 87% of the world's wetlands have been lost in the past 300 years. For this reason, many groups have been working to conserve wetlands as well as to create new constructed wetlands.

Environmentalists from all over the world work together to promote wetland conservation. The Ramsar Convention, also known as The Ramsar Convention on Wetlands of International Importance Especially as Waterfowl-Habitat, upholds international law regarding wetland conservation, and acts to protect all wetlands across the globe. The convention also has created action plans such as the 'Muscat Action Plan for Wetlands in the Arab Countries' to urge governments to conserve these natural habitats.

Wetlands are among the most biodiverse ecosystems and are homes to important and endangered plant and animal species not just in Jordan but also globally. Unfortunately, Jordan's only two natural wetlands, the Fifa and Azraq, are struggling against climate change, water diversion, and pollution. We call for giving attention to the restoration and protection of wetlands in Jordan and around the world, as their loss will be an ecological disaster with untold consequences.

Note of Gratitude

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