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Eritrea, Seawater Hydroponics

Expanding Eritrea's Economy and Lowering Hunger Levels Through Sea Water Hydroponics

Eritrea has faced a devastating war for over three decades that has left the Eritrean people with subsistence lives. By implementing seawater hydroponics, the country could potentially sustain itself and help other countries in need through trade. Low income farmers could prosper greatly through this system as well as the entire country by lowering hunger/poverty rates, increasing exports, and protecting the Eritrean environment. Barren land now has the potential to become utilized with seawater greenhouses. Crops can be cultivated at any season, securing the countries ability to sustain food.

Located on the Red Sea, Eritrea is in northeastern Africa with a population of approximately 4.5 million people. The country is bordered by Djibouti, Ethiopia, and Sudan. “Thirty years of war” with these countries devastated Eritrea, whose economy depends mostly on agriculture, and “the task of reconstruction is enormous. Eritrea is one of the poorest countries in the world. Most of the population live a subsistence lifestyle, supported by aid imports” (Economy of Eritrea).

Government wise, “Eritrea is a unitary state with a parliamentary system. The parliament elects the president, who is head of state and government” (Eritrea, *Every culture*). Over seventy-five percent of the population lives rurally; only around twenty percent are traders and workers. No major goods are exported from this forty five thousand square mile country. Eritrea has a vast geography, from lowland plains to mountains. They use both plow agriculture and agro-pastoral farming, the practice of both livestock and crop farming. Farming is small scale due to the wartime devastation. “The more thorough cultivation made possible by the plough, especially in the many areas where the layer of surface-soil is thin and light, has led to a considerable exhaustion of the land. The result is visible in the frequent periods of fallow which the Eritrean farmer must adopt,” stated S.F. Nadel (Nadel). The geography of Eritrea varies by region; “Eritrea offers three major areas in agriculture: South Western Lowlands, Eastern Lowlands and Southern Highlands suitable for crops, horticulture, dairy and forest products, livestock breeding and fattening, and poultry” (Agriculture in Eritrea).

Families of Eritrea include close kin, such as a nuclear family- mother, father, and the children they have together. The Nation Union of Eritrean Women is an organization that helps eliminate misogynist stigmas that have mostly been derailed from their defense of liberation in the War of Independence. This organization can help women out of jobs maintain a life far from starvation and dehydration most of the country faces in a comfortable environment. Common homes for lower income families include these styles: “The hidmo… made of wood, stone, and clay… The Agdo.. Raw materials used are timber, grass, tree barks, soil, and stones… The construction materials used to build Agnets are: long, dried branches; mats” (Denison).

Just under half of the prior homes mentioned do not have access to electricity and running water. “Despite working hard Eritrea has made only ‘moderate progress’ in achievement of the MDG drinking water target with 58% of the total population having access to an improved drinking water source” (Eritrea, UNICEF). Nearly half of the country does not have clean water for drinking, making the use of clean water for farming unlikely. Based on the design of these homes, there is a viable way to create a greenhouse out of atypical materials and lay out. The Agdo design include an inverted cone roof could be made, unconventionally, from recycled plastic bottles collected from fundraisers in schools and any company wishing to participate. This could catch interest in company owners, as taking part in giving back to a community could mean an easy tax break. Outsourced material include; recycled plastic roofing, solar panels to the filtered water containers, honeycomb polycarbonate. As the greenhouse begins making money from it's waste-based exports, a water system could be installed to cut back on the work it takes to hand water. Walls could be stone and the dried branches seen in the Agnet design with plastic bottles to allow enough light for optimal plant growth, eight hours, with the exception of two portions of the cylinder walls being a polycarbonate in the shape of a honeycomb. The continuous circulation of heated

freshwater should keep the structure at a constant ninety percent humidification, along with the correct application of bottles and stone material.

Eritrea's agriculture is impacted by less than optimal growing conditions, such as; climate, altitude, and thin or light surface soil. "The Eritrean plateau has two cultivation seasons. The majority of the crops are sown in the main rainy season, in June- July, and harvested in November...fields are cultivated for only three years in succession and left fallow for two," explained S.F. Nadal (Nadal). There are few ways to fix these problems, each one being expensive. As mentioned prior, half the country does not have access to clean drinking water; therefore, it is unlikely to have water access for farming. Fallow soil treatments include immense amounts of freshwater and/or fertilizers. Implementing a traditional greenhouse would help stabilize temperatures in non cultivation seasons yet: requires freshwater. Currently, rainfed cultivated land covers only 3.4 percent of the country (Splinter).

Another challenge Eritrea faces is its low exports. If the export of salt could be increased, the resulting profits would benefit all Eritrean people. "Being one of the least-developed countries on the planet makes it difficult for the government to implement lasting changes to prevent hunger in Eritrea, as the infrastructure and supplies for long-term economic changes and aid programs are largely lacking." Not only are aid programs lacking, but "in the past three years, the Eritrean government has focused on improving agricultural infrastructure in order to decrease food insecurity, and though hunger has declined during that period, it has not declined significantly enough for Eritrea to achieve the first Millennium Development Goal of halving hunger and poverty levels by 2015" (Riley). By using seawater hydroponics, hunger rates will improve as well as the country's economy through exports. As farmers are the lowest paid among careers in Eritrea, seawater hydroponics could bring more money to low income farmers. Besides what hydroponics can do for a country, the environment is impacted minimally.

Some environmentalists make note of "the problem of the disposal of the highly concentrated salt brine that's dumped back into the ocean, which can be too salty for marine life to inhabit" (Amelinckx). In this case, the salt brine would be packaged and sold to other countries to prevent iced-over streets. Salt brine is proven more successful in preventing unsafe driving conditions. Erin Cassidy explains, "Roadway crews are now using more effective measures to prevent dangerous road conditions. Using salt brines, which is any liquid salt mixture, before anticipated snowfall was discovered to be more effective than using solid rock salt. Brines have the same melting characteristics of solid rock salt, but since it is applied in liquid form, the salt can begin to work immediately. The brines are also more effective in lower temperatures." (Cassidy).

Seawater hydroponics uses two readily available resources: sea water and sunlight. Water is a renewable resource, meaning it will not run out as well as the latter. In South Australia, Sundrop Farms "is the first commercial agricultural system of its kind: It doesn't use groundwater, soil, pesticides or fossil fuels to grow crops… the construction of a nearly 50-acre facility in 2014 that, as of earlier this month, is now fully up and running with a projected capacity of 18,000 tons of tomatoes- the crop the company is focused on at this facility- a year" (Amenlinckx). Instead of producing a mass amount of one specific crop, the system could be used to grow a variation of food. Available fruits and vegetables are marketed seasonally, but with a hydroponic system it will always be the right growing conditions year round. "Some Eritreans cannot afford a meat-based diet and they eat *shiro* a chickpea porridge made in many different ways" (Eritrean Cuisine). Chickpeas do well in hydroponics, and new varieties allow for easy growth hydroponically, “The development of new, dwarf, or ‘container’ varieties of peas and beans are particularly advantageous to indoor gardens and small hydroponic systems, as they produce high yields on relatively small and compact plants that don’t require trellises or supports like the tall climbing types

do.” (Morgan). Chickpeas offer a cost effective protein for lower income Eritreans, and already commonly eaten in the country. Chickpeas are a member of the legume family, and the seed pods

produced a symbiotic relationship with bacteria, rhizobia, within nodules in their root system. This process creates nitrogen compounds which have a major advantage in hydroponic systems. The legumes provide a nitrogen fix to a system without the organic solution found in soil crops. As hydroponic crops are under rapid growth conditions, Nitrogen generally cannot keep up with the vigorous plant growth, therefore chickpeas can eliminate the need for uncostly fixes.

Chickpeas, or Garbanzo beans, are a good choice to grow in the seawater hydroponic system due to the ability we have to store the beans for a later date. This could be beneficial for the country, as the beans can make their way on anyone’s plate. The drying process will add time to the process of getting the food grown and to consumers, but will provide sustenance to the country. To store the dried beans I would recommend another fundraiser, where people collect their old store bought containers to keep the beans safe from pests and humidity which causes the food source to spoil.

Vegetative nutrients necessary for hydroponics include; 6.00 grains of Calcium Nitrate, 2.42 grains of Magnesium Sulfate, 2.09 grains of Potassium Nitrate, 1.39 grains Monopotassium Phosphate, .46 grains Sulfate of Potash, and .4 grains of seven percent Iron Chelated Trace Elements. The amount of each formula is based on a one gallon of nutrient solution. After receiving necessary nutrients, greenhouse workers can mix the solution themselves and alter the amounts based on the crop yield.

As for power of Hydrogen of the water, “Commercial growers often use a narrower range of 5.8 to 6 for most crops when they are using automatic controllers that regularly dose acid into recirculating systems to maintain this precise level” (Morgan). A recirculating system would be helpful for this method, to maintain precise regulation of pH and nutrients. Plant nutrition in hydroponics can come from a premixed nutrient solution which contains different minerals plants need to grow. “Many growers prefer to buy a 'pre-mixed' nutrient solution which simply needs to be diluted (for liquid concentrates) or dissolved in water before use. Often these 'pre-made' nutrients come in 2, 3, 4 or even more 'parts' so a grower can change the ratio of the mineral elements to allow for either vegetative or fruiting growth or for different crops” (Morgan). A basic premixed solution will work well for farmers using sea water hydroponics. The are more natural ways to alter the pH of water in one of these systems which could be a cost effective option. To measure the pH, the greenhouse needs a partspermillion meter. A fix for high reading pH is white vinegar, as only a few tablespoons are needed to lower the pH drastically in one gallon of water. The Basic baking soda can be applied to raise power of Hydrogen.

Crop yields in hydroponics do extremely well when compared to regular soil farms. “Hochmuth says an average acre of traditionally farmed land will earn a farmer between $20,000 and $30,000 per year. An average acre of hydroponically grown crops will earn between $200,000 and $250,000 per year” (Podolsky). With “70% of Africans dependent on agriculture of livelihoods” (Biteye), many people will benefit greatly from technology such as a seawater hydroponic system. As for the greenhouse, water is pumped from the ocean to converters, which are distillation plants to separate the water and salt. With solar panels, the sun’s energy is harnessed, the heat is directed to a tower, heating the water to steam, and filtering out salt. Solar panels are costly when installed but are a renewable source of energy, proving, over time, to be more cost effective. Sunlight’s energy is a renewable source with a low impact on pollution. To improve Eritrea’s exports of salt brine, which is proven more effective in lower temperature areas to prevent icy roadways, seawater hydroponics could be a cost and environmentally effective option. Due to the lack of not only food, but having no access to fresh water puts low income families in severe danger. Another feasible way to help imports would be to turn the salt water waste in to sea salt. This process would include the separation of sand and debris by using a loose woven gauze to filter, then to boil ninety percent of the filtered seawater. Next, the salt infused water will need to sit uncovered, for three to five days, or until the water evaporates. As the freshwater drips down honeycombed shaped pads, the humidity of a greenhouse will increase to ninety percent. A portion of this distilled water can be bottled for the country to consume. This may appeal to UNICEF as the organization is currently aiding Eritrea in the water crisis. Funding is an issue for anyone planning to make a difference, and with the help of investors like UNICEF, can be eliminated.

Hydroponic farming could also benefit this self sufficient society sustain animal based farming, for fodder can be grown in the system alongside the legumes. The price of grain is already high, and forecasted droughts could put a stint in grain production. Pedretti explains, “A number of companies have developed systems for automated or semi-automated sprouted barley production. Some of these systems have recently been installed (or are being installed) on organic dairy farms in the Midwest” these installations have been proven more stable, with reliable production. One issue the farms faced was overheating from the LED lighting. One site describes Eritrea as “sunny 68.5% of daylight hours” (Sunshine & Daylight Hours in Asmara, Eritrea) based on this information, The greenhouse in Eritrea would have enough light through the plastic walls and ceiling to sustain plant growth. In comparison to regular grain, “improved protein, starch and sugar” (Dr. Sylvia Abel-Caines) which “reduces acidosis problems, as the rumen pH stays more stable without the constant input of starch” (Pedretti). By Implementing barely specifically to the system, people’s dietary needs of grain and protein can be fulfilled. The money saved in one system is drastic, “At conventional pricing, it costs between $8 and $10 per day to feed a Holstein cow on a standard grain/forage diet. Jim Kern reported that it costs about $0.80 to produce 1 Animal Unit, or 20 pounds, of fodder (conventional prices) using a fodder feed system.” (Pedretti) as seven dollars and twenty cents to nine dollars and twenty cents being saved per cow.

As for funding, UNICEF might invest, due to their help in the water crisis stated earlier. The United Nations, as well as the Borgen Project, would be potential investors due to their help with hunger issues within Eritrea. The Eritrean government would also put forward some funding to help the people of the country as well as boost the economy by trade of salt brine and the taxes they choose to put on it. Within Eritrea “there is no lack of determination. The Eritreans have always had a justified reputation for being industrious, and their determination to rebuild the country, so clearly visible, is matched by their courage in winning their freedom against massive odds. A fundamental principle of the national development program is 'progress through self-reliance'. Eritrea has never accepted any aid that had conditions attached.” (Economy of Eritrea) With funding for sea water hydroponics, the people of Eritrea would become capable of providing a steady amount of food for themselves, allowing them to practice self reliance.

Potentially, seawater hydroponics may help Eritrea recover from decades of war. Cleaning up what the war left behind will provide the country with what it is currently lacking. The amount of food that can be grown by utilizing seawater hydroponics can help feed this growing population. Benefits lie in the economy, food security, and environmental protection. Funding is the biggest downside to this system but as the country utilizes the hydroponic system, the issue of funding could be eliminated. The people have shown to persevere through a three decade long war, and will continue to do so by implementing seawater hydroponics into their self reliant society.

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