

3. Environment



Research Team: Alternative technologies and green innovation in theory and practice

Grand Challenge: Green Infrastructure for Sustainable Development

Key Terms:

Halophyte, seawater irrigation, freshwater lens, salt tolerant, water conservation

Student Leader: Erin Hicks

Student Members:

- Jennifer Arizala - The Benefits of Seawater Agriculture in Conservation of Freshwater and Farmland in the United States
- Verlin Frazier Jr.- Application of halophytic and xerophytic vegetation to sustainable landscape architectural design
- Erin Hicks - Seawater Agriculture: Its Effect on Global Warming and our Ecological Footprint

Mentor(s) Leader:

- Ned Daugherty
- John Robertus

Team Narrative:

The Benefits of Seawater Agriculture: Combating the degradation of Our Natural Resources

Our research team's projects focused on finding alternative technologies to help combat the effects of global warming, degradation of farmland, and the depletion of freshwater resources. The main topic of interest was the utilization of halophytes, salt tolerant plants that possess high saline tolerance levels and have the ability to reclaim otherwise barren

desert and coastal lands through greening highly saline soils and carbon sequestration. The reality is that freshwater is scarce and using salt-tolerant plants and sustainable practices such as landscaping with halophytes, greening deserts and developing commercial crops, will provide alternatives to freshwater use. Referencing books such as *Salt-tolerance and Crop Potential of Halophytes* by Edward Glenn, which examines the usefulness of halophytes as a seawater crop, scientific journals found through engines as Science Direct, interviews with professionals knowledgeable in seawater based technology, and participant observation, we were able to gather data relevant to our three micro topics within the larger sphere of seawater agriculture.

The first project was completed by Verlin Frazier Jr. Verlin, who researched the application of halophytic and xerophytic vegetation to sustainable ecological landscape design. He analyzed the effectiveness of emerging halophytic agricultural technology as it relates to preserving freshwater resources. His research also re-introduced already existing xerophytic landscaping methods, which focus on utilizing plants which are drought-tolerant and are grown in indigenous areas. Verlin's analysis on alternative vegetation for freshwater conservation was completed through a case study of two regions, Eritrea, Africa, and Sonora Mexico, that have already realized the effectiveness of utilizing halophytic technology through the implementation of farms irrigated on 100% saltwater. His analysis on xerophytes included methods of incorporating drought-tolerant plants in "native" areas, or that have evolved to survive in a particular ecosystem. In addition to this analysis, Verlin described how xerophytes could be implemented into the landscape. His research concluded that freshwater would indeed be conserved through the use of halophytes, because only seawater would be used, and hardly any supplemental water would be utilized for xerophytes.

The second project by Erin Hicks focused on how we can use seawater agriculture to help mitigate the amount of greenhouse gases in our atmosphere and reverse the effects of our deteriorating ecological footprint. Seawater agriculture is an innovative approach to help impede the effects of our ecological footprint and create a more resourceful environment. Environmentalists, scientist and landscape architects are working together to create a landscape that promotes the use of our natural resources, cleans our terrestrial environment, and encourages a green lifestyle. The overall goal of seawater agriculture is to create productive, aesthetically pleasing, environmentally responsible landscapes that will enhance the environment. Through this research it has been found that through the greening of coastal deserts and the use of halophytes more greenhouse gases can be pulled out of the atmosphere. The use of seawater as an alternative to freshwater will conserve freshwater resources as well as replenish its supply.

The third project, by Jennifer Arizala, focused on seawater agriculture as a way of conserving freshwater and farmland in the United States. The main hypothesis pushed for a switch to seawater irrigation in farming, with use of halophytes as the main component in successfully farming highly saline soils, long deemed unfarmable for conventional cash crops. In the United States 41% of freshwater is used for irrigation. The implementation of a sea-water based farming system, developing a commercial crop that can produce organic byproducts, such as biofuels in the United States, provides a natural method of farmland reclamation. It is feasible to develop a halophytic farm at a smaller scale in the United States, with the right amount of political backing that would

induce policy changes regarding agriculture. Experiments with genetically altered conventional crops that have been engineered to possess halophytic characteristics have been done, showing the potential of utilizing halophyte traits in seawater agriculture.

Using these transgenic plants, which are genetically crossed with other plants for their salt tolerant traits is a far more expensive route than simply using halophytes. These findings concluded that the feasibility of developing a seawater farm in the United States is plausible with the ability to generate economic stability and reversing the depletion of farmlands and freshwater resources. The world urgently needs projects focused on solving planetary environmental problems. Seawater technologies are proven, holistic, integrated alternatives to conventional landscape development and commercial farming. Through the foresight, innovation and commitment of government officials, public policy makers and private enterprise, global environmental solutions can be realized through the application of sunlight, seawater and human intelligence.

References:

Bashan, Y., M. Moreno, and E. Troyo. "Growth Promotion of the Seawater-Irrigated oilseed halophyte *Salicornia Bigelovii* Inoculated with Mangrove Rhizosphere Bacteria and Halotolerant *Azospirillum Spp*". *Biol Fertil Soils* 32 (2000): 265- 272.

Epstein, Emanuel, Jack D. Norlyn, Dale W. Rush, Ralph W. Kingsbury, David B. Kelley, Glen A. Cunningham, Anne F. Wrona. "Saline Culture of Crops: A Genetic Approach." *Science, New Series*, Vol. 210, No. 4468. (Oct. 24, 1980), pp. 399-404.

Glenn, Edward P., J. Jed Brown and Eduardo Jed Blumwald "Salt Tolerance and Crop Potential of Halophytes" *Plant Sciences*; Volume 18, Issue 2, March 1999, Pages 227-255.

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Links:

Seawater Foundation - <http://seawaterfoundation.org/toc.htm>

Global Seawater - <http://globalseawater.com/>

Multimedia Archive:

Available presentations for this group can be found on the Senior Sequence website at: http://seniorsequence.net/?page_id=440