Lettuce Turnip the Beet: Abstract

In a world where healthy food has become a luxury rather than a necessity, companies like Global Food Foundation have been tasked with the challenge of providing proper nutrients to food deserts, or areas of people in which do not have access to nutritious food. Food deserts struggle with limited availability of sustenance, an increase of cost of the food given, and dependence on external sources to supply nutriment to the people. Across the globe, people strive to receive any form of aliment in order to survive. With the implementation of the suggested plan, there will be a shortage of food deserts, rather than food itself.

The plan has 3 main items, which were condensed to form one large-scale system which can be effectuated into a variety of geological areas. The first portion of the solution was applying urban/community greenhouse gardens to create a more personal, closer form of growing healthier food year-round, effectively decreasing dependence of outside produce suppliers. The second item of the solution was to employ a homegrown system of aeroponics for irrigation, which harnesses no soil and minimal amounts of water. Therefore, it can be used worldwide, including locations with sparse water resources. Expanding off of this, the final factor of the plan is using vertical urban farming, which grows food in vertical or inclined surfaces in other structural buildings, using indoor farming techniques and controlled environmental factors.

In order to create the final proposal, the benefits of each design were integrated into the system. With the closed system of the greenhouse, the low water and high output of aeroponics, and space efficiency of the vertical gardens, the blueprint will be versatile in most climates in different locations internationally.

The ideal location to implement the plan would be in a food desert in the lower socioeconomic classes centralized in Los Angeles, California. With the localized access to vertical urban farming, utilizing aeroponics to grow the food, and greenhouse gardens, the food desert will soon dissipate due to a “cornucopia” of food, year-round. Soon enough, with a surplus of food, the cost of aliment will decrease in response, making healthier food more easily accessible.

In conclusion, the execution of the plan in food deserts can give a positive impact on the areas of people, making a more efficient and healthier place for people to live in. With year-round, versatile close systems, people are encouraged to grow food independently while remaining environmentally conscious. Together, we can help rebuild a flourishing world, one bite at a time.

Lettuce Turnip the Beet

Hunting and gathering have been replaced by a short hop to the nearest convenience store to pick up a frozen pizza. However, in the rush to make food convenient and attractive, nutrition has become an afterthought. The situation is so severe that many impoverished citizens, those who are most susceptible to poor health conditions, have found themselves living in food deserts: areas with limited availability of nutritious foods (Hendrickson et al., 2006; Food Desert Locator, 2016). At least 23.5 million people in America inhabit such regions, while millions more only have access to processed foods from local stores (Smith, 2012). To prevent this pandemic of nutritional poverty with accompanying skyrocketing rates of obesity, diabetes and heart disease, a community greenhouse solution incorporating vertical aeroponics has been developed that is cost-efficient, requires minimal space and provides a consistent yield of fresh produce year-round.

To design and evaluate the merits of various food production processes, several criteria have been considered. Transportation costs have been documented as huge factors in determining food price, quality and availability (Perez, 2010; Walker et. al, 2010), so solutions have been considered which minimize the distance from farm to consumer. Start-up investment and maintenance, along with energy consumption during operation are also key costs to be minimized (Pirog et. al, 2008). The dependence of food costs on unpredictable economic factors must further be minimized (Pirog et. al, 2008, Hendrickson et. al, 2006). Solutions have been developed to minimize all the above factors and so provide a stable and affordable source of nutritious and healthy food.

One design considered is urban/community gardens, which offer a local, more home-grown option. Independent from distant farmers that set their prices and ship food from afar,

greenhouse gardens provide local control and can optimize space usage by utilizing vacant lots, warehouses, and parks as growing areas (Corrigan, 2011; Community, 2017). Although installation costs reach approximately $1,000 per 6-by-11 meter greenhouse (Hickman, 2017), simultaneous year-round production of crops at optimal growth conditions will guarantee a return on investment, along with the added benefits of no agricultural runoff, no pesticides, and low water usage (Hickman, 2017). Especially when paired with hydroponics, where plants bathed in nutrient-rich water are grown without soil, greenhouses can produce roughly 65 tons per acre of fruits, veggies, herbs, eggs, and honey under ideal conditions (Fox, 2011).

[1]Another potential solution utilizes aeroponics, similar to hydroponics but using nutrient vapors instead of water. This farming method reduces water use by 98%, fertilizer use by 85%, and pesticide use by 100% when compared to a traditional soil-grown system (Dunbar, 2017). It requires an investment in setup, but its comparatively lower maintenance costs and ability to deliver an 80% increase in dry-weight yield, as well as a 300% productivity increase, are significant benefits (AlShrouf, 2017). With its high efficiency and productivity, home-based aeroponics systems are a viable solution to the food desert crisis.

An additional technology that can enhance these local farming options is termed indoor vertical farming, which conserves space by arranging plants in various vertical configurations, including pipes, walls and rotating vertical conveyor systems (Despommier, 2013; Despommier, 2011). By protecting the crops from heavy evaporation, harsh weather conditions, and pests, vertical farms take advantage of one acre of land to produce as much yield as 30 acres of traditional farmland (Banjeree, 2014). Although installation the plant towers is expensive - almost $1,000 per specialized tower - and uses ordered materials (Birkby, 2016), an application

in Singapore since 2014 has succeeded in providing locals with comparable costing, easy-to-access greens (Krishnamurthy, 2014).

Combining the above systems into a large, community garden aeroponic greenhouse utilizing a vertical geometry yields a practical and efficient solution to food deserts. The design provides the local control and constant maintenance characterizing community gardens, efficient and protective greenhouses, the low water use and high yield of aeroponics, and space efficiency of the vertical gardens. The greenhouse maintains provides adaptability to different climates and regions (Learn, 2017).

While the proposed design requires an initial investment in hardware as compared to a soil-based traditional farm, the greenhouse can be made economically from a wood or recycled metal frame with translucent tarp. It will use less land and will be cheaper to operate than a traditional farm (Dunbar, 2017), enabling year-round efficient food production. Furthermore, because aeroponics "succeeds more in vertical growing arrangements," our vertical aeroponic design will be ultra space-efficient (AlShrouf, 2017).

A possible challenge for our design is the need for reliable access to electricity for the aeroponics nutrient delivery. Two solutions to this challenge are use of solar panels, or of manual vertical farming techniques (Holloway, 2012). Another challenge is maintenance of the misting system and climate-control. Although a new ultrasonic nebulizer has been designed to not clog (Mohammad, 2000), careful maintenance of the nutrient solution spray is still required.

The South Los Angeles food desert locations such as Compton, Bell Gardens, and Harbor City (Food, 2017) are promising regions to implement the new system. There are many vacant lots and under-utilized, post-industrial spaces to construct both the proposed gardens and markets

to sell the products. The vertical aeroponic greenhouse design will enable people in these regions to enjoy year-round access to healthy and affordable food.

Food deserts are a multi-faceted problem that demand complex considerations. Community greenhouses that use vertical farming and aeroponics address resource conservation, economic, and capacity issues, allowing for a well-rounded solution that is applicable to any worldwide scenario. By first testing and refining the design in impoverished locations like South L.A., and then expanding to other locations while making regional adjustments to the design specifics (e.g., greenhouse construction and aeroponic vaporizers), people around the world can become more self-sufficient and have ready access to healthy produce.

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