Feeding Future Cities

Problem Definition

Era Verde is located between Guadalajara and Aguascalientes at an elevation of 2,600 feet. The lush, mountainous region cradles our city within but is split by a deep gorge, which is home to the Rio Balsas River. It is an attractive place for investment because of its geographic proximity to Mexico City, but, with a meager population of 229,000, our
city still has room to expand. Culinary norms vary based on income and social class. Working class staples include corn, wheat, beans, rice, tomatoes, chili peppers, and chorizo. Middle and upper income Verdeans’ meals are similar to Americans and Europeans. Mexico has a strong tradition of farming which has become increasingly important to the economy due to deregulation and privatization.

Agriculture is enhanced here because of its mild climate and average rainfall of 100 inches. Crops account for 50% and livestock for 30% of agricultural output. There is much land that is available to grow crops because of its irrigation programs initiated by the government in the 1940s. However, because of increases in population and a reduction of land available for food production, we designed a solution to feed our city.

Specs and Solution

The requirements of a healthy diet, which are fluids, amino acids, fatty acids, vitamins, minerals, and calories are provided by the products
it produces. We based the food needs of our citizens on a 1,500 calorie diet of the two most common foods, beans and tomatoes, which are strongly tied to the Mexican culture. We genetically combined the pinto and soy bean, called the pinyoy, which tastes and cooks like a pinto. It still retains the benefits of soy which is rich in isoflavins, helps regulate inflammation, and has disease fighting capabilities. Pintos are fat free, high in protein, help lower cholesterol, and regulate blood sugar. Our genetically combined tomato and chili pepper, called the chilio, has the taste of a tomato with the spiciness of the green chili. Tomatoes are rich in disease fighting antioxidants and help to prevent osteoporosis. Chili peppers boost the immune system, prevent stomach ulcers, stop the spread of some cancers, assist in weight loss, and lower the risk of type 2 diabetes. To feed the city for a year, we need to produce 13,740 metric tons of chilio and 14,427 metric tons of pinyoy. The robotic planting, tending, and harvesting of these plants is determined by the agricultural cycle which includes seeding, germination, watering, pollination, and harvesting.
Typically food is grown in rural farms, but Verdeans are way ahead of their time in 2025. They developed the Fully Integrated Growing System known as FIGS. The system includes vertical growing tubes that are integrated into the walls of the regional Gorge.

Our merry-go-round concept allows plants to take maximum advantage of sunlight as they are revolved continuously inside the tubes. Urban farm resources include engineering knowledge, water, and nutrient rich cow manure. Also, locally mined silica, limestone, and soda ash are the ingredients needed to create tempered glass for the vertical greenhouses.

LED lights are interspersed among plant leaves. Because each leaf receives maximum lighting, they gain the most benefit from vitamins and minerals and grow 10 times faster than traditional growing systems. In addition, sensors are strategically placed throughout the growing tubes and are linked to the master control system. It regulates humidity, water, light, nutrients, air, and temperature levels. For example, when a
sensor detects less than optimal light, LED intensity is increased in that quadrant. Hydroponics negate the need for soil. Plants are suspended and roots are sprayed with a mist that contains all the nutrients and enzymes needed for ideal growth.

Our FIGS system uses an energy recycling process which regulates the optimal temperature of 70°-82° F. The vertical tubes are double walled, and, as the air temperature rises between the glass layers, heat is captured. Sensors regulate this capture of heat, and vents located at the bottom of the tubes open and close as needed to allow intake of outside air. Wind turbines located on top of vertical tubes rotate the plants and excess energy is sent to the power grid.

Risks to using this type of system include damage to the tubes during natural disasters and natural wear and tear. We incorporate self-healing nano-technology into the glass and other associated infrastructure. Another risk is electronic equipment failure such as
breakdown in the integrated control system. To decrease this chance, sensors detect failures beforehand and repairs are made. Also, we use dual redundancy, to decrease the chance of system failure to 0.001%.

Benefits of the indoor environment are a reduction in water usage by 90% and a decrease in damaged and/or wasted produce from 50% to 10%. Any waste that is produced is recycled into fertilizer, and because the plants are enclosed, use of pesticides is significantly reduced. Air quality is managed through SEAS or Systematic Exchange Air System. Air is continuously monitored and exchanged between vertical green houses and commercial/office buildings. This exchange not only benefits plants with carbon dioxide, but also benefits citizens with oxygen. A tradeoff is the cost of the system. However, we convinced investors to buy into the system because of Earth’s exponential population growth. Loss of farm land necessitates efficient use of space which vertical farming incorporates.
Understanding Engineering

Engineers are vitally important to us all as they create solutions to problems in society. Many engineering disciplines were involved in the creation of FIGS. Genetic, food, and agricultural engineers worked together to create pinyoy and chilio. Electrical and computer engineers helped create the sensor and control system. We believe mechanical engineers were the most crucial to our solution. They were involved each part of the design, which includes the growing apparatus, sensors, power, cooling, watering, robotics, and the main vertical structure. Engineers apply scientific concepts to practical applications which helps make work easier and enriches everyone’s life. Without engineers, we would not have been able to create a sustainable food growing system to feed the entire city.

Word Count 999
Works Cited


