Ecosystem Engineering: Sustainable Agri-Aqua Culture using Abandoned Saline Wells to Revive Desert with Mangrove, Mullets Fish, Mycorrhizal Fungi, Bio-cement Bacteria, and Solar Energy.

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ABSTRACT

There are countless untapped subsurface wells in our desert. Many Egyptian desert areas were **reclaimed**, and be cultivated by crops of superior quality for export. But as time went on, **wells** water turned to be **more salty** as deplete, the lands yield was drastically reduced, and even worse, the majority of the crops were dying. The researchers in this project, as **agri-aqua culture** project, came up with a plan to use **mangrove** trees to restore the flora and produce sea fish under these conditions. They can survive high salinity levels. These trees have a wide range of uses, including the **extractions** of anti-cancer, antibacterial, and antioxidants compounds, also bio-purification components for water. Additionally, by **storing CO_2** emissions inside their structure, they contribute significantly in reducing **climate change**. This project also **maintains** Egypt's agricultural land. As part of the renovation, we also included **solar panels** as tool to use renewable energy. This project fulfil some **SDGs** as in Goal(1): No poverty, Goal(2): Zero hunger, Goal(7): Affordable and clean energy, Goal(8): Decent work and Economic growth, Goal(13): climate action, and Goal(15): Life on land.

Keywords: reclamation, salinity, well, ecosystem engineering, agri-aqua culture, mangrove, extraction, bio-cement, diatoms, mullets, climate change, adaptation, solar panel, renewable energy, CO_2, and SDGs.

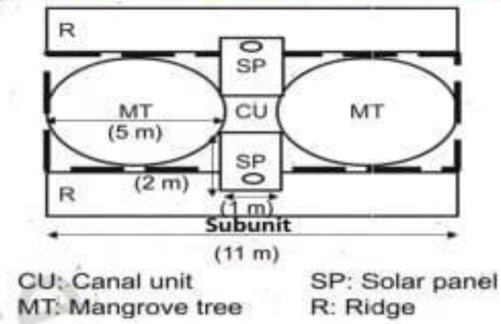
INTRODUCTION

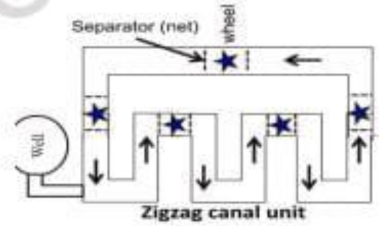
The desert in our region **(96% of Egypt area)** is vastly underutilized. A considerable portion of the reclaimed lands rely on well water. However, the farmers realized that as using of wells proceeds, the salinity of its water increases **(nearly 100 ppm/year)**, thus, cultivation shift towards certain plants **tolerate** that (*e.g., Casuarina* sp.), until the rise of salinity prevent any of our **economic crops** to be grown. Instead of **desertion** of farms or enrich them with **Nile or recycled water**, which are very **costly**, A new approach; **ecosystem engineering**, is more likely to be implemented by introducing new elements in a new way or new place for a certain goal. **Mangrove** tree, as a new element in the desert, is a tree that loves to grow in **seawater** with high salinity, accompanied with various creatures as birds, micro and marine organisms, also Mangrove has high **economical and environmental** importances. In our new ecosystem, we uses wells that became saline and consequently useless with time, we chose mycorrhizal fungi to form **additional roots that ease** absorption of water and nutrients uptake as to its symbiotic relationship with Mangrove, as well as giving **shelter for mullets fish**. We aim to revive deserted arid lands to become flourished wetlands.

METHODOLOGY

Cultivating **mangrove trees** (*e.g., Avicennia marina*) in desert requires ecosystem engineering **to convert** arid lands have saline wells to wetlands depend on saline water. We suggest the cultivation of mangrove in **basins** using the **saline water** of wells, as mangroves tolerates saline water up to **42,000 ppm**. Adding **mycorrhizal fungi** can be additional roots which stand for salty water logged habitats and enhance the absorption of nutrients. Depending on saline well water, we engineer new ecosystem composed of independent **zigzag unit** provided with **wheels** for aeration and prevention of water stagnation. Each unit is a basin composed of subunits. Each one is 11m in length and consists of 2 **solar panels** (Each of them has a width (1 m) x length (2 m), 72 solar cell equal **300 watt/panel** on telescopic leg) to help us use renewable energy, and 2 mangrove trees (5 m in diameter for each). This basin is lined by ***Sporosarcina pasteurii*** which accumulates calcium ions (Ca) over cell membrane to make **bio-cement** prevents water leakage .In nature, the roots of mangroves serve as a dwelling place for many bacteria, fungi, and algae, along with various invertebrates and vertebrates Therefore, we used **mullets fish** and **diatoms algae** that the fish feed on, as they adapt to this environment.

RESULLTS and DESCUSSION





CONCLUSION

Our new ecosystem consists of Mangrove trees, mycorrhizal fungi, mullets fish and diatoms algae to form **agri-aqua culture**. in addition to that, this ecosystem is placed in zigzag canal unit which is composed of smaller subunits and lined by bacterial biocement. Also, the presence of solar panels to provide us with renewable energy (72 solar cell equal **300 watt/panel)** and reduce evaporation. In the end, this project solves the problem of wells and lands abandonment, reduces global warming, in addition to its high-profit products.

FUTURE PROSPECTS

Our future work proposals revolved around inventing a method for **nursering Mangrove** trees throughout the **Red Sea** coasts, using their **adaptation** for its habitat. Furthermore, we propose **factories** are constructed to manufacture vaccines and other medicinal items derived from the **active components** of Mangrove trees. Also, using **solar panels** to power farms and factories is critical to achieve one of the aims of sustainable development.

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