UNIV 391 Grant Proposal

San Pablo Community Plant Nursery

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The collaboration between the California Polytechnic State University of San Luis Obispo and the students and community members of the village of San Pablo, San Marcos, Guatemala has enriched the lives of both groups through a "learn-by-doing" philosophy. Both communities have brought their own unique life experiences and knowledge "to the table", so to speak. As a village already known for being proactive and self-improving, San Pablo is the perfect community in which to begin a community nursery. Members of the village have expressed the desire for a dependable and more accessible way to obtain tomato seedlings. Our proposal seeks to facilitate this need and will require approximately $13,600 to complete the nursery itself and provide enough funds for around 300 tomato seedlings. Below is a question and answer format of the grant proposal guidelines explaining the intentions and proposed methods for this community nursery.

> ***Problem:*** *What problem(s) are you are trying to solve? Why is your innovation needed?*

San Pablo residents are purchasing seedlings from nearby villages for growing personal crops. Our innovation is needed to minimize costs to San Pablo residents as well as create an educational, sustainable business that will grow over time.

> ***Solution:*** *What is your solution? What is the value proposition?*

Create a greenhouse nursery and everything inside where the San Pablo residents can cultivate crops like tomatoes for home use. This greenhouse will be sustainable, and only require minimal care. Along with a greenhouse a business plan will be developed that the San Pablo residents can reference, as well as teach from it. Eventually, the greenhouse nursery will be able to produce an abundance of crops so that the residents can export them. We have completed a lot of research that will keep the creation of this greenhouse and business costs very low to the residents. Some of the research that we have found is planting deciduous trees around the greenhouse that will insulate the green house. We have thought how we can obtain maximum sunlight 365 days of the year, and the 'green building materials' that can be found in San Pablo.

> ***Design:*** *Does your solution work (yet)? how does it compare to what's already out there? What stage are you at with regard to concept/prototype/testing? What will it cost?*

We are not sure as to whether this is a solution to a program, but through our extensive research found that it is a possibility. Currently there is nothing out there that compares to our project. Below is a description of the different attributes of the project which are key components to the solutions of this project. In regards of what stage we are at regarding concept/prototype/testing, we have compiled extensive information and suggestions that we will pass on the subsequent class of this series. The next class will apply our research to the idea of a community plant nursery that potentially solves the San Pablo problem. The other class will also be in charge of putting our plan into action.

Greenhouse Covering Materials

There are a number of options that we could use for covering the greenhouse. Economically, we can rule out such coverings as glass and fiberglass; they are just too expensive for the locals of Guateca. The cheaper options are film plastic and Double-wall plastic. They each have their advantages and disadvantages but the Double-wall plastic has a key feature that sets it apart from the Film Plastic. The Double-wall is a rigid structure with double layers of acrylic or polycarbonate separated by webs that give long life (up to 10 years) and retain heat within the greenhouse. This is a key point for the area considering temperatures reach freezing at night. The constraint with double-wall plastic is that 10% of the heat is lost with each layer. Therefore, only 80% of light is getting through the plastic. Of the greenhouses in San Pablo currently, none that we know of use the double-wall plastic and instead use a single layer.

Foundations and Floors

After some reserarch, we have come to what we think to be the most economically suitable, strongest, and best heat retaining foundation and floor. The average dirt stays a temperature around 55 degrees down to three feet below the topsoil. By digging the greenhouse into the ground, it is protected from wind that would normally threaten a greenhouse that was not dug into the earth. Additionally, a large area of the double-walled plastic on the sides of the greenhouse will be eliminated which reduces the chance of heat loss. We will use old tires filled with dirt or black barrels filled with water to support the greenhouse walls. These materials will reduce budget costs while being environmentally responsible. The tires and barrels are used on the sides of the excavated greenhouse to support the skeleton of the double-wall plastic. The tires and barrels will also attract heat from the sun and retain it, keeping the greenhouse warm through the cold nights

A great attribute about digging the greenhouse into the ground is that there are virtually no constraints to the design besides the extra labor to excavate the hole. And since the plants are place above the ground on shelves, no direct sunlight to the plants is lost.

A low-cost, practical floor will be as simple as using several inches of gravel instead of concrete. The gravel can also be used for drainage of excess water. With this system, water can be sprayed on the gravel to produce humidity within the greenhouse if needed. A walkway of concrete or other big stones is recommended for ease of access to the plants

Heating

It is required of the caretaker to the nursery to manipulate and maintain a sustainable environment in the greenhouse. This is done by using heaters, fans, thermostats, and other equipment. Several attributes to our greenhouse mentioned already will reduce heat reduction. But for those really cold nights in San Pablo, an extra layer of insulation might be needed to ensure the safety of the plants in the greenhouse. A cover that can be pulled over the greenhouse is a simple solution that will keep the warmth from escaping. We would prefer to find a cover in

the local area that is a material of no use to anybody. A lot of materials can be used for this cover, as long as it is semi-thick but not so heavy that it threatens the instability of the greenhouse

Air Circulation

During the winter months, air circulation can become a factor. Without a circulation system, hot air will rise to the top of the greenhouse and cold air will settle at the bottom. This thermal convection can be dangerous for the plants. A much faster and even circulation system must be created. Fans placed horizontally from each other can achieve such a uniform temperature that we are looking for.

Ventilation

Ventilation is a simple idea to understand. It is needed during the summer months in order to exchange hot air for cold air, cold air for hot air, remove the moisture, and replenished vital carbon dioxide. Roof vents allows for the warm air to escape from the sides while sucking in cooler air from side inlet vents

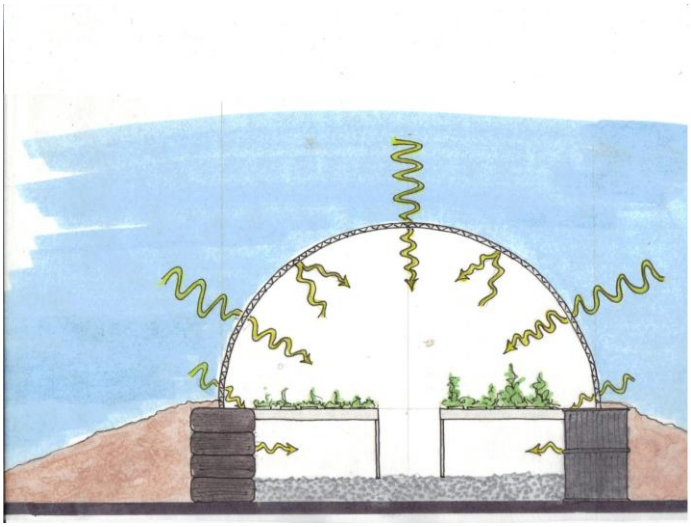

Figure 1: Sample design of greenhouse

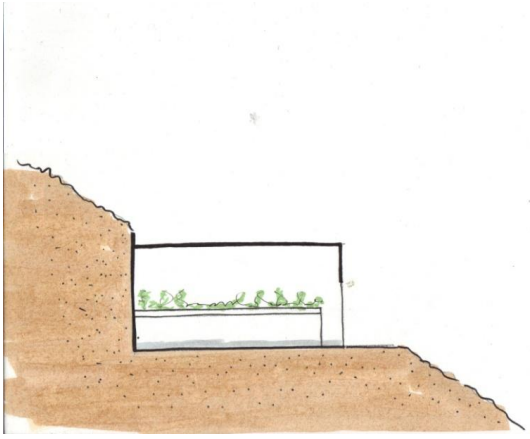

Figure 2: building greenhouse into side of a hill

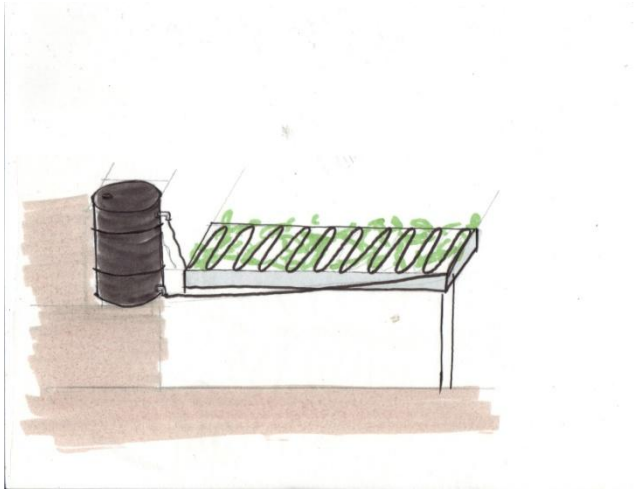

Figure 3: water heating technology

Cultivation Process

Plant Type

The main crops grown and utilized in San Pablo include potatoes and tomatoes. The village has already found a successful method of starting potato plants, through quartering whole potatoes and planting them. However, they lack a similarly successful manner of starting tomato plants. Currently, the village's people travel out of town to obtain tomato seedlings, wasting both time and money. Thus, the focus plant of this project is the tomato plant.

Materials

The basic needs in regards to cultivating the tomato seedlings include containment, nutrition, and water. The seedlings can be housed in various items. For instance, a more tailored option is what is termed a seed pod. A seed pod is a mesh casing that is filled with nutrient rich starter soil. The seedlings can germinate in the pods then the whole containment system can be transplanted into the ground to develop into a full-grown tomato plant. This is due to the fact that the pods are environmentally friendly and biodegradable. They will break apart naturally once the roots of the seedlings spread. An additional method of cultivation includes planting the seedlings in a rectangular slab of soil and then dividing the soil slab into numerous squares, each containing a seedling. This is simple approach to separating the seedlings and would require the use of a cutting device, whether metal, plastic, or cardboard. The soil cubes are then transplanted into the ground when ready. Using this method, the soil around the seedlings is less contained and compact. For more structure, boxes or plastic pots may be utilized. These allow for the soil to become slightly more compact. The roots must be loosened before transplantation with this method of containment. All containment methods previously listed will be effective in producing seedlings, yet they vary in the mode of transplantation. Seedlings in general require specific nutritional soil as opposed to plain ground soil or top-soil. Once they have grown enough for transplantation, they can be put in less nutrition rich soil. In regards to hydration, they seedlings need to be watered regularly. Thus, access to a steady water source is essential for their successful growth.

Growth Requirements

Tomato seedlings require a somewhat extensive amount of tender care. The various areas in

which they must be closely monitored include temperature, hydration, light, and nutrition. Tomato seedlings, as well as whole plants, require the temperature in their environment to remain relatively constant during their growth and development. Their preferred temperature range is from 65 to 70 degrees. Thus, a sealed and regulated external environment is necessary to house the seedlings. Regulation from this temperature range will stunt growth and cause a lag in the normal growth time of approximately one to two weeks. In order to produce a successful yield of seedlings, it is imperative that the temperature be maintained.

Tomato seedlings require varying degrees of hydration during their growth and development. In the initial stage after planting the seeds, they should be watered moderately, avoiding soaking the soil. It is essential that the seeds do not receive too much water when they begin to germinate. After this initial watering, they should be kept hydrated and the soil should be saturated.

Varying amounts of sunlight (or artificial light) can be shown on the plants, with those varying levels of light determining the rate at which the seeds germinate and grow. In order for seedlings to grown within one to two weeks, they prefer to receive between fourteen and sixteen hours of light a day. Less light, to a certain extent, will still allow for successful growth, however, the time in which they grow will be slowed down. Instead of happening within one to two weeks, seedlings may take three to four weeks, or longer, to grow. An artificial light source may be utilized during the growth of the seedlings. However, this method either requires the use of the grid, or the obtaining of solar panels to power the electric light source.

As mentioned briefly earlier, seedlings require nutritious soil during the early stages of their cultivation in order that they develop properly. Simple ground soil or potting soil will not provide enough nutrition for the plants, due to the fact that they are low in nitrogen content, an element essential to the success of any crop. Thus, soils rich in nitrogen, phosphorous and other essential elements must be used to initiate seed growth.

Recycling unwanted materials

Our mission in designing a community nursery is to benefit the village as much as possible. We would like to both save the people time and money, as well as potentially clean up the community. Thus, it is a mission of ours to use materials that are already prevalent in the village itself. This would help eliminate garbage and waste around the community while fostering the mentality of the importance of using all materials creatively. Old plastic water bottles can be cut and used for seed containment as well as egg cartons. To mimic the nature of the mesh-like seed pellets, old tee shirts may even be used to contain the seedlings. The availability of any of these such materials, or similar materials, will allow us to truly utilize the materials already present in the village for brand new purposes.

Pricing

The main materials, in regards to the cultivation of the seedlings, to be purchased include the containers, soil, and seedlings themselves. In regards to the containers, seed pellets, complete with their own nutritious peat moss soil, can be purchased for approximately $0.12 per pellet. If instead, there are materials suitable for recycling into seedling pots, then the cost for containment will be minimal to non-existent. However, then a nutrient rich soil type will also need to be purchased. Soil suitable for seedling growth costs around $7 for a bag that contains 9 quarts of

soil. The seeds themselves vary in price depending on specific tomato type. They range from $1-4 per container of approximately 30 seeds. The total cost of supplying the initial seedlings and other growing materials depends on the size of the greenhouse created but can be calculated using these approximate numbers.

Containment			
Materials	**Cost (U.S. dollars)**	**Benefit**	**Drawback**
Soil Pellets	$0.12/pellet	biodegradable	accessability
Soil Cubes	N/A	made purely from soi	need to break apart roots
Plastic bottles	free if made from tras	readily available	toxic to environment
Peat pots	$6.00/30 pots	easy to use	accessability
Plastic pots	$5.00/12 pots	easy to use	accessability
Clothing	free if made from tras	readily available	may not break down like pellets

Business Plan
In collaboration with another Cal Poly group, we are developing a business plan that we can present to the San Pablo residents to implement. A cool thing about this business plan is that it can be applied to many different developing areas with only a few modifications.

With the completion of this project, both group will pass on information to the subsequent class UNIV 392 where they can help the San Pablo residents implement this plan of action.

> ***Distribution:*** *Assuming the technology will work and there is market demand, what is the commercialization plan and how will you take this to scale? Have you talked to potential customers?*

While we have not made direct contact with the residents of San Pablo yet, we have many connections to them through both email and Facebook and plan to contact them for their opinions and recommendations for our project. We have communicated with people that have been involved in the Guateca program and took their suggestions in account.

Team: Who is on your team? Who is focused on the technology and who is focused on the business development? Who are your outside advisors?

Kyle Sato -- Team leader
Focusing on project development and communication with collaborating groups. Senior Forestry and Natural Resources Major California Polytechnic State University, San Luis Obispo

Brecken Thomas -- Head biologist
Researching ways to cultivate greenhouse plants. 4th year Microbiology major, California Polytechnic State University, San Luis Obispo

Travis Cook -- Lead Architecture
Designer of the Greenhouse. Researching low cost, 'green' building materials. Architecture Junior at California Polytechnic State University, San Luis Obispo

Matt Griego --Historian/Communicator
Researching the history and background information of San Pablo. Communicating with people that have been to San Pablo as well as other informational sources. 4th year Mathematics major, California Polytechnic State University, San Luis Obispo

Advisors:

Pete Schwartz -- California Polytechnic State University Professor

Poly Plant Shop -- has experience cultivating greenhouse plants.

> ***Work plan and outcomes:*** *What does success look like and how will you measure it? Please create a work plan in a table or spreadsheet format and be explicit about the milestones you hope to achieve by the end of the grant period. This table can be uploaded as one of your appendices.*

Table 1: Work plan for San Pablo Community Nursery

Items	**Time**	**Cost**	Goal
Greenhouse building materials	1 week	11,000	Use the most recycled and local materials available
Greenhouse construction	350 labor hours	$2,500	To make a sound envrionment for plant cultivation
Plant cultivation	3-4weeks	$100	Provide seedlings to locals within 4 weeks
Maintenance on nursery	N/A	200/yr	Maintain sustainable and profitable enterprise
Total Grant Time frame	5 weeks	13,600	