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GEORGIAN HEATED GREENHOUSE VEGETABLE INDUSTRY FEASIBILITY

STUDY

FINAL

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ABSTRACT

This report explores the past, present, and future of greenhouse-grown vegetables in the Republic of Georgia.

To properly contextualize greenhouse growing in Georgia, the report looks first at the history of greenhouses in the region, both during the Soviet era and after Georgia's independence in 1991. Many greenhouses were built in the decades that Georgia was a part of the Soviet Union, but the transition to a market economy in the past two decades has significantly changed the way that they operate. Market-based fuel prices make heating some greenhouses exorbitantly expensive and the industry is a fraction of what it once was.

Several suggestions are made for the development of an economically viable future for heated greenhouses and greenhouse-grown vegetables. Many are ground-level issues, such as understanding the importance of temperature, humidity, and wind; knowledge of grafting methods; and information about proper spacing, variety selection, and nutrient management. There are also some higher-level administrative and organizational suggestions, such as the formation of working groups and greenhouse growers associations. These types of organizations will serve as a vital web of support for the development of viable and efficient greenhouse vegetable production.

The report also describes a newly created Greenhouse Budget Template, a tool that investors, owners, and growers can use to determine the economic feasibility of the changes recommended in the report. Throughout the report, there are suggestions of how to most efficiently use the Greenhouse Budget Template.

A final section of recommendations contains specific suggestions for how to best implement many of the ideas presented earlier in the report. Included are instructions on what types of personnel would be required to maintain and manage efficient greenhouses, what systems might be necessary for interns and consultants, and an overall plan for building a support network of growers, investors, and consultants.

ABBREVIATIONS

EPI	Economic Prosperity Initiative
FtF	Farmer to Farmer
GH	Greenhouse
HAF	Horizontal Air Flow
IPM	Integrated Pest Management
USAID	United States Agency for International Development
MAST	Minnesota Ag Student Trainee
CAEP	Communicating for America Education Program
BMP	Best Management Practices

CONTENTS

I. EXECUTIVE SUMMARY

The Republic of Georgia has a long history of growing a wide array of fruits and vegetables. The cuisine of Georgia portrays that history. In the past, there were certain foods that were consumed only in their traditional season. Yet, there is a consistent demand for vegetables through the year. Neighboring Turkey has fostered the growth of its off season greenhouse industry to the point that it is able to export winter and spring greenhouse vegetables to Georgia and other countries. These heated greenhouse vegetables include tomatoes, cucumbers, and eggplant. There is a clear demand for these products in Georgia. Georgia itself has the ability to produce these products internally if the industry is fostered. When production eventually satisfies the internal market of these heated greenhouse crops, potential export channels that have already been established by the Georgian greens and herb industry can be utilized to assist in the exportation of other crops.

Georgia has a wide range of climates, from cool and dry to warm and humid. Greenhouses can be constructed in virtually any area of the country, but each area will present its own difficulties and benefits. Each potential location will need to be considered on its own merits independent of other nearby greenhouse businesses. The newly created greenhouse budget template will aid in determining the viability of a particular heated greenhouse by inputting its specific variables.

Heated greenhouses are extremely capital intensive. Sizable loans or owner equity will be required for the industry to mobilize. Yet there is a clear and stated lack of knowledge of how to properly operate the heated greenhouse and cultivate in the winter heated environment. Without proper knowledge, crop yields will not be sufficient to give the rate of return needed by the investors and lenders. There are many who are hesitant to invest in the construction of greenhouses until a knowledgeable management workforce presents itself, or until a system is in place to train the greenhouse growers. While the lack of financing is a barrier for many, the lack of a knowledge base is causing hesitancy for almost all. Knowledgeable growers will produce high yields, which will allow the owners to reinvest into expanding their operations.

A well-planned educational/training program will be the most cost-effective long-term investment for the future growth and viability of the Georgian heated greenhouse vegetable industry.

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A. BACKGROUND

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A. BACKGROUND

OVERVIEW

The Republic of Georgia has a long history of producing a variety of excellent fruit and vegetable crops. It is reputed to be the first place that wine was made over 7000 years ago. Georgia sits at the cross roads between Europe and Asia, right on the old silk road. The nation is nestled amongst fertile valleys between the Caucuses to the north and the little Caucasus to the south. Georgia's diverse topography creates much variation in climatic conditions from one area of the country to another. These varying microclimates allow for a longer than normal growing season and a wide range of growing conditions. This central geographic location between different cultures and amongst different climates allows Georgia the ability to be the vegetable garden to the wider area and to the Soviet Union that it became a part of in 1921. Being one of the more southern areas of the Soviet Union and somewhat proximate to the population centers of Ukraine and Russia due to its access on the Black Sea and rail lines, Georgia was encouraged to supply the Soviet Union with a large amount of its fresh vegetables in the winter months while the more northern areas of the Soviet Union bore the brunt of the harsh cold winter. Many glass greenhouses were constructed. Some were left unheated for cold tolerant greens crops. Others were fully heated to provide production of tropical vegetables, such as tomatoes and cucumbers. The vast majority of these heated greenhouses utilized natural gas as the heat source.

The Soviets had a strong history of drilling deep wells in search of petroleum to satisfy its energy needs. Georgia did not have a sufficient amount of natural gas, therefore, it was necessary to pipe it in from Russia and Azerbaijan. The availability of natural gas allowed Georgia to heat a very large number of greenhouses and provide out of season produce to the Soviet Union. The situation changed dramatically after the fall of the Soviet Union. The Republic of Georgia regained its independence in 1991, but also lost its source of inexpensive fuel. Natural gas, now a worldwide commodity, became similarly priced to other parts of the world. Most of the natural gas was being purchased from Russia and Azerbaijan. In 1991, the Georgian vegetable industry was thrust into a market-based system and needed to produce at a profit. In short time, it was found that these natural gas heated greenhouses were no longer viable. By 1993, at least half of the heated greenhouses were out of production. In 2003, the government offered a compensation program to greenhouse owners. Since the fuel source was now gone, $5,000-$10,000 was offered to each large greenhouse owner that agreed to have their greenhouse demolished. Some previously heated greenhouses were transitioned into unheated structures for cool growing greens. A few are still in use growing for specific markets. A handful have transitioned to using alternative fuels. This study will focus primarily on heated greenhouse production of tomatoes, and secondarily on cucumbers, eggplant, and basil.

CURRENT MARKET SITUATION

The Georgian agricultural statistics system is not able to provide clear data on present production levels. One estimate shows that, in the middle of the winter, Georgia imports as much as 95% of its fresh tomatoes. Regardless of the number, it is clear that many tomatoes and cucumbers are imported from Turkey. Georgians consume a large amount of cucumbers and tomatoes. The Georgian salad is made up of mostly these two vegetables. Georgians value the flavor of these crops highly and find that the Turkish imports are of inferior flavor. A better tasting Georgian tomato will command a price of at least 25% higher

than a Turkish tomato. Having a wide range of microclimates, tomatoes are grown outdoors and in unheated greenhouses/high tunnels for much of the year. Outdoor tomatoes are harvested from June-November. High-tunnel tomatoes are harvested from September-December and April-July. The heated greenhouses could produce year round, but the price of the main season outdoor tomatoes is very low. The price of tomatoes is highest from November through April, with the peak usually being in February.

ECONOMIC AND INVESTMENT OPPORTUNITIES

With the level of winter imports being as high as they are, winter production of tomatoes and cucumbers in Georgia should have a market ripe for the taking. Georgia is not a very large country, having a population of only about 4 million. Although the average person does consume a high amount of these items, the internal market could become saturated rather quickly if a lot of heated space is constructed. A quick rate of return on investment would isolate the investor from much downside risk. There is a whole host of alternative crops that could be produced in heated greenhouses in the future if tomatoes and cucumbers become less profitable. Traditionally, besides the structural costs of the greenhouse, the main costs are heat and labor. If these two variables remain in check, the outlook on the Georgian heated greenhouse vegetable industry should remain very positive, save a financial crisis, or military incursion. It was the rise in heating costs that ended the previous greenhouse industry. Luckily, there has been new interest in a fixed cost heat source- thermal hot springs. This heat source appears to be the savior that will help to resurrect the industry. With low heat costs, relatively low labor costs, and eventually attaining high yields, the greenhouse vegetables should be competitive in export markets.

B. METHODOLOGY

To perform this assessment, the consultant conducted interviews with experts in the greenhouse industry to identifiy challenges and opportunities for the heated greenhouse vegetable industry. The consultant had vast knowledge of the industry from years of experience as a producer. While undertaking this assessment, the consultant utilized the following methods:

- Farmer-to-Farmer volunteer assignment
  - Interviews and work with Georgia Farmer-to-Farmer staff
  - Collaborated with Georgian greenhouse production organizations
    - Menji Limited
    - Zana ECO Limited
- In-depth interviews
  - Agriculture Value Chain Manager, Avtandil Korakhashvili
  - Georgian greenhouse production and supply house organizations
    - AgroInvest
  - Professors from University of Massachusetts Amherst and University of Connecticut who specialize in greenhouse vegetable crops
- Online data sources
  - NASA

C. FINDINGS

HEATED VERSUS UNHEATED GREENHOUSES

Tomatoes can be grown in unheated greenhouses for part of the year. Temperatures below 10 degrees Celsius will cause blossoms to abort and tomato flavor to diminish. Between the months of December and May, it can be assumed that the only tomatoes harvested in the country will be from heated greenhouses. However, there are opportunities to extend the harvest window with minimally heated greenhouses. With minimal heat, a harvest could be extended to Christmas in certain areas of the country. This holiday is a popular time for feasts. With minimal heating in warmer areas of the country, an earlier harvest can be expected by April. The January-April harvest window remains the purview of the fully heated greenhouse. If an investment is to be made in a good heating system, a well-equipped modern greenhouse should accompany it to maximize the return on the investment. Heated and unheated greenhouses will continue to have their roles in Georgia and one will not necessarily push out the other. Georgia has a well-established industry of growing greens in minimally heated greenhouses and in unheated high tunnels. The heated vegetable industry will complement this and may someday join in its export trade.

HEAT SOURCES

Georgian greenhouses used to be heated primarily by natural gas. This is still an option as a heat source. However, for mid-winter production, it is often viewed as too expensive to be a viable option for many growers in cooler regions of the country, unless they have a higher priced niche market product or are in a much warmer part of the country. A grower targeting non winter production and not growing in the middle of the winter months might find natural gas a viable option as the heat needs will be a small percentage of the costs. Growers in cooler parts of the country that are growing higher temperature preferring crops in the coolest months of the year need to find alternative heat sources to remain financially viable. Some growers are using firewood or biomass as a heat source. The main biomass used is hazelnut shells. There is presently a good supply of this fuel source, but if many growers switch to it, it could be in short supply quickly. Firewood will continue to be an option for growers, but will be limited by proximity to the source and cost.

In the 1960s, the Soviets were drilling for petroleum in several areas of the country. Some wells drilled did not yield petroleum, but did yield hot water. In many cases, this resource has been flowing out of the ground, unused for the past 40 years or more. Recently, the government has been granting 25 year leases on these wells. The cost generally has been 0.06 lari per cubic meter of flow from the well per month. A well that yields 360 cubic meters per day will cost 3000 gel per month. Some wells are reportedly charging 0.1 lari per cubic meter or more. There are over 200 hot springs or geothermal wells in Georgia with temperatures ranging from 35 to 108 degrees Celsius. 80% of the hot springs are located in West Georgia. Unfortunately, West Georgia is also the warmer and more humid part of the country. Less heat is required where the ambient temperature is higher. More disease problems are manifested with higher humidity levels. Less sun is available in areas with high humidity and more clouds. Higher humidity locations tend to have lower yields, but some of the humidity problems can be mitigated with corrective greenhouse management. This corrective greenhouse climate management requires additional heating needs. But, the heating costs from the geothermal source will be fixed, so the corrective climate

management costs to mitigate the damaging effects of higher humidity will be minimal if performed correctly.

Four aspects of a particular well should be analyzed before deciding to utilize it as a greenhouse heat source. They are water volume, water temperature, water quality, and location in relation to the planned greenhouse structure. The higher the temperature and the higher the water volume of each well will mean that more greenhouse space can be heated from that single well. A higher water temperature will lead to a lower initial heating cost investment because fewer heat exchangers will be required. Lower water temperatures will need more heat exchangers to provide sufficient temperature rise for the greenhouse. Each well will provide a different quality of water. Some wells will provide water that calcifies in the pipes. "Dirty" or water prone to calcification can be put through a heat exchanger before being circulated through the internal greenhouse piping and heat exchangers. This will isolate the area that needs to be cleaned frequently to just one heat exchanger. A pair of these primary heat exchangers could be installed in order to allow one to always be in operation while the second is being cleaned/decalcified. Heavily calcified thermal water will lead to higher maintenance costs for heating greenhouses from such wells and this aspect of the geothermal well should be considered before purchasing a lease on a well.

GREENHOUSE LOCATION

The greenhouse location needs to be determined based on many aspects. The most important aspect needs to be the relation to the sun. The winter sun is much lower in the sky than the summer sun. Any shadows cast by a hill or tree in the summer will be amplified in the winter. Obstructions on the north side cause few problems. The focus needs to be on maximizing the sun from the south and the southeast. Early morning sun from the southeast will begin photosynthesis food production in the plant earlier in the day, maximizing production. In addition, any dew that formed on the leaves of the plant needs to be dried off the plant by that early morning sun as soon as possible. Shorter leaf wetness time reduces the incidence of disease. The greenhouse should be located in a site that has natural air and water drainage. The greenhouse area should be higher than the surrounding land so that rain water will not accumulate in the subsurface of the greenhouse. A greenhouse in a naturally wet area should be raised up with drainage material (pipes and stone) underneath it. If the crops in the greenhouse are to be grown directly in the soil of the greenhouse, the roots of the crop may extend down as much as one meter. These roots will not live in a saturated material. A very high water table under the greenhouse will lower the yields of the crop. When the roof of the greenhouse is opened to allow excessively warm air to exhaust, a natural air flow will help to exhaust that hot air. When the roof opens, it is best if the exhausting air flows into the natural outside airflow. If the roof vent is wrongly positioned, the outdoor air may be pushing against the exiting exhausting air, preventing it from leaving the greenhouse. In positioning the greenhouse, the prevailing winds should aid in the natural exhausting of air, not prevent it. However, the greenhouse should not be placed in an extremely windy location. Strong winds can shorten the life of the greenhouse roofing. A constantly wafting plastic will become stressed and may eventually tear. In addition, wind will wick heat away from a greenhouse and cool it down, thus increasing the heat needs for the greenhouse in colder temperatures. Yet, winds in combination with a correctly positioned greenhouse may be easier to cool in warmer parts of the year. Windbreaks of trees or fence-type structures should be considered in windy locations, but placed far enough away so as to not block the sun in the winter. Proximity to the road, utilities, and the heat source must also be considered.

CROP DIVERSITIES

Virtually any crop that can be grown can be cultivated in a greenhouse. The heated greenhouse is expensive real estate and so the crop grown in it must be of high enough value to pay for its "rent." The greenhouse budget template is a tool to show the profitability of four different crops grown in the greenhouse. Any other crops could be substituted in the model to test their profitability. The different variables of yields, market price, crop timing, and heating costs will need to be input for the profit to be estimated by the model. Crops, such as tomatoes, cucumbers, eggplant, and basil, are already listed in the model. The model may be run for other crops, such as raspberries, strawberries, peppers, greens, other herbs, cut flowers, flower transplants, vegetable transplants, or any other crop that can be grown. The pricing of different crops may vary from one year to the next, so the grower should remain open to the prospect of changing crops from one year to the next.

NURSERY/TRANSPLANT SYSTEMS

VARIETIES

There are a great number of different varieties of these crops. Great care must be taken in choosing the variety. There are many newer varieties of tomatoes and cucumbers that are known to perform better in the greenhouse environment and produce higher yields than more traditional varieties. These varieties should be considered. However, it must be acknowledged that the traditional Georgian varieties tend to command a higher price in the market, though they may yield less. A profitability comparison will be needed between the lower yielding but higher priced Georgian varieties and the newer higher yielding but often lower priced varieties. The growers will get a handle on this profitability after determining the yield potential in their respective greenhouses of each variety. For production in the depth of the winter, the newer varieties will probably emerge as the stronger choice as they have often been bred to withstand the lower light conditions of the winter greenhouse. However, outside of the depth of the winter, the Georgian varieties may end up being the more profitable choice until the market of that higher quality product becomes saturated. When, in future years, the internal Georgian market for these crops becomes satisfied, a more in-depth study of international export markets will be necessary. If and when the border with Russia reopens, the export potential of these crops could change quickly and drastically.

GRAFTING

Grafted tomato plants are becoming more common in the greenhouse industry. The stronger root system of the grafted plant will support more growth of the plant, will be more resistant to soil borne diseases and will increase total yields significantly. This increase in yields will vary from 5% to as much as 30%. If the soil in the greenhouse has already been used for several crop cycles, the increase in yield versus a nongrafted variety will be more pronounced. Rather than every greenhouse operation grafting their own plants it would be best for only a few operations to be involved in the sensitive process of tomato grafting. Similar to the grafted apple tree that is now the global norm, a bottom/rootstock variety is chosen with superior root qualities that will better support the upper/scion variety of the type of tomato that is being sought. Both seeds are planted into their respective growing trays/pots within days of each other. When they are about 4 cm tall the tops are cut off both plants. The upper stem of the tomato fruit variety is grafted onto the bottom stem of the rootstock variety. These new plants are immediately placed into a "healing chamber" where they are monitored for a week. They are then returned back into the normal greenhouse environment to continue growing until they are large enough to transplant into the ground of

the greenhouse. It will take a good level of experience to attain a low loss rate of the grafted plants. Rootstock seeds are somewhat expensive and it will now take two tomato seeds to produce a single grafted tomato plant. This process will also add about a week of extra grow time to the grafted tomato plant versus the ungrafted plant. This, combined with the mortality rate of the grafted plants while they are in the "healing chamber," will lead to a much higher cost per plant in the greenhouse. This added cost is not usually viable for the lower priced field tomatoes, yet for the higher priced greenhouse tomato, it is almost always worth the added expense. Greenhouse growers should place orders well in advance for their grafted tomato plants. The production of transplants should be viewed as a separate enterprise than the production of the tomatoes themselves. With the higher cost of improved seed varieties and of the grafted plants, specialized vegetable transplant producers should be fostered and trained properly.

PLANTING AND HARVEST PLANNING

CROP TIMING

Utilizing the Greenhouse Budget Template, the growers should input their anticipated costs, their anticipated yields, and the anticipated monthly market price for crops that they are considering. They can then explore the profitability of their crop mix options for different harvest periods. Even though prices will be highest in the winter months, the grower may decide to offset his production period slightly if he utilizes a more expensive heat source that will make greenhouse production more profitable outside the mid winter season. If the cucumbers are harvested for only a three-month period, that three-month period can be determined by the seeding date and then a second crop of cucumbers or another crop can be planted at the end of that harvest. The greenhouse budget template will allow the grower to maximize the use of the greenhouse for peak profit. Time to harvest will always need to be adjusted with the time of year. The plant will grow at least twice as much in April as it will in December due to the amount of sun at that time of year. A seed planted in November will take longer to produce fruit than a seed planted in March. In late fall, the amount of daylight is waning. After the winter solstice, the daily growth will increase with each passing day.

PLANT POPULATION

The heated space in the greenhouse is very valuable and no space should be wasted. Plants should be planted as close together as possible to maximize the production per square meter. However, the low light levels in mid winter are often the minimum amount needed to allow for proper plant growth of certain crops. Some crops will abort flowers and fruit if there is not enough light. To counter this possibility, plants that will be flowering in the deep winter should be spaced slightly further apart to reduce the chance of one plant shading its neighbor. Late winter plantings can be planted closer together as they will not come into flower until the daily amounts of sun have increased. Any benches of plants can be placed on rollers so that the walkways between the benches are eliminated until someone rolls them apart to gain access. This rolling bench system can increase growing space by as much as 15%. Similarly, the trellis system can be established to allow the upper part of the trellis to be gently moved horizontally as much as 0.3 meters. This will allow the growers to access the plants without harming them and will allow all the entering light to be utilized by the plants without any light entering the greenhouse to directly hit the greenhouse floor.

GREENHOUSE ENVIRONMENT MANAGEMENT

HEATING

The crops in the greenhouse in the winter months must be protected from the cold outside air. Many fruiting crops, such as tomatoes will abort their blossoms if the ambient temperature falls below 10 degrees Celsius. If the air and/or soil temperature is too low, certain nutrients, such as phosphorus cannot be taken up by the plants. For maximum yields, a consistent ideal air and soil temperature of approximately 20 degrees Celsius needs to be maintained in many tropical crops, such as tomatoes and eggplant. Soil warming is often by warm water pipes about 0.3 meters below the soil surface. The ideal temperature will vary with the actual crop, growth stage, and time of day.

Georgia not only offers a very wide range of climates, but also a very wide range of heat sources. Geothermal wells are one of the newer heating options. The geothermal wells presently in use are sufficient to adequately heat upwards of one hectare each and in some cases many times that amount. This geothermal heat source offers the greenhouse growers/investors a fixed heating cost. It is expected that fossil fuels will continue to increase in price in the future. This is expected to put added pressure on alternative fuel sources causing their cost to rise also. The geothermal option will lock in the heating costs for the near future allowing for lower risk investments in heated greenhouses.

Natural gas is the default heating source. Natural gas may be the most profitable heating method for the warmest areas of the country, especially if the crop is not yet in production in the coldest time of year. A fruiting crop that has not yet begun to flower could be cultivated at a slightly lower nighttime temperature in an effort to reduce costs. In this scenario, a very small amount of heat will be needed to produce the crop.

There is a well-established unheated greenhouse industry in Georgia producing a good amount of cool weather herbs and greens. Harvest of these crops usually ends in January with the onset of the cold dark months. Recently in the U.S. it has been found that if a small amount of in-ground heat is added to these crops in the winter months, yields can often double. In addition, the combination of the cold and dark weather often virtually stops the growth of these crops in December and January. The addition of this “bottom” heat will encourage the plants to continue to grow in the low light conditions and to grow much faster than they would otherwise when the amount of sun begins to increase significantly in February. These Georgian greens have a sizable internal market, but also a sizable international market, mostly to Ukraine. Because of the lack of winter production, exports usually stop in January before recommencing in the spring. When geothermal waters are used to heat a heated greenhouse, the water is circulated through the greenhouse heat exchangers; its heat is extracted to heat the air and then some of it to warm the soil. The water then exits the greenhouse after it has been used. The water usually enters the greenhouse between 60 and 108 degrees Celsius and exits the greenhouse between 30 and 60 degrees. At lower temperatures, it becomes inefficient to extract the heat to warm a greenhouse to 20 degrees. However, this water can easily be used to warm the soil of a neighboring unheated greenhouse. The conjoining of the heated and unheated greenhouses near the geothermal wells could significantly change the winter greens production of the country. A singe geothermal well could have the potential to heat not only two hectares of warm-loving crops, but also an additional two hectares or more of cool-loving crops. The cost of installing the in-ground heat would be minimal and limited to the water pipe and the circulating pumps. Because the in-ground heat pipes will contain warm and not hot water, a less expensive/non heat tolerant pipe could be used to lower costs.

There is a rather large nut industry in Georgia, led by hazelnuts. The shells of the nuts provide a waste product that can be used as a heat source. Presently, nut shells are seen as being at least half the cost of natural gas. However, the number of nut burners in the country is increasing and this increase in use may cause the price of heating with nut shells in the near future to be less beneficial than it is at present. Yet, nut shells should always remain cheaper than gas, unless there is a sudden drop in nut production caused by unfavorable weather conditions. Most of the nut burners are manufactured in Zugdidi.

Other fuels, such as coal, firewood, sawdust, straw, and diesel can be considered as alternate heating sources. The monthly cost of heating with these fuels can be entered into the greenhouse financial budget template to determine which fuel will be most profitable to use.

Energy conservation should be considered to reduce the heating costs. Especially, in very cold areas of the country, a second layer of greenhouse plastic should be installed with an inflation fan to create an air pocket between the two layers of plastic to add an insulation factor in the roof and walls of the greenhouse. This second layer of plastic will slightly lower the amount of light entering the greenhouse and thus lower productivity of the crop in the darkest time of the year. This lowering of heating costs must be weighed against the lowering of yields. An energy audit should be performed yearly to determine the location of air leaks in the greenhouse.

COOLING

High temperatures in the greenhouse can cause an adverse reaction of the plants. Many fruiting plants, such as cucumbers, tomatoes, peppers, and eggplant will abort their blossoms if the ambient temperature rises above 35 degrees Celsius. An automated opening roof will allow the heat to escape from the greenhouse. An opening is needed to allow air to enter the greenhouse. Roll-up side walls will allow air to enter. As the warm air rises and exits through the roof, air will enter through the sidewall creating a natural breeze that will help to keep the inside air not more than a few degrees warmer than the outside air. When the temperature inside the greenhouse falls below the desired temperature, the side walls and the roof should close.

HUMIDITY CONTROL

Greenhouse crops encounter more problems when the humidity is constantly high. If the air inside and outside the greenhouse are both 100%, the humidity inside can be reduced if the temperature outside the greenhouse is lower than the temperature inside the greenhouse. Higher temperature air holds more water than lower temperature air. If cooler outside air is brought inside the greenhouse and warmed, it will have a lower humidity because as it warms it can hold more water and will then be less than 100%. This action of changing the air can be performed as often as is necessary to lower the humidity inside the greenhouse. Yet, this humidity reduction will require additional heat to bring the air back up to temperature. In a geothermal heated greenhouse, since heating costs are fixed, this humidity control will be a minimal cost. In greenhouses heated by other means, this humidity control will be an additional cost that must be measured against the application of fungicides in cool and cloudy times of year. For this reason, the geothermal heated greenhouse will be a good candidate for organic/biocertification in the future. The fixed cost of heat will allow the climate to be manipulated extensively and inexpensively to avoid the problems that pesticides are often needed to resolve.

GREENHOUSE CROP MANAGEMENT

NUTRIENT MANAGEMENT

A soil test should be taken at least one month before the planting of each crop. There does seem to be some sense of variability of results between different soil test labs. The lab should be trusted and/or tests should be sent out to more than one lab to verify the results. Soil amendments should be added according to the results of the test. Organic matter content of the soil should be increased to as high as 10%. This organic matter will act as a buffer against any buildup of salts in the soil from synthetic fertilizers. The organic matter will also provide a continuous supply of nitrogen to the crop so that there are no significantly deficient nutrient periods in the crop cycle. Additional nutrients will be needed in the crop cycle. A second soil test should be performed a few weeks before the crop begins to mature. This will allow for the proper amount of additional fertilizer to be added through the drip irrigation system. A trained eye can usually identify many nutrient deficiencies by examining the leaves. Many nutrients can be applied foliar for faster uptake by the plant. PH of the soil should be maintained at the proper level of about 6.5 for most crops.

POLLINATION

Certain crops and certain varieties do not need pollination. The rest of the crops will be sufficiently pollinated by area bees when the outside air temperature is above 10 degrees Celsius. On sunny days, some doors should be left open to allow bees to enter and transfer pollen from one flower to another. In cold periods when there is no outdoor bee activity, the grower must somehow ensure that the crop is being pollinated. Boxes of bumblebees are often purchased and placed into the greenhouse to pollinate the flowers. Alternatively, a vibrating fork tool can be used on each plant to shake the pollen out of the flowers and into neighboring flowers.

PRUNING AND TRELLISING

In order to maximize the space in the heated greenhouse, the plants must be encouraged to grow more in the vertical plane than the horizontal plane. Any branches or leaves that will not add to the plant should be removed so as to not remove energy for the plant needlessly. Leaves and branches should be removed from the bottom of the plant below the bottom fruit. Suckers should be removed from the tomato plant and the plant should be maintained as a single or double leader plant. Removal of the bottom growth allows for more air circulation and discourages disease growth by removing the oldest leaves. Indeterminate tomato varieties should be chosen for growing through the winter to maximize the vertical space. The top of the trellis should be an absolute minimum of 2.5 meters from the floor. The trellis twine should have the ability to be lowered and lengthened when the plant gets to the top of the trellis. The bottom of the plant stem can be simply looped at the bottom when the trellis twine is lowered. This will allow the plant to continue to grow while remaining in the space of the greenhouse and remaining at a workable height.

IRRIGATION

No irrigation water should touch the leaves of the plant. The irrigation water should preferably be delivered by a drip irrigation line. Unless the plants are being grown in a hydroponic system, it is not necessary to water daily. Soil moisture should be monitored by a soil humidity probe, or simply by digging into the soil to determine its moisture content. The moisture should be monitored not only at the soil surface, but also to a depth of 0.5 meters below the surface. For interruption of certain insect life cycles, it is best to allow the

top centimeter of soil to dry out periodically. The drying of the soil surface will kill off the eggs of some insects. While taking care to not allow the plant to endure any drought stress, it is important to not water too frequently so that the plants roots stretch out and down in search of water so that they may also find nutrients throughout the soil profile. Allowing the plant to dry down and then giving copious amounts of water will encourage the fruit to split open when it receives the irrigation. In addition, over watering will lessen the flavor of the crop. Consistently high soil moisture will encourage the spread of soil borne pathogens. A delicate balance needs to be maintained in the irrigation regime.

PESTICIDES

Georgians believe that their produce is better than imported produce because it usually has fewer pesticides. This could be the case, yet, there is definitely pesticide use in Georgian greenhouses. Sometimes there is misdiagnosis of the problem in the greenhouse, sometimes there is an incorrect recommendation given by the pesticide dealer, and sometimes there is a lack of knowledge of the life cycle of the pests and diseases. If Georgian greenhouse vegetables are to truthfully maintain the image that the public has of them, the growers must learn the details of the pests and diseases that they are seeking to avoid. By understanding the conditions that promote the growth of those insects and diseases, the grower can create the conditions in the greenhouse that will discourage the insects and diseases. There are many natural beneficial insects and bacteria that can be released into the greenhouse to attack the detrimental pests. These do not yet seem to be available in Georgia, but with the apparent open importation regulations, they should be able to be ordered from the U.S. or Holland, and shipped in on plane and released within a two or three-day period. Normally, once the population of beneficial insects has accumulated in the greenhouse sufficiently, they are able to keep the population of detrimental insects at bay. However, the initial release of beneficials must be made at the first sight of the problem or even before. The use of yellow sticky cards will be an excellent way of knowing when a certain insect first appears in a greenhouse, hopefully allowing sufficient time to obtain and release the benficials.

YIELD IMPROVEMENT

At the June 3rd conference, a decision-making tool was presented to help growers better understand how to achieve peak yields. This tool is very general and the values given should only be considered as a rough guide of how to improve tomato yields in the heated greenhouse. Percentage yield increases will vary depending on other conditions affecting growth. For example, the benefit of grafted tomatoes will be greatest if many other conditions are not met. However, if other conditions are not met, the benefit of grafted tomatoes will be that much greater.

HEATED GREENHOUSE TOMATO YIELD IMPROVEMENT RATING	POSSIBLE AMOUNT	RATING
1. Soil/Nutrient Management	Potential	
1.1 Soil Test before each growing season	2%	
1.2 Soil Test midseason	0.50%	
1.3 Organic Matter/Composted Manure application preplanting	2-8%	

2=2cm, 4=4cm, 6=6cm, 8=8cm		
1.4 Lower synthetic fertilizer use	0.50%	
1.5 Soil Compaction Reduction via no heavy equipment and dedicated walkways	2-4%	
1.6 Crop Rotation	2.00%	
Subtotal:	~13%	
2. Water Management	Potential	
2.1 Raised Beds/Drainage/Sand if needed	4%	
2.2 Drip Irrigation and Fertigation	6%	
2.3 Water only when needed and monitor soil moisture	4%	
Subtotal:	14%	
3. Temperature/Humidity Management	Potential	
3.1 Maintain Ideal Air and Soil Temperatures day and night	5-10%	
3.2 Reduce nighttime temperature fluctuation within 1 degree=4points, within 2 degrees=2points	4%	
3.3 HAF/Circulating Fans almost always operating	2%	
3.4 Vent Humidity every evening	4%	
3.5 Vent Humidity on cool, high humidity days three times/day = 2 point, once every hour=4 points	2-4%	
3.6 Have generator to provide emergency electricity in case of power outage	0.50%	
Subtotal:	~21%	
4. Variety Selection and Disease Elimination	Potential	
4.1 Improved variety and Certified disease free seed	8%	
4.2 Disinfect all greenhouse surfaces before planting	0.50%	
4.3 Seed into only new or disinfected pots and use only sterilized growing media in transplant pots	1.00%	
4.4 Remove all weeds inside and outside within 20 meters of the greenhouse	0.50%	
4.5 Proper pruning, trellising, and removal of lower leaves	6%	
4.6 White or reflective ground cover/fabric to cover all soil in the greenhouse	8%	

Subtotal:	24%	
5. IPM and Crop Strength	Potential	
5.1 Hire a crop consultant to weekly scout for pests or learn many aspects of IPM to implement Best Management Practices	2-10%	
5.2 Set out new yellow sticky traps weekly to capture and identify insects in the greenhouse	0.50%	
5.3 Grafted Tomato Plants	20%	
5.4 Bees or pollination method (winter production only)	10%	
Subtotal:	~36.5%	
Cumulative Rating:	~108.5%	

Maximum score is 110% (100% outside of winter production), although it ultimately depends on the number chosen within some ranges.

For each item, a rating should be indicated whether it be 0 or as high as the maximum rating for that question.

The Cumulative (Sum) Rating should be used to help determine the expected yield of your crop.

POST HARVEST HANDLING AND MARKETING

Georgian greenhouses have the ability to produce an excellent product. However, the value chain after harvest needs to be improved to reduce the shrinkage further down the chain. Luckily, the heated greenhouse will be harvesting mostly in the colder time of the year when refrigeration is not so critical.

HUMAN RESOURCE DEVELOPMENT

GREENHOUSE ASSOCIATION

In Georgia, there exists an association of greenhouse producers, however, it appears to be a weak association. If this or another association is open to a diversity of producers, it could become the foundation of the improvement of the heated greenhouse industry. A strong association would work to educate and advocate for the industry. Many NGOs and government organizations would be more likely to provide assistance to an association of growers rather than to individual growers. Foreign greenhouse experts could be requested by and guided through the association to offer workshops and on-site trainings to improve the knowledge base in the industry. International study trips could also be organized through the association so that growers could see firsthand how others around the world are improving their greenhouse operations.

INTERNATIONAL INTERNSHIPS AND TRAININGS

Younger Georgians could spend up to a year in another country working and learning the details of greenhouse production. There are many agricultural work programs in Europe that

would provide excellent work training in the sector. For the U.S., the J-1 visa would provide entry as an intern or trainee. The intern would have to be a student of agriculture, presently studying at the university or having graduated within one year. The trainee under the J-1 visa would need to have an agriculture degree and at least two years of work experience in agriculture or no degree and five years of experience in agriculture. There are at least three organizations that would host the interns/trainees and place them in greenhouses in the U.S. Hosting organizations could be Minnesota Agricultural Student Training program, Ohio State University, or Communicating for America Education Program. After working in greenhouses abroad, the interns could return to Georgia to offer their knowledge to the growing industry. Approval of the visas would hinge on embassy approval. An NGO could offer its services to initiate these internships and eventually charge a placement fee to the interns to cover their staffing costs.

EMPLOYEE MOBILITY

Sometimes there is an understandable hesitancy for a Georgian to move from one part of the country to another for work. Family ties are strong and dialects vary widely in Georgia. Yet, new greenhouse owners should not hesitate to try to find knowledgeable growers/employees in other parts of the country. Attractive incentives may be needed to lure the employee away from their home area to provide the knowledge and experience that the greenhouse management needs. Additional attempts could also be made to attract knowledgeable employees from the neighboring countries of Azerbaijan, Turkey, and Armenia.

CROP CONSULTANTS

Since the Georgian government is hesitant to offer very much support to the agriculture sector, and since most NGOs are working in Georgia for only a short term, it is left to the responsibility of the greenhouse industry itself to provide an educated work force. The least expensive method of effective broad reaching knowledge is via crop consultants. Each greenhouse operation must pay for the services. The service can be a minimal cost when considered amongst the greater costs of greenhouse production. Large investments are being made and the small cost of expert advice can significantly increase the payback of those investments. A single crop consultant visiting a circuit of many greenhouses for only one hour each per week could offer critical knowledge and services to as many as 30 greenhouse operations. These crop consultants would need to be highly trained and interested in the fine details of greenhouse management. If a greenhouse owner feels that the crop consultant is not providing correct or valuable advice, the consultant's services can be terminated and a different consultant can be hired. Eventually, the best consultants will have the most clients and be able to charge well for their services. With the assistance of the crop consultants, the yields and profits of the greenhouses will increase and the owners will reinvest into more structures. The crop consultants may be the most critical key to the industry's long-term strength.

GROWER MEETINGS

One of the best resources for growers is each other. Crop consultants, government offices, associations, NGOs, or growers themselves can organize meetings in their greenhouses to discuss a myriad of issues surrounding growing in the heated greenhouse. These meetings should be held at a rotation of greenhouse operations. As a precondition to attending the meetings, growers should agree to host a meeting in the future so that as much as they are learning from others, others are learning from them.

E-NEWSLETTERS

Digital newsletters and blogs offer an excellent venue for industry communication. An NGO, crop consultant, or association should offer some staff time to initiate a weekly or monthly newsletter full of articles and advertisements by industry suppliers, crop consultants, and foreign experts. This newsletter will keep the industry abreast of the latest technology, grower meetings, NGO workshops, and grants available to the industry, market reports, and classifieds related to the industry. Eventually, paid advertisements could cover the staff costs of managing the newsletter.

GREENHOUSE BUDGET TEMPLATE

The use of this dynamic tool should be encouraged for potential investors, present owners, and growers. This tool may be utilized to determine the profitability of a greenhouse before it is even constructed. This tool can be used by a grower to project the profitability of different crop choices before the seed is even purchased and before the planting date is determined. The fields in the template are intentionally left variable so that each grower can customize the template to best match their exact situation. The original values in the blue shaded fields are real values that can be used as a general starting point to run the program. Yet, values will need to be adjusted to match the reality of the location in terms of heating costs, yield potential, market price, etc.

EPI Georgia

Agriculture Sector Component

Greenhouse Budget Template

David Dumaresq and Lucas Caltrider

Greenhouse Enterprise Budget: Tomatoes

Heating System: Natural Gas

Based on the Gutter Connect Style

Number of Bays: 2

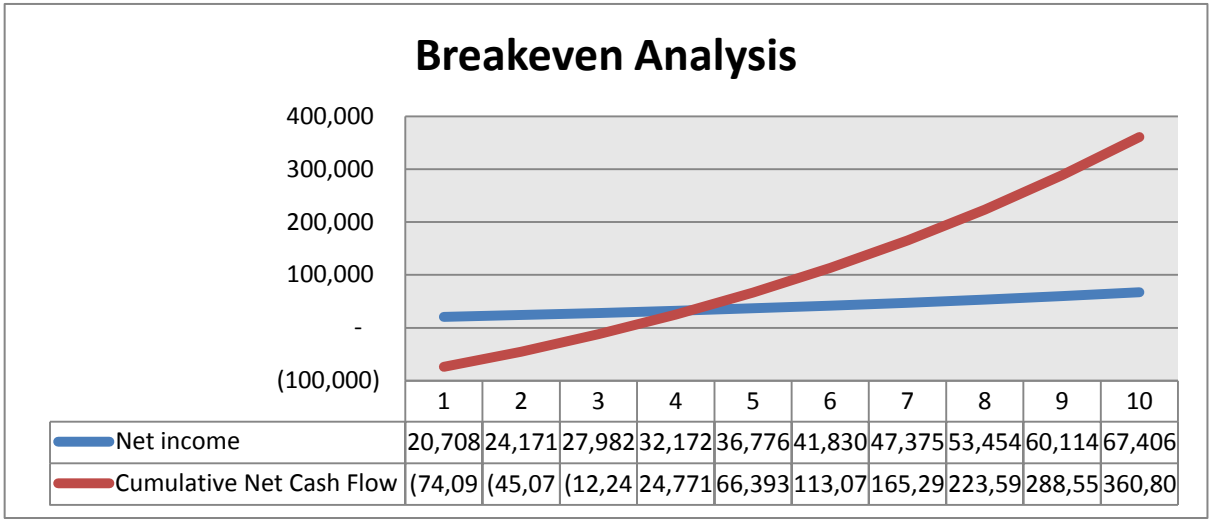
Bay Dimensions: 10m X 50m (500m2)

Total Size: 1000 m2

ANALYSIS

Sales in Year 1	GEL	74,787		5-Year Internal Rate of Return	2 %	Payback (Years)	4.82
Start-Up Capital Required	GEL	172,368		10-Year Internal Rate of Return	22 %	Discounted Payback (Years)	6.41

EBITDA Projections



	1	2	3	4	5	6	7	8	9	10
Net income	20,708	24,171	27,982	32,172	36,776	41,830	47,375	53,454	60,114	67,406
Cumulative Net Cash Flow	(74,09	(45,07	(12,24	24,771	66,393	113,07	165,29	223,59	288,55	360,80

EPI Georgia

Agriculture Sector Component

Greenhouse Financial Template

David Dumaresq and Lucas Caltrider

Greenhouse Enterprise Budget: Tomatoes & Cucumbers

Heating System: Thermal Springs

Based on the Gutter Connect Style

Number of Bays: 2

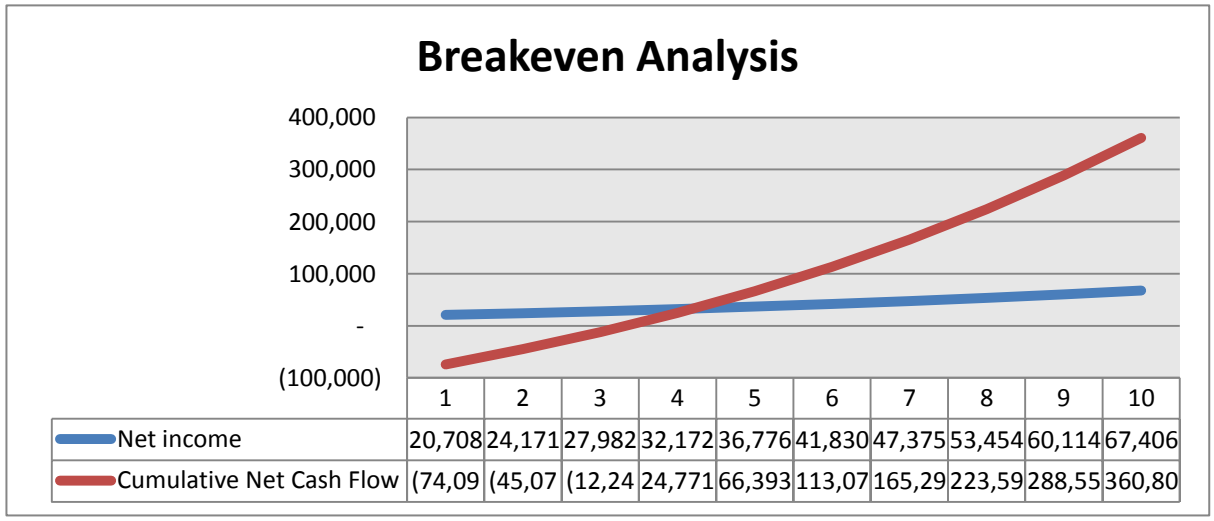
Bay Dimensions: 10m X 50m (500m2)

Total Size: 1000 m2

ANALYSIS

	GEL	5-Year Internal			3.3
Sales in Year 1	72,841	Rate of Return	18%	Payback (Years)	3
Start-Up Capital	GEL	10-Year Internal		Discounted Payback	3.9
Required	146,936	Rate of Return	34%	(Years)	9

EBITDA Projections



	1	2	3	4	5	6	7	8	9	10
Net income	20,708	24,171	27,982	32,172	36,776	41,830	47,375	53,454	60,114	67,406
Cumulative Net Cash Flow	(74,09	(45,07	(12,24	24,771	66,393	113,07	165,29	223,59	288,55	360,80

EPI Georgia

Agriculture Sector Component

Greenhouse Budget Template

David Dumaresq and Lucas Caltrider

Greenhouse Enterprise Budget: Tomatoes

Heating System: Natural Gas

Based on the Gutter Connect Style

Number of Bays: 20

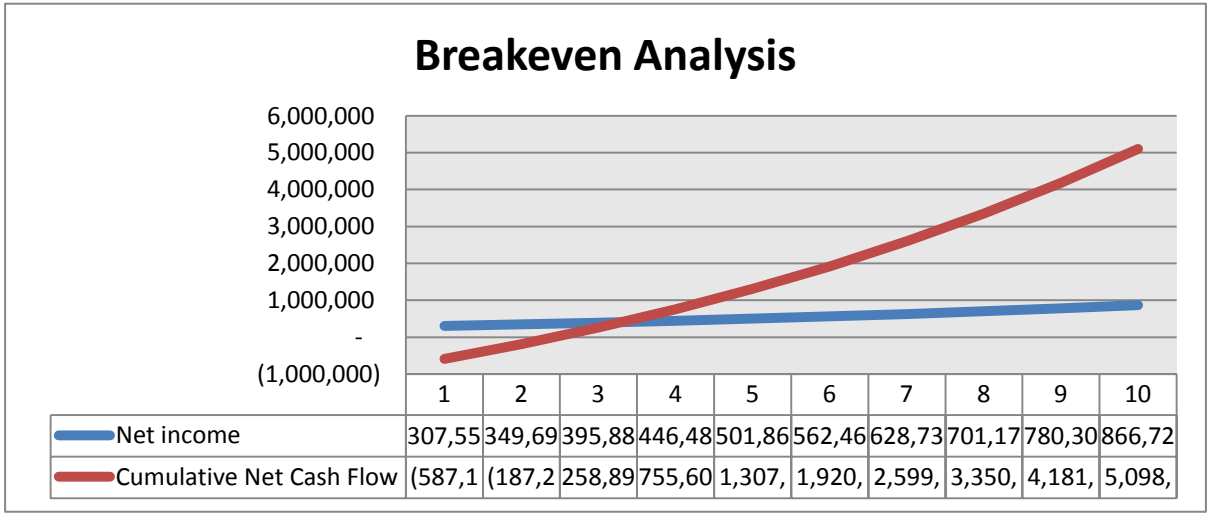
Bay Dimensions: 10m X 50m (500m2)

Total Size: 10000 m2

ANALYSIS

	GEL	5-Year Internal Rate of			
Sales in Year 1	808,417	Return	35%	Payback (Years)	2.42
Start-Up Capital	GEL	10-Year Internal Rate of		Discounted Payback	
Required	1,395,569	Return	47%	(Years)	2.71

EBITDA Projections



	1	2	3	4	5	6	7	8	9	10
Net income	307,55	349,69	395,88	446,48	501,86	562,46	628,73	701,17	780,30	866,72
Cumulative Net Cash Flow	(587,1	(187,2	258,89	755,60	1,307,	1,920,	2,599,	3,350,	4,181,	5,098,

The most sensitive variables in the budget model tend to be heat source, greenhouse size, crop choice, crop timing, and inflation rate.

Independent Variables				Performance Analysis					
Region	**Size**	**Crop(s)**	**Heating System**	**Sales in Year 1**	**Start-Up Capital**	**5-Year IRR**	**10-Year IRR**	**Payback (Years)**	**Discounted Payback**
Sensitivity to Crop									
Central Georgia	**1,000**	**Tomatoes**	**Thermal Springs**	**76,523**	**156,596**	**20%**	**35%**	**3.22**	**3.82**
Central Georgia	1,000	Cucumbers	Thermal Springs	72,337	156,996	14%	30%	3.66	4.49
Central Georgia	1,000	Eggplant	Thermal Springs	68,334	156,121	9%	27%	4.06	5.12
Central Georgia	1,000	Basil	Thermal Springs	90,697	155,325	38%	50%	2.26	2.50
Sensitivity to Region									
Central Georgia	**1,000**	**Tomatoes**	**Thermal Springs**	**76,523**	**156,596**	**20%**	**35%**	**3.22**	**3.82**
Eastern Georgia	1,000	Tomatoes	Thermal Springs	80, 842	156,596	25%	39%	2.89	3.33
Western Georgia	1,000	Tomatoes	Thermal Springs	74,787	156,596	17%	33%	3.37	4.05
Sensitivity to Heating System									
Central Georgia	**1,000**	**Tomatoes**	**Thermal Springs**	**76,523**	**156,596**	**20%**	**35%**	**3.22**	**3.82**
Central Georgia	1,000	Tomatoes	Natural Gas	76,523	182,368	1%	21%	4.82	6.43
Sensitivity to Size									
Central Georgia	**1,000**	**Tomatoes**	**Thermal Springs**	**76,523**	**156,596**	**20%**	**35%**	**3.22**	**3.82**
Central Georgia	500	Tomatoes	Thermal Springs	38,261	99,386	-17%	10%	7.32	11.54
Central Georgia	2,500	Tomatoes	Thermal Springs	191,307	325,978	42%	53%	2.12	2.32
Central Georgia	5,000	Tomatoes	Thermal Springs	382,615	608,280	50%	60%	1.87	2.00
Central Georgia	7,500	Tomatoes	Thermal Springs	573,922	821,582	60%	68%	1.62	1.71

Central Georgia	10,000	Tomatoes	Thermal Springs	765,230	1,078,884	62%	70%	1.58	1.66
Central Georgia	**1,000**	**Tomatoes**	**Natural Gas**	**76,523**	**182,368**	**1%**	**21%**	**4.82**	**6.43**
Central Georgia	500	Tomatoes	Natural Gas	38,261	108,995	-23%	5%	8.42	14.37
Central Georgia	2,500	Tomatoes	Natural Gas	191,307	400,234	16%	32%	3.45	4.17
Central Georgia	5,000	Tomatoes	Natural Gas	382,615	763,346	22%	36%	3.10	3.64
Central Georgia	7,500	Tomatoes	Natural Gas	573,922	1,057,457	28%	41%	2.76	3.16
Central Georgia	10,000	Tomatoes	Natural Gas	765,230	1,395,569	29%	42%	2.70	3.08

GREENHOUSE CONFERENCE

On June 3, 2011, a conference was held at the Holiday Inn in Tbilisi. Well over 100 people were in attendance. Several speakers offered presentations about the industry, including production methods and marketing by two established growers, the financial budget template, and actions to improve yields by the greenhouse consultant, greenhouse structures by a greenhouse supplier, financing by a bank representative, the vegetable industry by the numbers by a professor. The conference was well received and attendees lingered after the close of the conference to gather as much information as they could. Many contacts between government, growers, NGOs, and banks were made as a result of the conference. Attendees learned that there is a good market for heated greenhouse-grown product, there is excellent profitability if done correctly and that the barriers that they thought were there are minimal.

FINANCIAL LENDERS WORKSHOP

On June 10, 2011, a workshop was offered in the EPI offices for lending institutions to learn more about the intricacies of the heated greenhouse industry. Over 20 were in attendance, representing varied institutions. Attendees were taught the difference in risk between traditional agriculture and greenhouse agriculture. The financial budget template was demonstrated and many qualms of the lenders were eased. With this greater understanding between the lending institutions and the greenhouse industry, the lenders should be more likely to extend affordable credit to the industry.

CONSULTS/MEETINGS/INTERVIEWS

The June 3rd conference fostered a lot of interest in the heated greenhouse industry. Many interested persons requested more in-depth consultations to better determine how they should proceed in their endeavors. Consultations were had with about a dozen different persons and groups.

D. RECOMMENDATIONS

The heated greenhouse vegetable industry has a lot of room for profitable growth. This growth can remain at its present rate, or it can be sped up through various incentives. There appears to be two main impediments to its growth. The first impediment is access to credit. In general, the larger the greenhouse, the more efficient it will be and the faster it will begin to turn a profit. However, since the start-up costs of a GH are so great, few, if any small farmers can ever reach that size of production to be efficient enough to compete with the relatively low prices of Turkish imports. Therefore, for the Georgian GH industry to meet its potential and compete with the imported competition, it must have access to the large amounts of capital it needs to become competitive. On the small scale, the GH industry will continue to do well with its small niche. Since banks are understandably hesitant to loan on a GH operation, guarantees will encourage the financing to flow out of local banks and into the industry.

The second hindrance to the GH vegetable industry in Georgia is the lack of technical knowledge. Since modern heated GHs are relatively new to Georgia, there is a lack of knowledge about the fine details of operating such a growing system. Small oversights can add up to much lower yields and with such high capital costs that slight lowering of yields can significantly lengthen the payback period of the investment. If the effective knowledge level can be brought up to speed fast enough, the industry could begin to finance itself much more quickly. In addition, if the yields are low because of that lack of knowledge, the growers may begin to spread the word that heated greenhouse vegetable production is a poor investment. Therefore, the immediate attention paid to the increased widespread knowledge base will be one of the most sensitive and effective investments in the fostering of the heated GH industry. In addition, once the internal markets are satisfied, the export market will be the next marketing venue. This market will have much tighter margins and higher yields combined with lower production costs will be the only way that the Georgian greenhouse vegetables will be able to compete.

For long-term sustainability of the industry by improving the knowledge base, a corps of private crop consultants should be trained. Since there is little government support of agriculture in Georgia and since many of the NGOs only work on relatively short-term projects, the greenhouse industry must be established in a system that will sustainably help itself from within. The greenhouse businesses themselves must fund their own improvement. Yet to do so, they must first understand the help that could be available to them and see its value. The private crop consultant often fits into agricultural industries that could be very profitable if the fine details are met. The Georgian greenhouse industry is that type of industry. Additionally, with the state of agriculture in Georgia, there are few viable alternatives to the crop consultant system.

One medium to long-term expat consultant or a team of medium/short-term expat consultants should be brought to Georgia to lead the heated greenhouse vegetable production self-improvement project. The consultant(s) should have in-depth knowledge of greenhouse vegetable cultivation, and hands-on experience growing vegetables in greenhouses. The consultant(s) should also have some experience in agricultural extension or comparable experience.

A corps of four to eight interns/employees/apprentices with good agronomic knowledge and interest in being private crop consultants in the future should be trained. Though not necessary, these apprentices will preferably have some experience working in greenhouses

and some experience working with vegetables. They will need to have decent English language ability.

The consultants and the apprentices (the corps) will all carry smart phones with cameras so that when they are on location in a greenhouse and are unsure of a certain pest or problem, they can send the others of the corps a picture or a video of the problem to try to offer an immediate recommendation. Short videos will be taken in the different greenhouses and downloaded to a drop box so that all the other members of the corps, including the consultant can review the problems that were viewed and the recommendations that were given. This large database of photos and videos will eventually be utilized to develop a digital interactive greenhouse growing guide in English and Georgian for all interested parties. The number of greenhouses that the corps works within the first year will somewhat be determined by the number of apprentices that are obtained. The ideal will be for the apprentices to work in teams of two. Three or four days a week they will work in the field visiting greenhouses on their circuit. Each visit will last not more than one hour and travel time between each visit will be not more than 30 minutes. They will lodge in hotels or other housing at least two nights a week. Each team will visit four to six greenhouses per day. Each team of two will visit at least 15 greenhouses per week. If there are four apprentices, the program could work with at least 30 greenhouse operations. The consultant(s) will travel with each team of apprentices every second or third week. They will remain in contact with the teams via smart phones as they make their weekly greenhouse visits. The consultant will have the ability to be “virtually” present at all of the visits. As many FtF volunteers as is possible will be sought to work with the teams on a short-term basis. European, Canadian, and other volunteers will be sought to provide assistance within the crop consultant structure that will be developed. These additional volunteers will add to the technical training offered and to the education of the corps.

One day a week in person or via video conferences, the corps will get together to look at certain problems presented in videos or pictures that need to be discussed and treated as systemic problems in Georgian greenhouse growing culture. Once a week or every other week, a growers meeting will be held in a participating greenhouse. In this meeting, the corps will make presentations on timely topics and explain the implementation of the ideas hands on in the greenhouse. All participating greenhouses will be invited to all of the grower meetings, yet the location of the meetings will rotate around the country so that they are accessible to all. Each grower meeting will focus on two or three topics of greenhouse management or finances. The grower meetings will also be an opportunity for growers to discuss problems amongst themselves and to develop a sense of common goal rather than competition amongst themselves.

One office manager/program assistant will work in the office supporting the corps by managing all of the pictures and videos, working out all logistic details of the corps, formulating and sending out weekly greenhouse grower e-newsletters, and beginning to formulate the production guide with the help of the consultant(s). The team members will be encouraged to write articles pertinent to the industry to be inserted into a weekly e-newsletter that will be sent to all growers and investors. The growers will be organized into an association. The corps will provide assistance to the association in its start up and organization. The corps will help to administer the association in its first months as an appendage of this project. After three months, the members of the association will be asked to pay voluntary membership dues. Paid members will get some added benefit over nonpaying members. After 3, 6, or 12 months, the growers will be asked to begin paying a subsidized fee for each weekly visit of the corps. This will be 20-50% of the actual cost of the visit. If a grower decides not to pay the fee, they will continue to receive the newsletters

and may attend the grower meetings. But their stop in the circuit of visits may be given up to another interested greenhouse grower that was not included in the initial circuit of visits. Or, if staffing issues are a concern, the number of weekly visits of the corps will be reduced. Paying growers will continue to receive the benefit of the one hour weekly consult.

At the conclusion of this project, the goal will be to have one to three private Georgian consultants being paid by the greenhouse growers to visit their greenhouse once a week to give recommendations that will maximize the yields of the crops and the profitability of the business. With greater profits, the owners will be motivated to reinvest in the expansion of the greenhouse space. The expat consultant(s) will continue to be available via phone/Skype/Internet to the private Georgian crop consultants. This will allow them to continue to offer the best knowledge possible to the greenhouse growers.

After the departure of the expat consultant(s), the private crop consultants will remain in contact with the expat consultant(s) via phone and Internet utilizing digital photos and modern technology to continue the education of the private crop consultants. Grower meetings should continue to be held in participating greenhouses. Suppliers/vendors should be invited to the meetings to explain their products. Potential buyers should also be invited to the meetings. A donation to the association should be requested of the buyers and vendors. The association should make requests for grants and technical assistance to various NGOs to support its members. The crop consultants should utilize the grower meetings as an opportunity to market their services to other growers and thereby increase their customer base.

The office assistant might continue on for up to a year after the disbanding of the corps. The office assistant will continue to offer support to the association and to the private crop consultants, as well as continuing publication of the newsletter. Eventually, the goal will be for the association to be awarded a grant to hire the office assistant to then work under the guidance of the board of directors of the association.

The timing of the development/establishment of this corps will be focused on the darkest months of the winter growing period. The most critical period will be December and January. As funding permits, the period of this project should be grown on both ends of this most critical period. The project length could be as long as a year or as short as two months. The project could be implemented in stages to minimize costs. The office assistant could be charged with laying all of the groundwork for the program. The assistant could contact all interested growers and promote the project and then select the participating growers. Prospective apprentices could have a Skype interview with the expat consultant before any of them begin. After selecting the apprentices, they could begin coordinating the logistics of the visits and begin learning the basics of greenhouse management. The expat consultant would be brought in when the groundwork has been prepared and the corps is ready to be begin its work consulting in the greenhouses.

http://ohioprogram.org

http://mast.cfans.umn.edu

http://caep.org

E. ADDITIONAL INFORMATION

CONFERENCE ATTENDEE LIST

NAME	COMPANY	CITY	COMPANY ADDRESS	PHONE	E-MAIL
Davit Shubitidze	I/E "Davit Shubitidze"	Mtskheta	Village Dzalisi	899 964964	kapl01@mail.ru
Besik Skhirtladze	I/E	Tbilisi	Qetevan Tsamebuli Avenue 2	899 930222	
Levan Chikhladze	"Nikora"	Tbilisi	M. Qavtaradze 11	895 250604	
Juanita Venter	Dutch Organic Farming	Tbilisi	Babiskhveni str. 14	895 330604	
Francois Venter	Dutch Organic Farming	Tbilisi	Babiskhveni str. 14	895 330604	
Johau Labuschayne	DOF	Tbilisi	Babiskhveni str. 14	895 186456	
Beglar Miqeladze	I/E "Beglar Miqeladze"	Batumi	Adbli str. 10	895 406707	

NAME	COMPANY	CITY	COMPANY ADDRESS	PHONE	E-MAIL
Giorgi Davitashvili		Qareli	Village Shaqshaqeti	899 225539	
Ivane Lazarashvili	Farmer	Gori	Village Zemo Khviti	899 755435	
Giorgi Abramishvili	"Viqtoria"	Tbilisi	Ateni str. 6/8	897 309030	
Eka Burduladze	Tbilisi City Hall	Tbilisi	Shartava str. 7	877 155585	
Giorgi Miqabadze	"Sense Selection"	Tbilisi	Barnovi str. 82	897 122458	
Gigla Agulashvili	LTD "Green Basket"	Tbilisi	Ateni str. 17	899 702000	agulashvili@gmail.com
Rusudan Mdivani	World Vision	Tbilisi	Imedashvili str. 17/18	899 199728	
Ioseb Mefarishvili	LTD "Agrou"	Tbilisi	Kostava str. 75/a	899 569338	
Zurab Fitskhelauri		Tbilisi	Khetagurobis str. 3	892 448669	

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