CHF CARIBBEAN INC.

Promotion of Regional Opportunities for Produce through Enterprises and Linkages (PROPEL)

CONSULTANT REPORT

PRODUCING FRESH PRODUCE FOR HIGH VALUE MARKETS (HVMS) IN GRENADA

NOVEMBER, 2013

Contents

1.0 Project Background

The Promotion of Regional Opportunities for Produce through Enterprises and Linkages (PROPEL) project is a sustainable economic growth project which aims to increase the value of Caribbean fresh produce accessing high-value markets in the Caribbean and internationally by CAD $100 million over five years. Funded by the Department of Foreign Affairs, Trade and Development (DFATD) and CHF (aka Canadian Hunger Foundation), the project will work with up to 28,000 farmers, private sector buyers, other value chain actors, and business service providers to facilitate the safe, effective and efficient movement of fresh produce from farm to fork.

The project will act as a catalyst for the development of agricultural production in the fruits and vegetables, roots and tubers, and herbs and spices subsectors to meet High Value Market (HVM) demands. PROPEL defines HVMs *as markets that demand high standards of quality, safety, timeliness and consistency (e.g. large supermarkets, buyers in the tourism industry – hotels, restaurants, cruise ships, airlines, importers and exporters).* PROPEL will support farmers to achieve standards of quality, quantity, and timeliness on a consistent basis through technical assistance and basic inputs. PROPEL will also provide business training and entrepreneurial support to producers to increase their capacity to efficiently plan production, manage their farms and market their produce. Women and youth will be specifically targeted and supported to engage in complementary, entrepreneurial activity tied to the expected employment and linkage opportunities. Finally, PROPEL will work closely with selected financial institutions and business service providers in the region to support greater access by producers to business development services such as credit and market information.

The objectives of PROPEL are:

1. Increased capacity of producers to meet high value market quality, quantity and safety needs in an environmentally sustainable manner;

2. Increased knowledge and capacity of young agri-preneurs to enter and operate businesses serving high value markets, based on the specific needs of each target group of producers (including youth);

3. Increased access of producers to appropriate financing, facilitating equitable access to women and youth;

4. Increased ability of national and regional associations, networks, producer groups and other organizations to facilitate meeting high value market demands in an environmentally sustainable manner; and,

5. Increased linkages between private sector buyers, producers and appropriate government institutions.

The eight countries targeted by PROPEL for implementation of project activities are Barbados, Jamaica, Guyana, St. Vincent and the Grenadines, Dominica, Grenada, Trinidad and Tobago, and St. Lucia. The PROPEL regional office is located in Barbados with satellite offices in Jamaica and Guyana, and additional staff and consultants in other target countries.

2.0 Summary of Consultancy

This Consultancy was for the provision of technical services for selected fresh produce producers in Grenada in the following areas:

i. Assessment of agriculture practices;
ii. Capacity building of producers to meet HVM requirements; and
iii. Development of technical training and information materials for producers relevant to HVM needs.

3.0 Purpose and Scope of the Consultancy

This assignment was conducted to facilitate PROPEL's market-led approach and to create opportunities for producers, in the Grenada context, to access high value domestic markets. The Consultant built on previous consultations held with local selected HVM buyers (hotels and supermarket). During the period July-September, 2013 initial engagements were conducted with seven HVMs in Grenada, namely: Foodland Supermarket, Food Fair Supermarket, Real Value Supermarket, Spice Island Beach Resort, Sandals La Source, True Blue Bay Resort and Coyaba Beach Resort to understand HVMs demand trends as well as opportunities and challenges in buyer-producer relationships and supply of fresh produce to the domestic HVMs. Technical staff and the Permanent Secretary in the Ministry of Agriculture were also consulted to explore potential to support relationships between HVMs and producers. During the initial consultations, HVM buyers, producers and the Ministry of Agriculture revealed that a wide variety of fresh produce was required, but poor quality and inconsistency in supply were obstacles. Twenty locally produced fresh produce with the highest retail dollar values were selected for increased access into the domestic HVMs. It was also determined that technical support was required at the levels of the Ministry, producers and HVMs to address the issues and to strengthen the relationships between the entities.

The Consultant was engaged to support and assist producers to adopt measures to improve quality and to provide consistent supply of safe produce. In addition, the Consultant was expected to engage the extension and agronomy staff in the Ministry of Agriculture to improve technical capacity to support buyer-producer relationships. CHF, in collaboration with the HVMs, also crafted a plan to develop the HVMs through training and coaching to strengthen relationships with producers and the Ministry of Agriculture. The first group of selected producers comprised those who were supplying and preferred by the specific HVMs and who had the potential to increase production of current commodities and or produce new commodities to meet demands of the HVMs. The Consultancy assignment was undertaken in close collaboration with PROPEL's staff in Barbados and the Ministry of Agriculture in Grenada.

4.0 Consultant's Findings and Recommendations, Re: Agricultural Practices

Seventy eight (78) producers were engaged by the Consultant during the period 24 September – 12 October, 2013 through consultations, field visits, and Farmer Field School (FFS) sessions. A number of factors were highlighted that have and continue to affect linkages between HVM buyers, producers and other stakeholders. Agronomical issues prominently affected the producers' abilities to supply the local HVMs consistently with safe fresh produce at the required quality standards. The Ministry of Agriculture was somewhat limited in its ability to address the issues of all the producers. Through the Consultancy, several agronomical issues were identified and technical support was provided to address some pertinent issues. Recommendations were also provided by the Consultant for further actions to address the issues.

Following are the specific agronomy factors identified by the Consultant and associated recommendations to improve good agricultural practices in Grenada that can increase absorption of local fresh produce by supermarkets and hotels.[1]

[1] Note: Findings and recommendations included in this report are those of the consultant and may/may not reflect PROPEL's views on these matters.

4.0.1 Seed quality, variety selection and seed characteristics

Seed quality is a very important factor in successful agricultural production. Farmers should seek to ensure that only seeds of a certain standard are used for crop production. Seed varieties will allow for the producer to select seeds that will exhibit varying characteristics such as:

- Variations in fruit quality, size, shape, texture, brix, colour, shelf life
- Resistance to varying bacterial, fungal and viral infections
- Maturity

Grenadian farmers were using cultivars of crops including, but not limited to, tomato, bell pepper, cabbage, lettuce. In most cases, cultivars were extremely old and offer little or no resistance to virus diseases such as tomato yellow leaf curl virus (TYLCV) and bacterial leaf spots. More resistant cultivars were available at local farm input suppliers, however, farmers were reluctant to purchase improved cultivars owing to factors such as:

a. Cost:

The cost of seed cultivars with improved resistance and improved production characteristics are normally more expensive. It is, however, more profitable for producers to invest in these cultivars and enjoy improved production from crops.

b. Availability:

The local seed suppliers did not carry large quantities of the improved cultivars owing to the slow uptake by farmers. Generally, suppliers are also reluctant to put up large amount of resources to purchase and import seeds coupled with the improved cultivars.

c. Farmer Adoptability:

Farmer adoptability of improved seed cultivars can be difficult. Farmers were reluctant to try improved cultivars due to:

i. *Cost* - Improved cultivars were significantly more expensive.

ii. *Fear of income loss* - Farmers were timid to try new materials when they were not sure they will get the same or better production results.

iii. *Availability* - Farmers feared that these improved cultivars may not be consistently supplied for continuous production of the crop for the markets.

iv. *Seed characteristics and information* - Farmers were not aware of improved cultivars and their abilities to increase production without making major modifications to their current agronomical practices.

Recommendations

1. Seed quality, variety selection and seed characteristics training and discussions should be conducted by a trained agronomist with experience in seed quality selection. Training and other discussions should be attended as follow:

    a. Producers and extension staff on:

        i. Seed production characteristics such as fruit setting ability in hot conditions (heat set)
        ii. Storage and shelf life of varying cultivars
        iii. Quality, texture, brix content, shape, size, flavor
        iv. Time to maturity

    b. Input suppliers on:

    Understanding types and quantities of cultivars that will be needed through discussions with the facilitator, producers and extension staff.

    c. Producers and extension staff on:

    Timelines when cultivars will become available.

2. Demonstration plots should be strategically set up across the different parishes using improved cultivars with desired characteristics coming out of the above farmer field school sessions. These demonstration plots will allow for producers to get a first hand view of how these cultivars perform and also allow for the extension staff to make recommendations for use of the cultivars.

3. Start-up sample seed packages of these improved cultivars could be provided to the selected high value market producers as well as technical support. Without incurring substantial cost, producers and extension staff can study and observe the performances of the cultivars under varying environmental conditions.

4. Documentation of these findings from the demonstration plots and trial plots must be done and this data/information published in flyer and posters with the recommended cultivars of specific crops.

5. There must be continuous research and development in seed quality and cultivar selection as yearly improved cultivars emerge. The Ministry of Agriculture can assist farmers to access new and improved planting material.

4.0.2 Plant nutrition and identification of plant nutritional deficiencies

Plant nutrition refers to the varying macro and micro elements needed for plant growth which will enable plants to carry out varying metabolic activities. This knowledge is a very crucial determining factor in agronomical production as this determines:

- Plant productivity
- Produce quality
- Produce shelf life
- Plant health
- Plant pest and disease resistance

The ability of producers to identify plant nutritional deficiencies and plant nutritional toxicity is another key aspect of the production cycle. Information on these areas was lacking by many producers and some extension staff.

Commonly, plant nutrients are placed on the surface of the soil, allowing the nutrients to be lost through volatilization. Pen manure, placed on the soil surface of soil, may also be a source of contamination for fresh harvested produce through physical contact.

Recommendations

1. Identification cards or posters on plant nutritional disorders can be developed and distributed to farmers and extension staff. These cards should have the following information:
   a. The name of the specific plant nutrient
   b. The importance of the nutrient to plants
   c. Pictorial illustration of deficiency or toxicity
   d. Symptoms of deficiency or toxicity

2. Producers and extension staff can be trained in groups of fifteen (15) to twenty five (25) persons in farmer field schools. The training can be conducted over three days in the following modules:
   - ✓ **Agriculture Ecosystem Analysis (AESA)**

   This module will cover field scouting after and field analysis
   - ✓ **Nutrient application and Management**

   Module would use data from (AESA) exercise to form as a basis for plant nutrition and application method
   - ✓ **Safe Use, Storage and Handling of Agricultural Chemicals**

4.0.3 Pest and disease identification

Plant Disease

A disease is any biological occurrence that prevents the normal development of a plant and reduces the economic and or aesthetic value of that plant. Diseases normally develop over a

period of time and may be present in the production area before symptoms are seen; referred to as the incubation period. Diseases are caused by living (biotic) pathogens, micro organisms, parasitic plants and non-living (abiotic) factors.

Symptoms of plant disease are normally visually identified by plant reactions which include but are not limited to; mosaic, wilt, yellowing, blight, rots, stunting, abnormal growths. Diseased plants are easily recognized by comparing it to a healthy plant.

Plant Pest

A pest is a plant or animal that is detrimental to humans or plants. Plant pest have negative impact on agriculture production. Pest normally act as vectors for varying infections, however, of major concern is viruses. Aphids, thrips and white flies are vectors for many plant viruses.

Grenadian farmers, and to some extent extension staff, were disadvantaged in identifying varying crop pests and diseases. Visits to the farm plots further reinforced this as farmers themselves could not identify differences between pest damage and disease damage. In addition, farmers were using insecticides where fungicides should have been used and vice versa. With limited access to plant pathology laboratory facilities, extension staff were disadvantaged in identifying certain pests and diseases. Overall, it was recognized that significant amount of emphasis needed to be placed on education in the area of *pest and disease identification.* Some of the major pests and diseases found on these plots included but were not limited to the following:

Crop Significant Pests Identified	Crop Significant Diseases Identified
Aphids	Bacterial Leaf Spot
Mites	Fusarium Root Rot
White Flies	Phytoptera Root Rot
Diamond Back Moth	Powdery Mildew
Varying Worms	Downy Mildew
Thrips	Early & Late Blight
Stem Borer	Anthracnose

The pictures below show varying infections affecting Grenadian farmers which can be corrected by using improved cultivars.

Tomato plant infected with Tomato Yellow Leaf Curl Virus (TYLCV).

Sweet pepper plant infected with bacterial leaf spot.

Cabbage plant affected by crown rot.

Melon showing leaf mottling - sign of viral infection.

Wilted tomato plant on a farm in the southern part of the Grenada

Recommendations

1. The Ministry of Agriculture may embark on the creation of identification cards or posters on crop significant pest and diseases for distribution to farmers and extension staff. The cards should have the following information:
    a. Local and or common name of pest or disease
    b. Scientific name of pest or disease
    c. Brief information on pest and disease
    d. Picture of pest or disease
    e. Symptoms of pest or disease
    f. Control methods for pest or disease

2. The provision of fact sheets on varying pesticides (insecticides and fungicides) will be very crucial as farmers lacked information on proper usage of pesticides, including fungicide and insecticide.

   Farmers were also found to be timid in the use of insecticides during crop cycles, and more so, do not do applications during periods of harvesting. Correct use of pesticides can extend the production periods by minimizing pest and disease loading within agricultural zones.

   The fact sheet provided to farmers and extension personnel should contain the following information:

   a. Pesticide Name
   b. Active Ingredient
   c. Class of Pesticide
   d. Mode of Action
   e. Pre Harvest Interval
   f. Re-entry Period
   g. Brief Information on Product

   Use of chemical information sheets will expose farmers and extension staff to information for proper usage of the chemical, potential environmental impacts, and to ensure that only safe and high quality foods enter HVMs markets on a consistent basis. Proper usage of chemicals is also important to ensure acceptable levels of chemical residues and for proper rotation of pesticides to prevent resistance to chemicals.

3. Producers and extension staff can be trained in groups of fifteen (15) to twenty five (25) persons in farmer field schools. The training can be conducted over three days in the following modules:

   ✓ **Agriculture Ecosystem Analysis (AESA)**

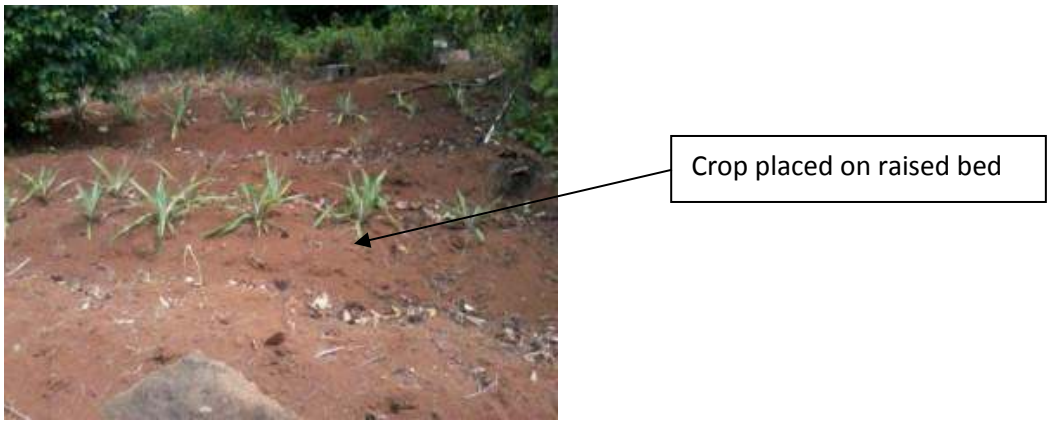
   This module would cover field mapping, environmental analysis, and scouting and pest impacts.

- ✓ **Integrated Pest Management (IPM)**
  This module would entail non-chemical insect control, sanitation and scouting.
- ✓ **Safe Use, Storage and Handling of Pesticides**
  This module would entail scouting, pesticide selection, pesticide storage facility requirement and safe use of chemicals.

4.0.4 Drainage, moisture retention and proper land preparation

Proper land preparation is crucial for sustainable and consistent crop production. Proper land preparation allows plants to maximize water and nutrients and also controls weeds.

Some Grenadian farmers need to be exposed to proper land preparation methods. In many cases, land preparation was not properly done and had negative effects on production. The picture below illustrates the point.



The picture above shows crops planted on raised banks. Raised banks normally facilitate good water drainage in areas where the soil drains poorly or where there is good irrigation infrastructure. However, this particular farmer had crops planted on raised banks without irrigation, and as a result, the plants were suffering severe water stress. Drainage of the soil moisture due to precipitation was enhanced by two factors; loamy soil and the use of raised banks.

The picture immediately above shows plants on raised soil beds, however, with irrigation. These plants, nonetheless, were under severe water stress as the irrigation system was not capable of providing enough water for these plants. The soil type also allowed relatively quick drainage.

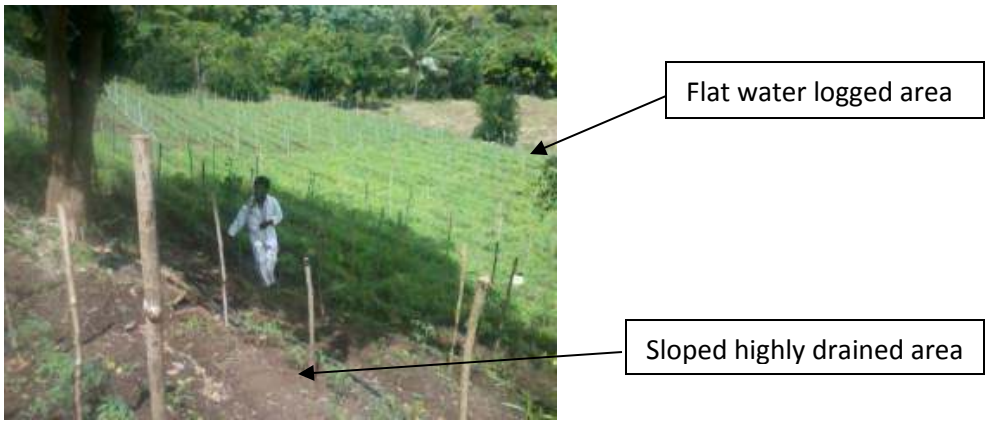
The orientation of beds is another important factor to consider in land preparation. In some areas, farmers positioned beds incorrectly, which also resulted in significant soil erosion.

The picture above shows a farm that was affected by erosion. On entering the plot, significant amounts of eroded soil were seen in the trenches. Farmers must be made aware of practices which will reduce soil erosion as soil is the media through which plants acquire water, nutrition and for anchorage.

Proper land preparation also includes drainage. Drainage is crucial to prevent crop loss due to root rot and other microbial damage due to excess moisture in plots.

The picture below shows a tomato farm in the western region of Grenada. A section of the plot was sloped and the other was flat. During irrigation or rain fall the flat section was completely saturated and consistently water-logged. The farmer complained about root rot which resulted in

about 25% loss of crops in the water logged area. Grenadian farmers must take care to use proper drainage to reduce rot root and bacterial related losses due to moisture retention.



Recommendations

1. Producers and extension personnel should be involved in a farmer field school session where they will observe and discuss proper land preparation. An activity demonstrating water infiltration can be used for the following purposes:
    a. Allow participants to be aware of plant water needs
    b. Allow producers to make correct decisions in land preparation
    c. Allow producers to decide on land drainage
    d. Allow producers to do proper bed orientation

4.0.5 Irrigation design, scheduling and timing

Irrigation is the artificial application of water to crops. Several irrigation methods can be used, however, the most common methods are: drip irrigation, sprinkler irrigation and flood irrigation. There are advantages and disadvantages in using each method.

On farm irrigation is lacking in Grenada. From discussions with farmers and extension staff, the main factors contributing to this lack are:

a. Lack of irrigation infrastructure (drip lines, main lines, fittings)
b. Lack of water for irrigation
c. Initial start up cost for irrigation system
d. Lack of knowledge about irrigation system

Where irrigation systems existed, most were either mini or micro sprinkler systems and it appeared that consideration was not given to the type of crop, land characteristics, potential for contamination and conservation of water. Producers did not consider the overall impact of the method of irrigation on the environment. For example, while sprinkler irrigation method was commonly used, the method is known to have long term effects on agriculture lands from nutrient leaching, particularly in sloped areas. The method also leaches nutrients out of the root zone of plants at a much faster rate compared to use of drip irrigation systems.

Shade house utilizing sprinkler irrigation in lettuce production. Plants under water stress as system does not provide significant quantities of water for plants. Arrows point to plants suffering from water stress.

Sprinkler irrigation used on sloped lands. Farmer furrowed across the slope to reduce soil loss and maximize water retention.

Recommendations

Efforts should be made to educate farmers, agriculture input suppliers and extension staff on irrigation practices as it relates to yield loss due to impacts on soil as well as foliar bacterial and fungal diseases.

1. The working and training sessions should allow farmers, extension officers and other technical personnel and input suppliers to understand how irrigation systems work and impact production and the environment. The sessions can best be facilitated using the farmer field school methodology, with a facilitator experienced in irrigation system design, installation and maintenance. Producers and extension staff may also have direct dialogue with input suppliers on types of systems required in Grenada and providing basic advice to farmers for selection of irrigation systems.

2. An irrigation demonstration plot can be established on a Government estate or on a private farm. The plot should be about one acre and used to produce a selected crop. Half of the plot can be irrigated using sprinkler irrigation while the other half can be irrigated using micro sprinkler irrigation system. The aim of this method of intervention is to allow both extension staff and farmers to:
   a. Compare advantages and disadvantages of using either system;
   b. Evaluate:
      - ✓ Plant growth rate
      - ✓ Plant production
      - ✓ Pest and disease impacts and management

- ✓ Weed growth impacts and management
- ✓ Water resource management and efficiency
- ✓ Soil structure
- ✓ Cost of production

Farmers may also consider use of lined water catchment facilities - constructed ditches lined with pond liner material and used as a water catchment and storage facility. These ponds should be constructed in areas that do not have a source of irrigation water; the pond will act as a catchment and also store rain water during periods of high rainfall for use in dry periods. This approach will allow for continuous crop cycles and reduce the shortage patterns of agricultural produce to HVMs and other markets that normally occur during extensive drought conditions.

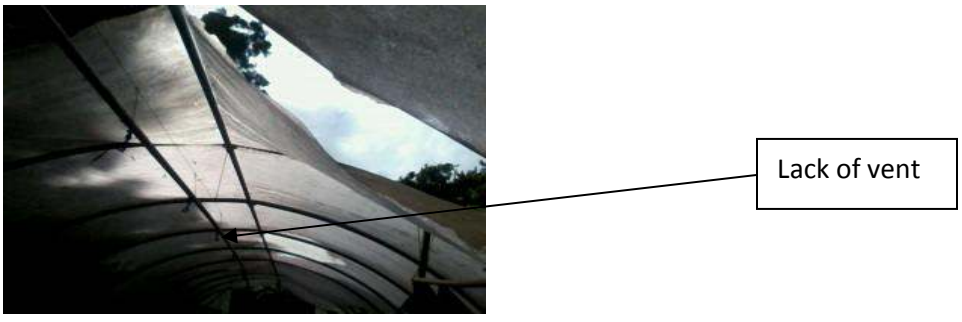
4.0.6 Protected Agriculture

The Grenadian greenhouse industry has a lot of potential and can produce crops in periods when open field farmers' production is limited. Green house production, however, must be managed properly so as to prevent market saturation of specific produce.

Greenhouse production is more predictable as compared to open field production. The protection of the plants from excess wind damage, pest and disease and intense rainfall contribute to the enhancement of yields. However, crop care and management of these protective production units are more intensive and require experience. Investments in greenhouses should also be based on a clear analyis of costs and benefits.

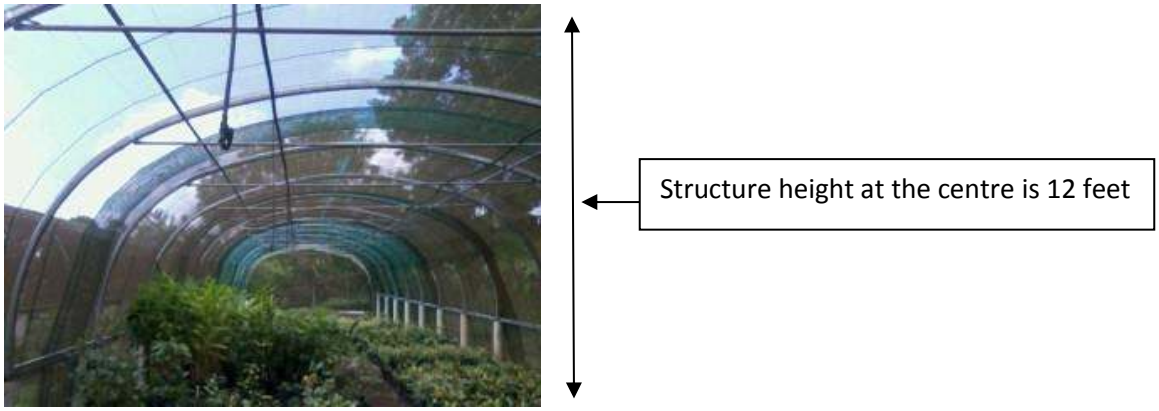
Field visit observations

1. The absence of ventillation in structures.



A vent is normally placed in the roof of a protective structure in tropical conditions to allow for the convectional removal of heat. The green house must be orientated so as to allow the normal wind flow to move over the vent to also act as a suction mechanism for hot air removal. Dome shaped houses and or houses without vents trap significant amounts of heat in the day. Trapped heat reduces the variation between day and night temperatures which are necessary to enhance plant production.

2. Structure height



Crop production in a greenhouse is over a more extended period compared to open field production. Height of the structure is important to accommodate the crops as plants such as peppers can grow up to 12 feet tall and tomatoes up to 40 feet tall.

Structure height is also very crucial in allowing cooler micro-atmosphere for plant growth as hot air will rise and cooler air sinks. This is a very important consideration in the tropics. Heat problems normally become more pronounced as the plants grow over 3 feet and are moving into a much warmer micro-climate. Structures should be selected properly given all these considerations.

Recommendations

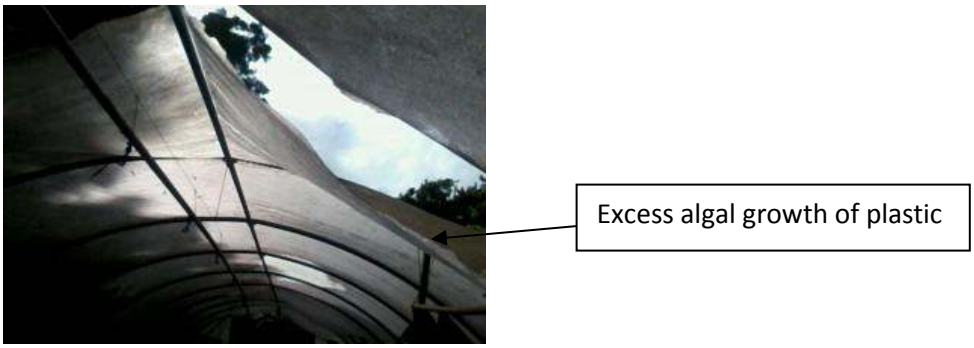
1. Erected greenhouse structure should have a vent, not less than 2 feet, to allow escape of hot air. Ventilation allows for a more tolerable growing temperature for crops and also assists in achieving a significant temperature difference between day time and night time to maximize production.

2. Structure sidewall should be no less than 10 feet from ground to gutter level and from ground to vent/centre should not be less than 18 feet, allowing hot air to move out of the growing zone of the plants and creating a cooler micro-climate in the structure.

3. The use of shaded plastic - all greenhouse plastic to be used should be UV treated. Some farmers do not use UV treated plastic. Use of a 30% or 60% shaded plastic, depending on the crop, will also regulate the amount of heat within a structure as the shaded plastic will reflect more of the unwanted solar radiation from the structure, allowing for a cooler environment and less damage due to excessive solar radiation.

Note the difference in the physical appearance of each type of plastic in the picture above.

4. Plastic and netting maintenance is very important. Due to the high humidity in the tropics, algae growth is an issue with use of plastic and netting. Algae growth can be prevented or minimized by using sulphur-treated plastic, however, this may be a very expensive venture. Plastics and netting should be washed quarterly (3 month intervals) so as to prevent the buildup of algae.



5. Intensive training sessions should be continued for producers and extension staff in greenhouse or protective agricultural technology. Eventually, more greenhouses can be used by producers. This training should be conducted by trained agricultural personnel with a minimum of three years experience in greenhouse technology in tropical conditions.

4.0.7 Post harvest management

Post harvest management is a very crucial agronomic practice that will allow for producers and selected high value market producers to capitalize on their investment and to ensure a regular supply of high quality produce. The application of proper post harvest techniques is aimed at reducing qualitative and quantitative losses in harvested horticultural commodities.

The issue of proper post harvest management of produce is critical and was discussed by both farmers and HVM buyers during a consultation session in Grenada. The harvesting of agricultural produce under unsuitable conditions, such as plants undergoing heat stress and extreme solar radiation, can have significant impact on harvested produce. Transportation of produce from the farm to the markets in Grenada was a major issue given the general lack of cold storage or covered transportation units.

The major objectives of post harvest technology are:

1. To prolong food availability longer than would be normally possible in the fresh state.
2. To maintain the quality of horticultural produce at the highest possible level as dictated by consumers taste or preference.

Post harvest losses can be either:

a. Qualitative:

Loss of:

- Edibility (eating quality)
- Nutritional quality
- Caloric value

b. Quantitative

Loss of:

- Salable weight

Guava harvested in slotted crates to allow for air movement.

Recommendations

1. Producers and extension personnel should understand the physiology, biology and biochemistry of fresh produce post harvest management. Training sessions should allow for identification of affordable and effective methods to reduce post harvest losses between the field and markets. It is important for Grenadian farmers and extension staff to understand:
    - The effects of respiration and transpiration on harvested produce
    - The factors that cause post harvest loss
    - The techniques in proper post harvest techniques
    - The methods to deal with field heat
    - How to minimize moisture loss in harvested fresh produce
    - Techniques in dealing with varying agricultural produce; seeds or pods, bulbs stems, tubers and flowers, stems, bulbs, leaves

2. Grades and standards should be developed for targeted crops. This can be achieved by soliciting the services of local experienced staff in the development of specific grades and standards charts for targeted crops accompanied by worded descriptions. A manual which

would encompass post harvest management can be developed and entail pre harvest practices of the fresh produce to the point of display or use in the markets.

3. Farmer field school sessions on post harvest management can be conducted across the island.

5.0 Implications for Food Quality, Safety and Consistency

Food quality, safety and consistency are key considerations for agriculture production focused on HVMs. Addressing the various issues outlined above in Section 4 would thus be centrally important if farmers are to enhance their access to HVMs on a sustainable basis.

Quality is an important factor for consideration in accessing HVMs. Producers are required to provide fresh produce that meet the HVMs requirements. Quality issues, unchecked, will ultimately affect the consistency of the local fresh produce trade through loss of produce and revenue by both HVMs and producers.

Presently, many vegetables and fruits are eaten raw. It is not unusual for consumers to also take in these foods without washing them properly. This places the burden on producers to take safety precautions, as much as possible, to avoid contamination of these produce from the farm to the table.

The practices listed below are currently being used by some Grenadian producers and may have some food safety implications if not corrected:

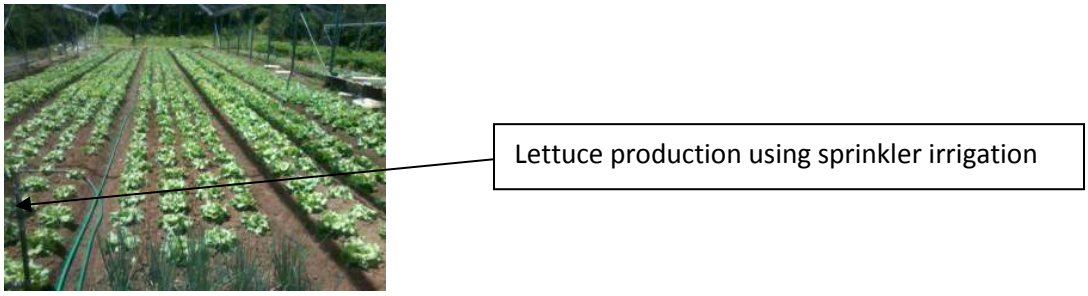
a. The use of pen manure

The use of pen manure is a very common practice across Grenada. Pen manure helps to improve the nutrient content of soil and also the organic matter content. Pen manure, however, should be properly covered in the soil. In most instances farmers spread the pen manure on the surface of the soil, exposing produce to be contaminated by bacteria such as *E.Coli*.

Pen manure should be properly decomposed before it is used on the farm. The manure should be properly covered with soil, at least eight inches or more, to decrease the risk of contact with fresh produce.

b. Sprinkler irrigation

The use of sprinkler irrigation is wide spread in Grenada. Irrigating plants by using sprinklers may also be a source of contamination as water used for irrigation is normally un-treated and untested - a potential source for transmitting food safety significant organisms. Micro sprinklers can also cause contamination as water droplets falling to the soil may splash soil particles or uncovered pen manure onto fresh produce.



Water to be used for sprinkler irrigation in the production of fresh fruits and vegetables should be tested at specified intervals to ensure that dangerous organisms are not present. The use of mini or micro sprinklers to distribute tested irrigation water is a good combination to minimize risk of contamination.

The use of drip irrigation where irrigation water does not come in contact with the fresh produce is recommended as water will be directed to the root zone of the plant, minimizing potential for contamination as a result of splashing.

6.0 Use of the Analysis and Recommendations

The analysis and recommendations offered above are for the consideration of various interested stakeholders - Grenada's Ministry of Agriculture, Grenadian producers, CHF Caribbean Inc. - to determine shared priorities for implementation of the PROPEL project in Grenada.