



**ENVIRONMENTAL
MANAGEMENT PLAN
*CAYO COVERED STRUCTURES***

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1.0 PROJECT BACKGROUND:

While the 2010 Country Poverty assessment report for Belize noted that the Cayo District has the second lowest poverty levels, 29.8%, in Belize, the rate in rural parts of the district are considered to be higher. The villages of Cristo Rey, San Antonio and Seven Miles are located in the western central portion of the district in an area that is traditionally known for logging. The three villages have a total population of approximately 4,000 inhabitants. In recent years economic activity has shifted away from logging and is focusing more on service (in tourism and the urban centres of San Ignacio and Belmopan), employment in agriculture with the Government of Belize or the Mennonite Community, and farming. The area is one of the largest producers of vegetables in the district and possibly the country. Crops grown include basic grains, mainly corn and beans, plantains and vegetable using the conventional farming system. However, youth unemployment continues to be a concern in the area. There are no statistics on the agricultural production or the economic activity from this area.

GROUP INFORMATION:

The Yax'ha Green Growers Farmers Group is comprised of twelve (12) mostly young farmers from the village of Cristo The Group was organized on February 19, 2014 and is in the process of being registered. Young women and all farmers' wives have shown interest in the group and the project.

The Seven Miles Farmers Association was established on February 15th 2014 and has not been registered. The purpose of the Association is to work with the farmers by introducing innovative technologies in vegetable production in order to increase income. Given that the Association is newly formed, it does not have experience in implementing projects however it will work with (NGO) already working in the area to be able to qualify. The group is comprised of 20 members.

The Ox Mul Kah Agro-processing Youth Group is a subset of the Ox Mul Ka women's cooperative. There are currently twelve members. The group was formed in January, 2006. This group of mostly women from San Antonio Village was started in order to provide income alternatives. The women did not have any background in business but their love of working together gave them the drive to start a new business so that all members of the group would have a little extra money to provide for their families. The group is the most experienced of the three and will be the lead for the project.

PROJECT PROPOSAL:

The project will expand on a new appropriate technological approach by involving 36 farmers in the cultivation of vegetables (and other high value crops) under protective structures using an agro-ecological farming system. The protective structure measure 20 ft wide, 100 feet long and 14 feet in height and will be constructed under supervision of persons who are trained and experienced in this particular farming system. The structures will come complete with ultra

violet plastic roofing, Anti insect sidewall netting and a drip Fertigation system. Each protective structure has the capacity to accommodate up to five hundred (500) plants and can produce vegetable for a period of seven to nine months, five months longer than the conventional farming.

There is a high demand for quality vegetables particularly for the restaurant and hotel trade. Currently vegetables are imported from Mexico to meet the local demands, particularly Sweet peppers, Cabbage, Carrots, Lettuce, Tomatoes, Potatoes, Broccoli and Cauliflower. The primary goal is to provide income alternatives through import substitution and food security. Production of vegetables will commence at the end of first three months. It is expected that 90% of the production will sold commercially (mainly at the local market and resorts) while 10% will be for domestic consumption. It is also expected that proven organic method of production will be used to reduce the impact on the environment and to improve yields. The use of such things as Bokashi, humus from the California Red Worms, chicken manure and compose tea should also help to reduce the cost of production.

PROJECT OBJECTIVES

GOAL

"An integrated system of men and women in plant production practices having a site-specific application that will, over the long term: (1) satisfy human food; (2) enhance environmental quality and the natural resource base on which the agricultural economy depends; and (3) enhance the quality of life for farmers and society as a whole. "

General Objectives

1. Enhance member's green production capacities in the production of organic vegetables through the use of appropriate technology and the transfer and dissemination of technical information
2. Provide farmers with information on the process, technique and management of protective structure using the integrated farming system approach.
3. Promote and protect the environment using organically homemade bio fertilizer and pesticides that are friendly to humans and to the environment.
4. Improve family's nutritional intake by introducing the consumption of vegetables as part of their daily diet.
5. Encourage the production and consumption of quality vegetables
6. Address unemployment challenges
7. Improve standard of living of farmers and their families
8. Empower women in sustainable agriculture
9. Reduce the use of chemicals and promote the use of organic products
10. Planting more intensively rather than seasonal using irrigation system on a small scale and at the same time conserving water for the community households

11. add more value to the group members' production
12. provide a sustainable livelihood for the members and their families

ACTIVITIES

The main activities of the project are:

1. Greenhouse Construction

Construct the different greenhouses in their specific areas. This will be done with the guidance of Technical Personnel for the Ministry of Agriculture. In addition the drip irrigation system will be laid.

- a. Identification and selection of sites for the construction of the Structures
- b. Land preparation – Clearing of existing secondary vegetation
- c. Purchase and delivery of construction materials
- d. Erecting the structures
- e. Purchasing of seeds and other supplies such as irrigation dripping hose, rotoplas etc.
- f. Installation of the Fertigation system
- g. Preparation of beds inside the structures

2. Planting

- a. Identification and selection of site for the construction of the Vegetable Nursery
- b. Preparation of nursery beds.
- c. Seeding the nursery – This will be scheduled to ensure that all the farmers are not planting the same vegetable at the same time.
- d. Transplanting of vegetable plants (sweet pepper, tomato, etc)

3. Maintenance

- a. Fertigation. This will be done using organic compost tea.
- b. Pest and disease control - Application of organic fertilizers, biofertilizers and pesticides. Because this is a new system for some of the farmers, the plan is to allow those farmers to use agrochemical controls for one cycle (8 – 10 months) while they receive training in the use of organic disease and pest control methods. It is expected that all farmers will transition to the organic method of production which is a niche that commands a higher price in the market.
- c. Weed control

4. Harvesting – this will be synchronized to ensure that all farmers are not harvesting at the same time and will not inadvertently create competition among themselves.

5. Marketing – This will be done through direct sales to larger purchasers and at the weekly farmers' markets in San Ignacio and Belmopan.

6. Trainings

Train farmers in green house vegetable production. In this activity, request will be made to the Ministry of Agriculture personnel to conduct such training upon notification of project approval. The Ministry of Agriculture is expected to assist the farmers in this.

- a. Hiring of facilitator for the workshops
 - b. Implementation of training workshops
7. Preparation of monthly narrative and financial progress reports

The project will provide 22 pre-fabricated covered structures (Tropical Greenhouses) equipped with irrigation system and water reservoir for farmers to be able to produce high value vegetables, primarily tomatoes and sweet peppers, year round in a sustainable way by promoting the use of organic pesticides and providing training to the farmers to better manage their crop in green houses by improving production.

EXPECTED RESULTS

1. The establishment of a sustainable fresh vegetable supply with a secure market
2. Cooperative production and sale of vegetables from the three communities.
3. An additional source of income for community members to improve their livelihood.
4. Reduced impact on natural resources through the efficient use of technology and space to produce high quality, high value vegetable products.

TRAINING/WORKSHOPS

Training is an integral part of the introduction of any new technology. Farmers will be expected to participate in all the training sessions. Training will focus on:

- Assembly and disassembly of the structures and accessories
- Management of the Protective Structures
- Crop production within protective structures
- Production and application of organic fertilizer and pesticides
- Pest identification and control
- Post-harvest handling
- Marketing
- Record keeping
- Leadership skills
- Project Management

2.0 EXPECTED IMPACTS:

The environmental impact of greenhouse production is poorly documented. Environmental benefits versus drawbacks of greenhouse production are not well known. Assessments that integrate pesticide toxicology and transfer of mass and energy are scarce. The expected impacts from the project are expected to be minimal because of the very distributed nature of the project.

A total of 22 structures, each 20 feet by 100 feet, will be located in three sites, each about five miles apart. Additionally, in each site the structures will be distributed over an area of approximately 1,000 acres. Thus, impact from any one structure will be small (2,000 square feet), localized and much easier to mitigate. These impacts include:

- Soil enrichment and fertilizer runoff. This occurs because some fertilization is required to supplement nutrients in the soil because of increased planting densities. While excess fertilizers tend to leach out of the soil in areas of high rainfall activity, this is not expected to be a concern as in this case the dosage can and will be carefully controlled in the fertigation process. Additionally, the rainfall will not directly hit the ground in the production spaces because of the covers. Rainfall will be collected and stored for irrigation purposes.
- Bioaccumulation of heavy metals. Studies done in China indicate that there is a tendency towards the accumulation of heavy metals in plants grown in greenhouses over time. The primary metals are Cadmium, Copper, Zinc and Lead, with Cadmium showing the highest concentration in the study. However, bioaccumulation appeared to be associated with a particular soil type; Anthrosols.
- Pesticide contamination and runoff. The management of pest and disease in crop production is fundamental for optimum production. Pest and disease can destroy one hundred percent of production if not properly managed. Integrated pest management (IPM) is a program used to control pest and disease. IPM includes all good agricultural practices for control of pest and diseases. Good agricultural practices include proper soil preparation, proper drainage system, good weed control, efficient nutrition program, monitoring of possible pest or disease in crop, monitor of severity of pest, monitor of damage in crop and base on damage decision of pesticide to use for control of identified pest or disease. Because of the higher planting densities and the antiseptic nature of the greenhouse environment, plants are more susceptible to contracting and spreading diseases and pests.
- Organic waste. For tomato and sweet pepper production it is estimated that every eight months there will be some 2 – 3 tons of organic material to be disposed of at the end of the crop cycle. This is because of the plant material that is left standing at the end of the cycle. For other vegetables grown in greenhouses this volume is much less primarily because of the small amount of residual stems and leaves after harvest. A list of potential vegetables to be grown can be found in Annex 4.

3.0 MITIGATION MEASURES:

Use of covered structures (tropical greenhouses) allow for a controlled environment that can be easily maintained. In addition, impacts are localized and sources of impacts are easily identified. This allows for quicker and more targeted response. In general runoff will be controlled because the structures are covered and prevents excess rainfall from impacting the growing area. This rainfall will be collected and stored for use with the fertigation system.

- Soil enrichment and fertilizer runoff. This will be mitigated through the use of fertigation techniques which allow for the delivery of the required amount of fertilizer and nutrients directly to the root of each plant. This reduces waste and excess nutrients in the soil. Additionally, compost will be used during soil preparation, while organic and biofertilizers (such as chicken and pig manure) will be used during the production phase.
- Bioaccumulation of heavy metals. The soil type found in the area is a calcium carbonate-based Calcisols. These tend to be lower in the heavy metals normally associated with other soil types, particularly the ones mentioned above. Additionally, the fertigation techniques being employed allow the grower to carefully control the type and amounts of minerals that are delivered to the soil.
- Pesticide contamination and runoff. The carefully controlled environment of the greenhouse reduces the incidence of pests and weeds. Therefore, weed control will be in the form of pre-emergent treatment before seedlings are placed in the ground and once during the growing cycle. Because of the planting densities most weeds will be preferentially excluded once the plants are a certain age, thus reducing or eliminating the need for further herbicide treatments.

In the treatment of pests the first line of defense are the physical/mechanical barriers. The use of screens and air-lock doors reduces the opportunity for certain pests to enter the structure. The structures will be treated between crop cycles to remove or reduce any residual pests such as aphids, white flies and red spider mites. For those pests that do enter the structure, treatment will be with biodegradable ecofriendly products such as NEEM-X. All agrochemicals are cleared for use by the Pesticides Control Board (PCB). The list of pesticides is provided below in **Annex 3**.

- Organic waste. All organic waste will be composted and used as mulch or in the production of 'compost tea'.
- Land Preparation between crop cycles. As part of the disease and pest controls soil within the structures will be prepared for the next crop cycle by (i) physically turning over the soil, (ii) treating with organic products such as Neem, and (iii) leaving the area fallow for about 2 – 4 weeks. Physical barriers such as screens and doors will be inspected and repaired as necessary.

4.0 MONITORING PROGRAM:

The group has developed a monitoring programme that involves documenting and reporting on all aspects of the production cycle. Growers will be responsible for monitoring their individual structures and reporting back to the coordinator on a monthly basis. This will allow for quick response in the event that technical advice is required to address a particular concern. The coordinator will report to BEST on a monthly basis for the first 12 months. The PCB and Department of Agriculture has their own monitoring and reporting protocols that will be followed. The forms to be used for recording and reporting are in **Annexes 1 and 2**.

5.0 LINES OF RESPONSIBILITY:

The first line of responsibility is the individual grower. He/she will be responsible for ensuring that the fertigation system functions properly and that measurements for nutrients and pesticides are accurate at the time of application. The managing committee for the project is the second and final line for responsibility. They will ensure that all growers are meeting the standards set and will monitor and review the production process and the reports for each structure. They will work in conjunction with the crop unit of the Ministry of Agriculture to ensure that appropriate management practices are in place for each structure.

6.0 COST ESTIMATES AND SOURCES OF FUNDS:

The cost of undertaking the mitigation measures is already built into the budget and no further allocation of funds is necessary.

7.0 ADDITIONAL INFORMATION:

The relevant technical and legislative frameworks associated with the construction and use of covered structures (Tropical Greenhouses). The Environmental Impact Assessment Regulations and The Environmental Protection (Effluent Limitations) Regulations will not be triggered because of the size and distributed nature of the project. No individual structure exceeds the 50 acres required to trigger an EIA nor will there be any effluent to trigger the effluent limitation regulations.

TROPICAL GREENHOUSE GROWERS MANUAL FOR THE CARIBBEAN -

Written by

Anthony DeGannes, Kamau Ra Heru, Aziz Mohammed, Compton Paul, Jervis Rowe, Lennox Sealy and Govind Seepersad

CARDI (Caribbean Agricultural Research & Development Institute)

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PESTICIDES CONTROL ACT, CHAPTER 216 REVISED EDITION 2000 Laws of Belize

PESTICIDES CONTROL ACT, CHAPTER 216 REVISED EDITION 2003, SHOWING THE SUBSIDIARY LAWS AS AT 31ST OCTOBER, 2003

ANNEXES

Annex 1

MONITORING PROGRAM

Environmental Management Plan

ACTIVITY MONITORED: DISEASE AND PEST CONTROL

DATE: _____

DEPARTMENT: Ministry of Agriculture/Pesticides Control Board
Representative: _____

ORGANIZATION/ASSOCIATION: _____
Representative: _____

TABLE OF COMPLIANCE

No.	Activity	Compliance		Observations
		Yes	No	
1	Training by Ministry of Agriculture and/or the Pesticides Control Board in the use of pesticides for greenhouse vegetable production.			
2	Certificate of Training in the use of agrochemicals by Pesticides Control Board.			
3	Establishment of a settlement area for the filtering of residues in water from the production site.			
4	Identification of pests, diseases or other malaises.			
5	Evaluate crop damage.			
6	Evaluate production losses			
7	Determine the most appropriate course of action based on evaluation			
8	Determine the most appropriate product(s) for use.			
9	Determine dosage and application rates			
10	Determine that responses are adequate and desired effect is achieved.			
11	Appropriate authorities informed and advice received.			
12	Settlement area properly managed.			

Annex 2

See attached file: ***PRODUCT APPLICATION RECORD - Cayo Covered Structures.xls***

Annex 3: List of agrochemicals approved for use with the covered structures

Trade Name	Active ingredient	Quantity	WHO Hazard Class	Label Colour
Neem-X 0.4 SL	Azadiractin	20 Kg	U	Green
Vectolex CG	Bacillus sphaericus	10 Kg	U	Green
Dipel 3.5 SL	bacillus thuringiensis	20 Kg	U	Green
Ridomil Gold	mancozeb	20 Kg	U	Green
Tryclan 50 SP	thiocyclam hydrogen	10 Liters	III	Blue
Phyton 6.6 SL	copper sulfate pentahydrate	10 liters	III	Blue
NewBt 6.4 WP	bacillus thuringiensis	10 Liters	U	Green
MAI 007 5 SL	pyrimidene nucleotide a/biotic	10 liters	U	Green
Karate	lambda cyhalothrin	1 liter	III	Blue
Bravo	chlorothalonil	2 liter	U	Green
Manzate	mancozeb	2 kg	U	Green
Positron	propineb	1kg	U	Green

Annex 4: List of Potential Vegetables to be produced in the greenhouses

- Bell/Sweet Peppers
- Cabbage
- Hot Peppers
- Spinach
- Chinese Cabbages
- Cucumbers
- Eggplant
- Lettuce
- Broccoli
- Carrots
- Tomatoes
- Pumpkins / Squash
- Radish
- Christophine / Chayote
- Zucchini