Thesis Project Portfolio

Hydroponic Crop Cultivation (HCC) for Food Security in Small Island Developing States

(Technical Report)

Incorporating Hydroponics into Academic Curriculum to Promote Education and Food Security in Developing Nations

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Sociotechnical Synthesis

(Executive Summary)

Hydroponic Crop Cultivation in Developing Nations

Hydroponic crop cultivation (HCC) is a method of soil-less agriculture that instead uses nutrient enhanced water to grow nutritious fruits and vegetables. HCC uses 90% less water and 75% less land space as compared to conventional crop cultivation. Clearly, HCC offers a large source of untapped potential as it can provide food for hungry individuals around the world. Specifically, small island developing states, or, SIDS, are particularly vulnerable to food insecurity because of their geographic isolation and reliance on food imports. In the aftermath of natural disasters, locals of SIDS can be left without a reliant food source for months. To combat this issue, my technical project focused on enhancing the design of a low-cost HCC unit to be placed in the Bahamas. More specifically, my team and I focused on strengthening the resilience of the unit to storms and hurricanes. In conjunction, my STS research sought to normalize and introduce the use of this new agricultural technology in developing nations by incorporating hydroponics into academic curriculums for young students.

Furthermore, in my STS research, I assessed current hydroponic curriculums through case studies and a detailed literature review in order to better understand what factors lead to a successful hydroponic program. The factors that I researched and analyzed were appropriate age level, academic environment, and levels of teacher involvement. The deliverables of my paper include suggestions for tailoring these three components in order to optimize the success of the educational program. With improved education, the new generation of locals in developing nations will be exposed to hydroponic crop cultivation and hopefully bring this knowledge with them into their communities as well as future careers.

My technical design team and I worked to create blueprints for the structure and design of a storm resistant, microgrid-supported hydroponic unit to be deployed in Abaco, Bahamas with the hopes that this unit will provide a consistent food supply for locals. Our design was influenced by four main attributes, including a versatile design, abundant water supply, solar power, and optimal crop selection. To improve versatility of the design, we designed the unit to be easily collapsible and transportable so it can be brought inside before a natural disaster to protect the crops. Additionally, we created design specifications that allow the unit to use water from a variety of sources, including well water, tap water, and rainwater. In SIDS, the grid power system can often be unreliable; therefore, we designed the unit to be micro-grid supported so it can run on solar power. Finally, we assessed several types of crops and associated metrics to create an excel spreadsheet that provides a conditional recommendation on which crops to grow based on a farmer's personal preference.

In conclusion, my STS and technical research projects helped to analyze the potential for hydroponic crop cultivation in developing nations. My technical team and I designed a storm-resistant unit that will allow local farmers to maintain a reliable food source consisting of hydroponic produce. My STS research focused on introducing hydroponic technology to students through an academic curriculum, so that eventually, these students may pursue agriculture as a career themselves, thus bringing an advanced background of hydroponics to the table. Overall, my research will help developing nations maintain a sustainable food source for locals.