Value Chain market Assessment

for each priority Area identified in the Resilient Rural Belize (RRB) Program

Product 3.3 Value Chain and Market Assessment of Sweet Pepper Production in Belize

VALUE CHAIN AND MARKET ASSESSMENT OF SWEET PEPPER PRODUCTION IN BELIZE

Conduct of Value Chain and Market Assessments for Resilient Rural Belize

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List of Acronyms and Abbreviations

BAHA	Belize Agricultural Health Authority
BBS	Belize Bureau of Standards
CATIE	Tropical Agriculture Research and Higher Education Center
CV	Climate Vulnerability Assessment
DFC	Development Finance Corporation
FAO	Food and Agriculture Organization of the United Nations
GOB	Government of Belize
IFAD	International Fund for Agriculture Development
MOA	Ministry of Agriculture, Food Security and Enterprises
PCB	Pesticide Control Board
RRB	Resilient Rural Belize
SIB	Statistical Institute of Belize
VCMA	Value Chain and Market Assessment

Executive Summary

Belize is a small tropical country with relative abundance in natural resources such as land and water. It is classified as a Small Island Developing State (SIDS) because it is threatened by many impacts of Climate Change, especially to its rural areas which accommodates 54.3% of the country's population. Also impacted by Climate Change is the agricultural sector, a major pillar of Belize's economy, and in particular small-scale farmers focused on the production of vegetables and other non-traditional crops. These challenges, along with poor market access, poor infrastructure (such as roads) and underdeveloped production systems have rendered small scale farmers unproductive or with sub-standard produce.

To alleviate the climate induced and productivity limitations faced by small scale farmers, and to strengthen food security, economic development and reduce poverty, the Government of Belize (GOB) sought assistance from the International Fund for Agricultural Development (IFAD) and the Green Climate Fund (GCF) to develop a programme entitled "Resilient Rural Belize" (RRB) Programme. The RRB Programme contracted the Tropical Agriculture Research and Higher Education Center (CATIE) to conduct the value chain analysis and market assessment, focusing on eight preselected commodities, namely, sweet pepper, tomato, pineapple, hot pepper, cabbage, carrot, onion and honey products. The analysis will guide interventions across and within the various value chains.

This study focuses on the structure and function of the sweet pepper value chain in Belize at the national level, examining all linkages between the actors. It identifies opportunities for strengthening horizontal and vertical linkages within the value chain, identifies end markets and makes recommendations for value chain upgrading strategies including improved production and quality of sweet pepper.

The sweet pepper market in Belize is estimated at approximately 2,250,776 pounds valued at BZ $4,501,552.00. The value chain is considered to be "simple" given that the product is sold as fresh fruit and no processing is involved. The main consumers of sweet peppers in Belize are households, restaurants, hotels and fast food establishments.

Sweet pepper is grown in all districts of the country. The Belize District is the leading producer of sweet pepper followed closely by the Cayo District. Main producers of sweet pepper are in a cooperative. The Belize District produces sweet pepper in the open field and the Cayo District

produce predominantly under covered structures. Imported sweet peppers account for only 0.5% of total consumption.

The Ministry of Agriculture, Food Security and Enterprises has in its policy to support and prioritize vegetable production as part of the larger agricultural strategy to conduct import substitution. Technical and financial services are provided by supporters(mostly governmental programs) and service providers along the value chain. Most farmers do not use financial institutions for financial assistance because they don't have sufficient collateral such as land as required by these financial institutions.

The strengthening of the sweet pepper value chain requires strengthening of the cooperatives who are the main producers of sweet pepper in the intervention areas. However, all farmers organized or not, require knowledge of good agricultural practices such as the use of appropriate seed varieties, good land preparation, integrated pest management, rational use of agrochemicals, efficient use of irrigation systems to conserve water, post-harvest technology, processing and others. Also it is important to note, farmers need the knowledge to farm as a business. In most cases during the study most farmers do not have records of cost of production or knowledge if they are operating at a profit or loss.

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1. Introduction

Belize is a coastal tropical country which lies on the northeastern coast of Central America, making it suitable for the cultivation of various horticultural crops. The United Nations has designated Belize as a Small Island Developing State (SIDS) because it has been greatly affected from vulnerabilities and threats similar to those of Small Island Developing State (SIDS). Impacts from threats such as Climate Change to Belize's agricultural sectors has prompted the adoption of many strategies such as Climate Smart Agriculture (CSA) to the population which is essentially based in the rural areas and whose livelihoods is based mainly in the agriculture sector.

Agriculture is extremely important to Belize's development, providing employment, foreign exchange earnings and is key to food security. Approximately, 172,000 hectares or 7.48 percent of Belize's total land area is suitable for agricultural use. An estimated 122,000 hectares or 5.31% of Belize's total land area is cultivated land (FAOSTAT, 2019). The agricultural sector employs an estimated 12.24% of the total population of Belize and an estimated 5.2% are females (FAOSTAT 2019). Primary industries in Belize include Sugar, Banana and Citrus Products which are normally the highest agricultural income earner. In 2020, the highest contributors to the economic output in agriculture in Belize was the non-traditional sector with grains and legumes being the highest contributor (MOA, 2021). The Gross Domestic Product per capita (constant) in 2019 was BZ$ 7066.09 with the agriculture sector accounting for 8.2 percent (SIB, 2021).

The Agriculture Output Value (at Producer's price) for fruits and vegetables in Belize has been on a fluctuating downward trend; notably, the decrease from 2016 to 2020 is 27 percent (SIB, 2021). In 2019, the dominant commodities in the tuber and vegetables category based on economic value were onion, potato, carrot and sweet pepper ranking from first to fourth places, respectively (MOA, 2020). The Belize District is the leading producer of sweet peppers followed by the Cayo and Corozal Districts, respectively. Despite this, there is no previous study recorded on the value chain analysis and market assessment of sweet peppers. Recognizing this gap, the Ministry of Agriculture, Food Security and Enterprises has sought the assistance of local and international partners to strengthen the value chain of sweet peppers in Belize and by extension improving the social and economic situation of small-scale local farmers and also improving food security in Belize.

This Value Chain Analysis and Market Assessment (VCMA) for Sweet Peppers (*Capsicum annum*) in Belize is being conducted by the Tropical Agriculture Research and Higher Education

Center (CATIE) in collaboration with the International Fund for Agriculture and Development (IFAD), the Green Climate Fund (GCF), and GOB through the Resilient Rural Belize (RRB) Project. Although the value chain will be studied at a national level, the priority area of the assessment is the Belize District which encompasses Nago Bank, Maskall, Lucky Strike, Bomba and Rock Stone Pond. The objectives of this VCMA were to (i) map and describe the sweet pepper value chain including the role and relationships between the different actors (producers, transporters, packers, processors, traders, retailers and consumers) in the value chain; (ii) market potential; (iii) identify challenges and opportunities for the sweet pepper value chain; and (iv) identify and recommend adequate policy interventions based on findings to strengthen the sweet pepper value chain in Belize.

2. Methodology

The Value Chain Market Assessment (VCMA) for Sweet Pepper is presented in four phases as described by CATIE (CATIE, 2020). The details of the methods used are as follows:

2.1 Description of the Study Area

The area for this VCMA was preselected by the Resilient Rural Belize (Belize) Project when the consultancy was initiated. The target areas in the Belize District are home to the main sweet pepper producers. These include the villages of Nago Bank, Maskall, Bomba, Lucky Strike, and Rock Stone Pond (Table 1).

Table 1. Population of the Target Villages in the Belize District, by Number of Households and Average Household Size, 2020

Belize Population by Number of Households and Average Household Size, 2020					
Village	Total	Males	Females	No. of HH	Avg. HH Size
Maskall	803	418	385	216	3.7
Rock Stone Pond	154	85	69	39	3.9
Lucky Strike	244	126	118	60	4.1
Nago Bank	135	81	54	45	3.0

Bomba	80	48	32	25	3.2

2.2 Data Collection

Collection of current and relevant data was done in three steps: Collection of secondary data through desk research; Collection of primary data using targeted interviews.

Collection of secondary data through desk research

There is no preexisting value chain analysis for sweet peppers in the Belize District or in the country. Raw data and information about supplies, production, transformation and marketing were accessed from various government departments such as the Ministry of Agriculture, Food Security and Enterprises (MOA), the Belize Agricultural Health Authority (BAHA), the Statistical Institute of Belize (SIB), Belize Bureau of Standards (BBS), Resilient Rural Belize (RRB) Project personnel and the online portal of the Food and Agricultural Organization (FAOSTAT). In particular, research and studies published on vegetable production and sweet Peppers within the last five years in other countries were targeted in order to identify innovations and technologies that could strengthen the sweet pepper value chain in Belize. The market trends of sweet peppers and cultivation of sweet peppers across Belize, quality standards, restrictions on the production and/or the marketing of the products were also sought. The main actors in the value chain and relationships between the actors were also identified. The output of the desk research was an initial value chain map.

Collection of Data through Primary Research

Major players in and outside the value chain were identified based on the preliminary value chain map developed from findings from the desk research. Personal interviews were carried out, but yet being mindful of the Covid-19 regulations. Electronic and telephone communications were also carried out.

- Personal Interviews: face-to-face interviews were conducted with leader farmers of various cooperatives including field visits to have an idea of the farming operations. Extension Officers from the Department of Agriculture, the Cooperative Department and Resilient Rural Belize were interviewed. A visit to the town/city market also allowed to interview vendors/retailers. These interviews allowed the consultant to have a better understanding of: how sweet pepper is grown and marketed, labour requirements, sources of raw-materials, market prices,

fluctuations in demand throughout the year, sources of financing and contractual relationships with clients.

- Telephone Interviews: telephone interviews were carried out with persons that could not accommodate a personal interview. The two intermediaries that collect the sweet pepper at Maskall village were interviewed and provided information on the way they conduct business with the farmers, one distributes to the market in Belize City and the other to the Orange Walk Town market, produce is collected every Thursday morning. A major restaurant in Belize City was also contacted and provided information as to how they procure sweet peppers, the amount they consume, and price purchased.

- Electronic Interviews: electronic interviews were done with persons that could not accommodate a personal interview. Via Email three of the major Agrochemical suppliers were contacted and they provided information on seed varieties, origins, and costs. They requested that their information remain confidential.

Limitations of the Study

While farmers were willing to cooperate in the study, in general none had records of their production costs and yields. Therefore, were unable to tell if they operated at a profit or loss. Hence this study depends mainly on the national statistics provided by the Ministry of Agriculture to the Statistical Institute of Belize.

Validation of Value Chain Map by Stakeholders

In order to validate the data and information collected during the desk and primary research, a workshop was carried out in Maskall Village with actors from different levels of the value chain. These actors included input suppliers, producers, intermediaries and technical officers from the government departments and NGO's.

The Objectives of the workshop were:

- Present the results of the Value Chain and Market Analysis for Sweet Pepper to stakeholders.
- Validate the results.
- Identify and prioritize potential value chain production, processing, and marketing efficiency improvements benefiting smallholders, women and other actors along the value chain.

The VCMA workshop consisted of the presentation of the sweet pepper VCMA and a group work to identify and prioritize needs that will help to improve or strengthen the value chain. At the VCMA workshop, a presentation of the sweet pepper VCMA was conducted using historical data collected by the Ministry of Agriculture and from information gathered from farmers, input suppliers and other focus groups. Participants were invited to validate the findings and the VC map as presented by the consultants through a group activity which allowed them to identify and prioritize needs that will help to improve or strengthen the value chain.

As shown in Table 2, a double prioritization matrix was used with the participants to prioritize problems/challenges previously identified by the consultants and validated early in the workshop. The more a problem is selected in the matrix, the greater the need to address the problem is. As many as 6 major challenges/problems were identified and prioritized: training and technical assistance, finances, infrastructure, improved seed, marketing and inputs purchase.

Training and technical assistance was prioritized first follow by marketing, finances, and road infrastructure, only purchase of inputs was not prioritized by participants. Farmers have gained some experience in growing sweet pepper, but there is much that is required in technical assistance and post-harvest storage facilities to meet the local market requirements.

Table 2. Sweet Pepper VCMA double entry matrix with priorities derived by workshop participants

Problems	**Finances**	**Input purchase**	**Training and TA**	**Improved seed**	**Road Infrastructure**	**Marketing**
Finances		Finances	Training	Finances	Road Infra	Marketing
Input purchase			Training	Imp seeds	Road Infra	Marketing
Training and TA				Training	finances	Training
Improved Seed					Imp Seeds	Marketing
Road Infrastructure						Road Infra
Marketing						

Finalization of the Report

After every validation workshop, meetings were held with the Lead Value Chain Consultant from CATIE, Local Consultants and the Agriculture Marketing Officer from the RRB Programme. During these meetings, further recommendations were made to improve the final document and to meet its objectives.

Value Chain and Climate Vulnerability Assessment Synchronization

The validation workshop of the VCMA was carried out together with the CVA, with the idea to catch any comment or question about climate change that members of the value-chain may have. During the CVA workshop most farmers expressed major concerns about unexpected droughts during periods of the year. Previously, these have affected their crops significantly. Most farmers have hand dug wells which are shallow and during these dry spells the water level lowers so much it becomes saline. So even though they have irrigation systems, the water is not enough and of poor quality to properly irrigate the crops. Floods was not ranked as a major concern as their occurrence is not frequent.

Synchronization of the CVA and VCMA consultations produced a new section in this report that is not traditionally included in VCMA studies. Section 8 on this report shows the findings concerning the suitability and climate adequacy changes projected in two scenarios.

3. History of Sweet Pepper Value Chain in Belize

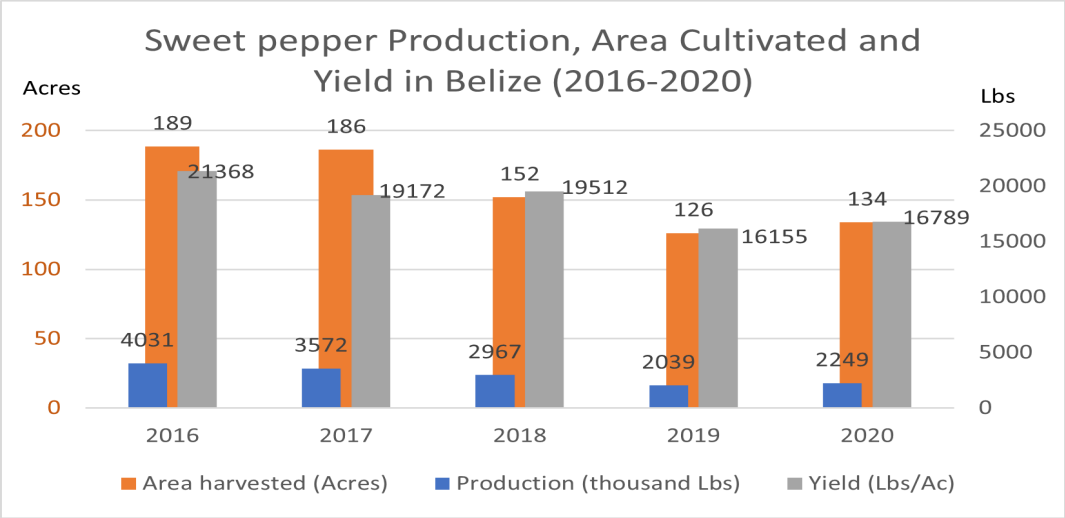
Sweet pepper is produced in all the districts of Belize with the Belize District being the largest producer follow by Cayo and Corazal Districts. (MOA, 2021). In both the Belize and Cayo Districts, sweet pepper production has been on a fluctuating downward trend since 2018. In interviews, farmers attribute the downfall in production to sporadic droughts and pest problems. It was also disclosed that farmers are collecting seeds from their crop so as to curtail the cost of buying the seeds from suppliers as they claim it is very expensive. The suppliers provide hybrid varieties so a downfall in production and pest problems can also be attributed to de- hybridization of the variety. In August and September of that same year two tropical storms affected the country coastline with heavy rainfall and caused floods in the Maskall area and many sweet pepper and tomato fields were damaged.

3.2 Sweet Pepper Production in Belize

Figure 1 shows sweet pepper production for the 2016 to 2020 in thousands of pounds. For the period, the average annual production is 2.9 million pounds, however, the production has seen a downward trend for the period. Such decline is explained by the reduction of area cultivated but also in lower yields: in 2020, a sweet pepper acre produces 20% less than what it used to in 2016. Understanding the reasoning behind lower yields is needed. In addition, specific productivity information for the two systems used in the sweet pepper production should also be relevant to clarify if losses in yields is generic or it is attached to a particular production system.

By 2020, the government decided to close all border entries, maritime ports and the airport. Immediately the tourism industry was affected, tourist resorts, major restaurants and supermarkets were also closed. This affected the consumption of many local produce including sweet peppers. Households became the major consumers of sweet peppers.

Figure 1. Total sweet pepper area harvested, production and yield in Belize (2016 to 2020)



The current estimated average yield per acre for sweet pepper is 18,500 lbs/acre, information from the Belize District Ministry of Agriculture department indicates the estimated yield per acre should be 40,000 lbs/acre. Obviously, there is much room to improve the production efficiency. Over the years, the MOA has been urging farmers to produce sweet peppers under covered structures to increase yield and reduce losses caused by heavy rainfalls and high pest pressure.

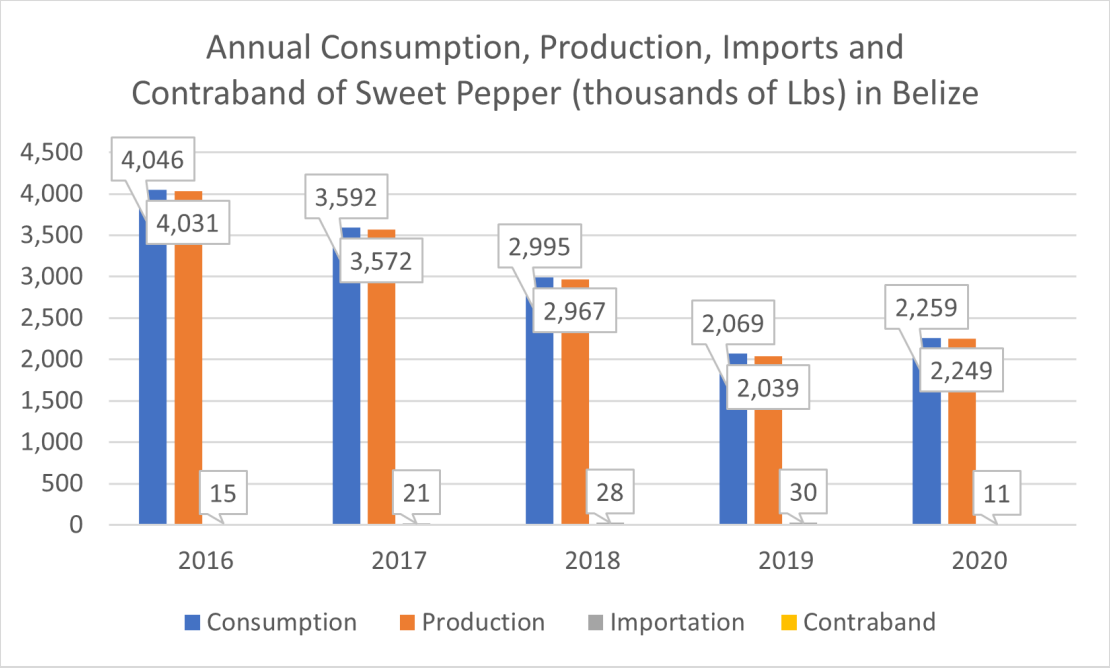
There are two production cycles of sweet peppers in the country for farmers growing in the open field and with irrigation systems. The first production cycle is from January to June and the second is from July/August to December. This is especially practiced by farmers in the Belize District who supply the largest quantity of sweet peppers to the country. Farmers in open field production depending on rainfall have one production cycle which runs from November to February (MOA, 2007). It is important to note, farmers in the Cayo District who have increased their share in the national production, grow the majority of their sweet peppers under covered structures and with irrigation. In these cases, the production time is extended significantly, and the plant can be kept from between nine months to one year. This is contrary to the farmers who grow in the open field; the plant cycle is six to seven months, at best, from seed planting to production.

Sweet Pepper production in Belize is exclusively for the domestic market, targeting households and the tourism industry, primarily the food suppliers in local restaurants and hotels in the country. Farmers or farmer groups sell the majority of their produce in bulk directly to an intermediary supplier (Collector) who resells/distributes to retailers such as market vendors. Some farmers sell directly to retailers or directly to consumers such as large upscale restaurants. Contractual arrangements between Farmer and Collector are informal.

3.3 Sweet Pepper Demand in Belize

Data from the Belize Agricultural Health Authority (BAHA) shows that there has been a constant importation of sweet peppers from the USA, between 2016-2020 a total of 104,724 lbs. of sweet pepper was imported. In Belize between 2016 and 2020 a total of 14,961,765 lbs. of sweet peppers was produced. Figure 2 shows the yearly production plus importation and total consumption of sweet peppers in Belize for the past 5 years. The estimated weekly consumption of sweet peppers in Belize is 43,500 pounds per week. Importation of sweet pepper into Belize seems to be relatively small in comparison to what is produced locally. During the validation workshop, farmers expressed concerns on the amount of sweet pepper coming into the country illegally from Mexico. They further expressed that 2020 saw significant reduction of illegal sweet pepper into Belize given the current Covid 19 pandemic and the closure of the border with Mexico. Information from BAHA states that the last recorded confiscation was in 2015 where a total of 107 pounds of sweet peppers were confiscated (BAHA, 2021).

Figure 2. Sweet Pepper Local Production plus Importation and Consumption in Belize



3.4 Quality Standards of Sweet Pepper Production in Belize

The Belize Bureau of Standards is tasked with developing, establishing, harmonizing, and promoting the use of relevant quality standards for key economic sectors/national development.

By extension, developing standards for the agricultural sector pertinent to the 8-value chains identified under the IFAD RRB Program is an opportunity to revise and introduce standards for the agricultural sector.

To date there are no established national standards for sweet pepper in Belize. In an effort to establish a level playing field, it will be useful to ensure that standards and other elements for Quality Systems are introduced and applied in all aspects of the sweet pepper value chain.

Notwithstanding the absence of national standards for sweet peppers, the CARICOM Regional Standard Specifications for Grades of Fresh Agricultural Produce for Sweet Pepper (CRS 24: Part 9: 2010) can serve as the basis from which to draw national requirements to meet the needs of the Belizean market, namely those requirements relating to fresh sweet peppers of commercial varieties inclusive of other relevant export markets of interest. The regional standard requirements include, but are not limited to the following.

1. **Blemish**: any physical injury affecting the surface of the fruit, such as scars, scratches, healed cracks or discoloured spots, which detracts from its natural appearance, but will not significantly affects its shelf life
2. **Clean:** free from dirt, foreign material and odours
3. **Damage:** any defect or combination of defects of physical or physiological causes that detracts from the edible quality such as decay, chilling injury, insect damage, open wounds, scalding, cracks or punctures which could lead to the abnormally quick deterioration of the fruit
4. **Diameter:** greatest dimension of the sweet pepper measured at right angles to the longitudinal axis 3.5 firm not soft, shriveled, limp or pliable, although it may yield to slight pressure
5. **Free from disease:** absence of any visible evidence of moulds, fungal and bacterial, rots, spots or any symptoms of viral infection
6. **Insect free:** no signs of insects at any stage of development on the fruit or in the package
7. **Intact:** not having any part removed or damaged
8. **Length:** greatest dimension of the sweet pepper measured from the base to the blossom end

9. **Mature:** having reached the full stage of development that will withstand normal handling and shipping
10. **Seriously misshapen:** badly indented, crooked, constricted or otherwise badly deformed
11. **Similar varietal characteristics:** lot comprising sweet peppers with the same general characteristics of the variety, except when more than one variety and or color is marked on the container NOTE Thin walled types and thick walled types of the same color shall not be mixed within the container.
12. **Sound:** produce not affected by rotting or deterioration which makes it unfit for consumption
13. **Well-shaped:** not more than slightly curved, slightly indented or slightly misshapen
14. **Well-trimmed stalk:** is cut to the shoulder of the fruit or 10 mm in length.

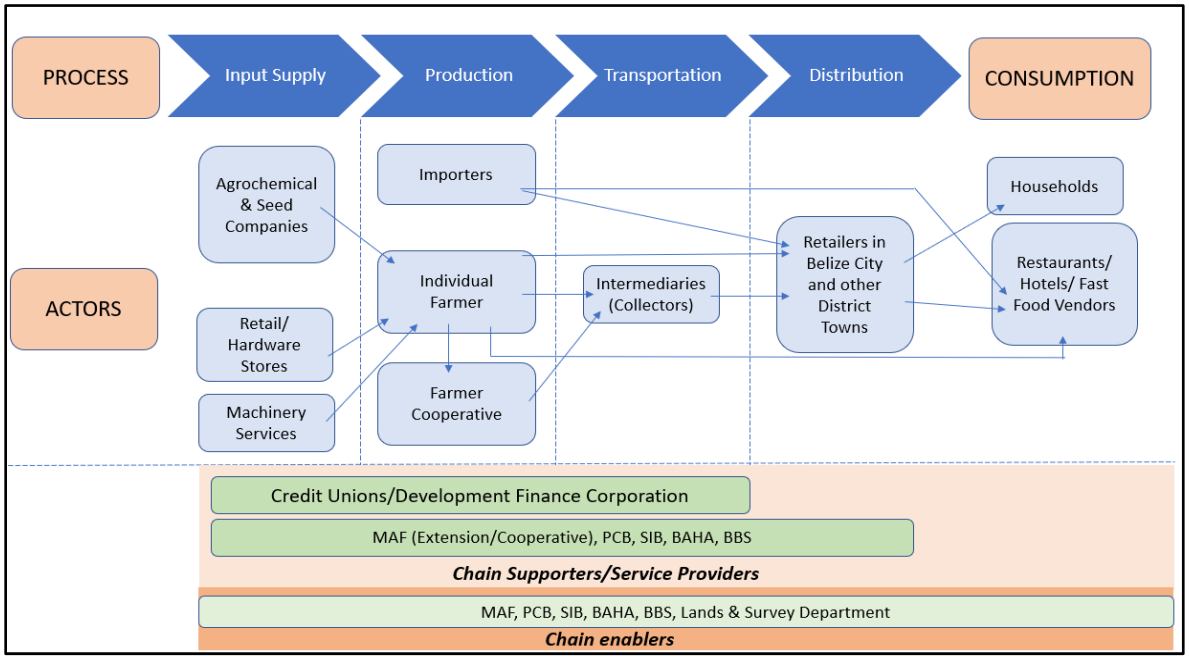
Currently there exists the challenge where, individual farmers apply their own company/farmer requirements, and at times no standards, which create inconsistency in size classification, seed selection criteria, pesticide management, agronomic practices such as land management, distinction in quality to imported sweet peppers, among others. This underpins the need to ensure that standards and quality systems are embedded in the sweet pepper value chain at all levels, thereby not only improving efficiencies and competitiveness, but ensuring that the buyers and sellers needs are met.

4. Value Chain Mapping

The sweet pepper value chain in Belize consists of input suppliers, producers, importers, intermediaries (Collectors), retailers and consumers. Other actors are classified as supporter and enablers, and they provide financial and technical services or provide support in developing policies to strengthen the value chain. Presented below in Figure 3 is the map of the sweet pepper value chain in Belize. This value chain map was validated in a participatory workshop at Maskal Village on October 19, 2021. Annex 1 shows the list of participants for the event that was held simultaneously with tomato farmers.

4.1 Value Chain Map

Figure 3. Value Chain Map for Sweet Pepper in Belize



4.2 Description of the Sweet Pepper Value Chain Actors and their roles

Input Suppliers

The first actors in the chain are the input suppliers. These consist mainly of the agrochemical and seed suppliers, machinery service providers, farm equipment companies, fuel service stations, and hardware stores. The main agrochemical and seed suppliers in the Cayo and Belize Districts that dominate in the sweet pepper value chain are Prosser Fertilizer and Agrotec Company Ltd., Agro-Vet Jiron & Sons, Brodies Ltd., Midwest Steel and East and West Enterprise.

- Bel-Agro Enterprise: Is the largest Fertilizer and Agro Chemical supplier in Belize supporting the agricultural sector with fertilizers and agricultural chemicals. The Company represents the most renowned global agricultural manufacturers. As a procurement and distribution company in goods and services they are committed to ensuring that all orders received are handled in a competent and professional manner, thus ensuring successful final delivery and best practical uses of the product. It´s important to say that Bel-Agro mentions on its website that there is a woman in its main team, who manages Inventory Management (BELAGRO, 2022).

- Prosser Fertilizer and Agrotec Company Ltd.: It is a commerce that sells Fertilizers, Insecticides, Fungicides, Weed Killers, Sprayers, Seeds, Swimming Pool Supplies, Water Tanks, Veterinary Products, Lubricants and Tires (Findyello, 2022).

As major actors in the value chain these suppliers provide seeds, pesticides, irrigation equipment, small equipment such as pumps for irrigation, tractors, land preparation equipment, screenhouse netting and many other farm equipment.

Producers/Farmers

In the sweet pepper value chain in Belize, the main producers are located in the Belize and Cayo Districts. In the Belize District, the five main areas are Nago Bank, Maskall Village, Bermuda Landing Village, Bomba Village and Rock Stone Pond Village. There are individual farmers and farmers which belong to Cooperatives. In Nago Bank, the majority of the sweet pepper farmers belong to the **Los Pequeños Productores y Ganderos de Nago Bank Co- operative Society Limited** formed in 2013 (RRB, 2019). Currently, this cooperative has 23 active members, of which two are female. Information from the Belize District Agriculture Department estimates that there are 60 farmers that produce sweet peppers.

Small, medium, and large-scale farmers cultivate 1, 2 to 2.5, and 5 acres, respectively. Small and medium-scale farmers are implementing open field production, with irrigation and sell to the local market. In Cayo District, farmers also have greenhouses with irrigation. Few women are among the farmers of sweet peppers, of the 124 farmers from Belize and Cayo Districts, only 8 are women.

In the Cayo District, farmers are part of a cooperative named the Maya Green Growers Co-operative Sociedad Ltd. located in the village of San Antonio consisting of 13 male farmers. The other sweet pepper production group is The Seven Miles Farmers Association (SMFA) with 17 members (including 2 females and 2 youths) and located at 7 Miles Village.

For many of these farmers, profit obtained from sweet pepper production is not their only income source as many of them do other vegetables such as tomatoes. In the Nago Bank Cooperative, some farmers plant an average of 5000 plants in the first cycle only and some wait for the second cycle, this is to prevent over production of sweet pepper by the cooperative.

Many of the farmers use family labor, especially women for harvesting, but also use hired labour at the peak of production.

Importers

Importation of sweet peppers can be conducted legally or illegally. Legal importing companies require an import permit from BAHA. The amount of sweet peppers imported is relatively small compared to the local annual production.

Data requested from BAHA on the illegal importation/confiscation of sweet peppers is negligible or non-existent. The last recorded confiscation was in 2015 whereby a total of 107 pounds of sweet peppers were confiscated (BAHA, 2021). However, farmers in the Belize District argue that the national figure is not a true picture and does not reflect the actual amount brought in illegally from Mexico.

The Observatory of Economic Complexity (OEC, 2022) shows that Belize imported pepper[1] at:

[1] The imported pepper could be sweet pepper because hot pepper imports are not allowed.

Belize – Country Commercial Guide shows that peppers are on the list of “Prohibited and Restricted Imports”. This means that fresh peppers and pepper sauces appears in the list of goods that are prohibited from being exported to the country (Belize) or are otherwise restricted (International Trade Administration, 2022).

- 2020 (US$ 0.136 Millions)
- 2019 (US$ 0.124 Millions)
- 2018 (US$ 0.140 Millions)
- 2017(US$ 0.172 Millions)
- 2016 (US$ 0.228 Millions)
- 2015 (US$ 0.218 Millions)
- 2014 (US$ 0.268 Millions)
- 2013 (US$ 0.194 Millions)

Intermediaries (Collectors)

Intermediaries are middlemen who collect and purchase sweet peppers locally and who sometimes develop long term relationships with farmers. In the case of Nago Bank, two of the main Collectors are now members of the Cooperative.

Collectors are well versed on the location of the farms; amount of sweet pepper produced and have very good knowledge of other crops produced by the farmer and their seasonality. These persons purchase directly from the farmer or cooperatives and sell to vegetable dealers/retailers at the market or persons who will resell the produce. These are the key personnel responsible for transportation of the sweet peppers along the value chain.

Potential effects of the presence of intermediates:

- They charge higher fees for transactions, compared to the investment of having their own system.
- The time to receive payment for the product may be shorter, compared to processes without intermediaries.
- Intermediaries are involved because they provide logistical support, as they ensure the uniform distribution of hot pepper.
- Intermediaries provide care services to producers, before and after sales.
- They provide feedback to the producer, to apply continuous improvement in the production process, harvest, and post-harvest.

Retailers

Retailers include market vendors and grocery stores who purchase sweet pepper from the intermediaries and resell to consumers. Brodies Supermarket in Belize City is a major retailer of fruits and vegetables. This company is also a private importer of sweet peppers for distribution to its supermarket and other upscale restaurants and hotels.

Based in Carballo (2016, p.11), the retailers of vegetables can be:

- Supermarkets have storage facilities/space for produce.
- Hucksters are permanent vegetable dealers.
- Farmers are also wholesalers in public markets.
- Retailers are normally found in public markets, where stalls are stocked with onions, as well as other items.
- Grocery stores, which are located conveniently almost everywhere, also retail vegetables which are obtained from wholesalers.
- Ambulant retailers play their role by going from house to house selling their produce.
- Mennonites are also seen as ambulant retailers (Northern Belize), because they often seen selling produce along the roadside.

Consumers

- Fresh fruit market: The most significant users of fresh sweet peppers are households. The main source of fresh sweet peppers are the markets because they have a closer relationship with the producers, or the rotation of the product is better.

- Food preparation: The main users of sweet pepper are tourist resorts, restaurants, hotel restaurants and fast-food establishments. The main source of retail sales are grocery stores and supermarkets because they are the ones that supply business that sell food.

4.3 Profit Margins and Share Benefits along the value chain

Cost of production and prices across the value chain were obtained by interviews with key persons from farmers associations in 7 Miles Village in the Cayo District and Nago Bank area in the Belize District. Table 3 shows an analysis of the profit margins and share benefits along the value chain. The data shows that for the farmer the cost of inputs is the highest. In Belize, agrochemicals and seeds are costly and are very important inputs for farming.

Table 3. Profit Margins and Share Benefits along the value chain

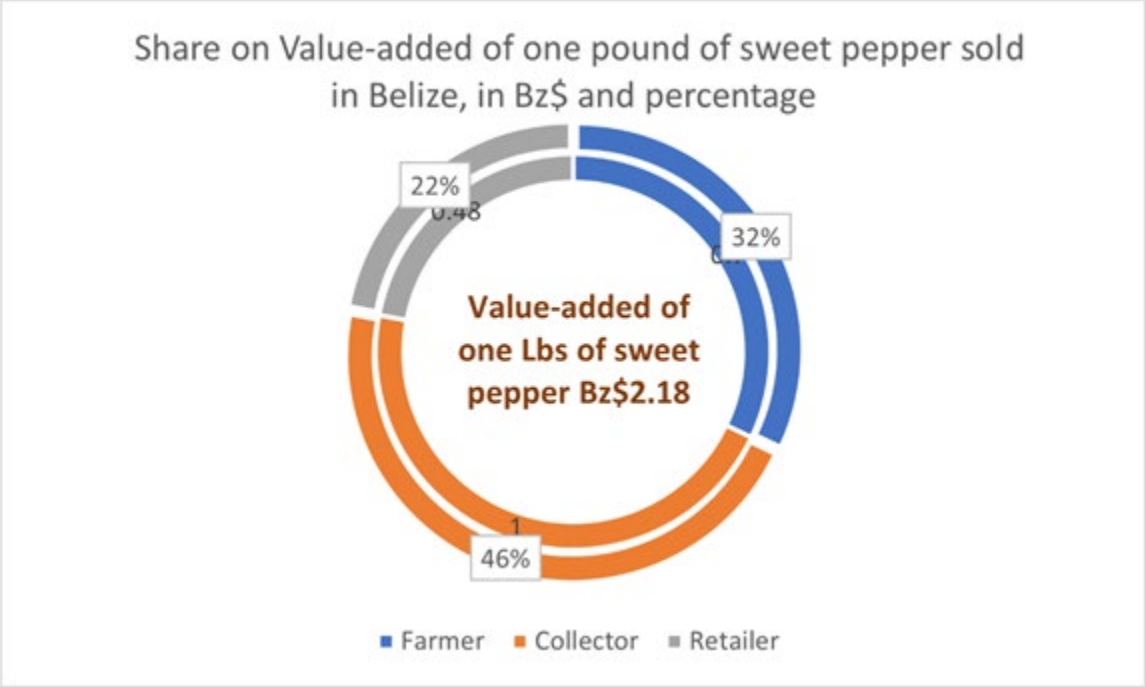
Description	Actors			
	Farmers	Collectors	Retailers	Horizontal Sum
Purchase Price (Bz$)	0.00	1.50	3.00	4.50
Total Input Cost (Bz$)	0.80	0.50	0.24	1.54
Sale Price (Bz$)	1.50	3.00	3.72*	8.22
Market Margin (Bz$)	1.50	1.50	0.72	3.72
% share of margin	40.3	40.3	19.4	100.0
Profit Margin (Bz$)	0.70	2.50	3.48	6.68
% of share of profit	**10.5**	**37.4**	**52.1**	**100.0**

*Based on 5 year average consumer price (source: SIB)

The second is the collector and is very likely due to transportation of the product given that fuel prices are high in Belize compared to other countries in the region. Together, the collectors and retailers take 89.5% out of the total profit margin. The retailer's profit margin constitutes the highest share (52.1%) followed by the collector (37.4%). The farmer share profit in this analysis is similar to what is seen in other pepper value chains across the globe; in Mareko District, Ethiopia, the share profit for farmers is 12.25% (Dessie et. al. 2018).

Considering value-added created of one pound of sweet pepper that is sold to a customer, we estimate the profit margins for each actor of the value chain. As value-added is basically defined as returns to labor and capital plus taxes, we will need information on investment and taxes to approximate profits. Thus, the participation of each actor in the value-added is a proxy to profits. Our analysis indicates that farmers are responsible for 32% (Bz$0.7), collectors for 46% (Bz$1.00) and retailers for 22% (Bz$0.48/Lbs) of the value-added created (see Figure 4). When a consumer buys a pound of sweet pepper and pays Bz$3.72 (the 5-years average consumer price), it is estimated that Bz$2.18 is value-added and Bz$1.54 is the amount needed to buy intermediate goods from other sectors

Figure 4. Share of profit of actors for sweet pepper value chain in Belize.



5. Market Analysis

Vegetable value chains are normally very basic and unsophisticated. This is exactly the case for the sweet pepper value chain in Belize. Generally, the selected variety is dictated by the farmer. Seeds are selected based on its adaptability to Belize's tropical Conditions, shelf life and ability of the variety to withstand physical stress such as those incurred during transportation on extremely poor road conditions of the Belize District.

The main sweet pepper varieties grown include Anaconda, Double up F1, Red Bull, Tecan, Sir Galahad, Kaveri F1 and Thames. The most popular varieties based on the aforementioned criteria are the Anaconda and Double up F1.

5.1 Market Size

The estimated local consumption of sweet peppers is 43,500 pounds per week. Table 4 details the yearly consumption for the last five years. As previously reported, the only data available from BAHA on confiscated sweet peppers in Belize was 107 pounds in 2015. Also noteworthy is the amount of sweet pepper imported by private importers is fifteen percent more than the amount authorized by BAHA on the import permit (MOA, 2021). However, the excess amounts are not classified as illegal importation.

Table 4. Annual consumption of sweet pepper(Lbs) in Belize (2016 to 2020)

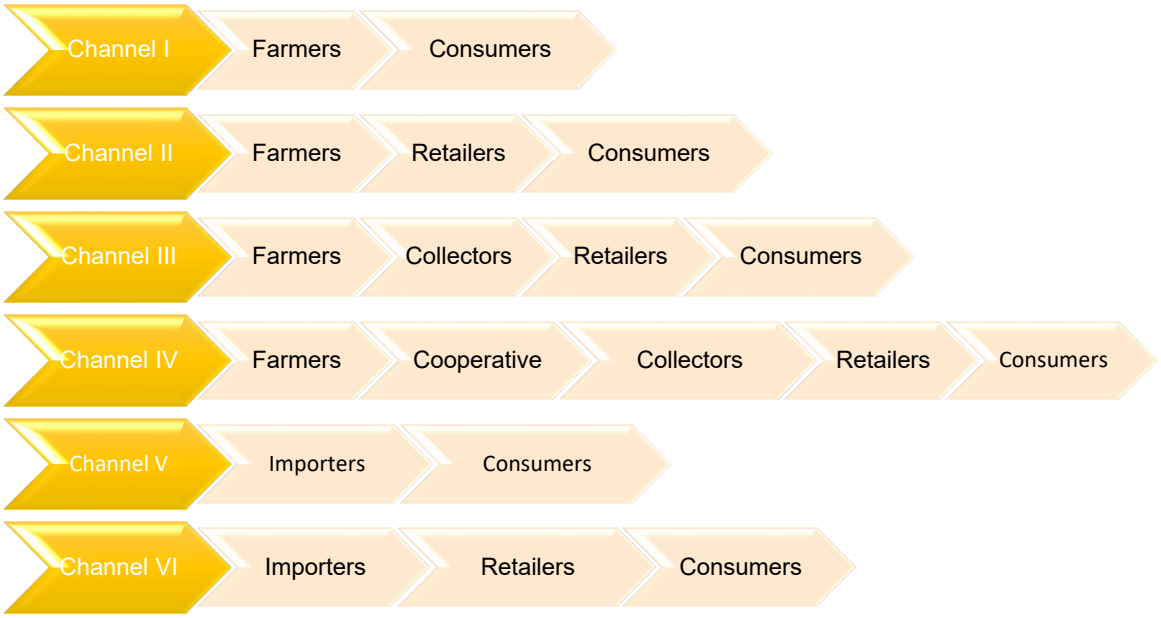
Yearly consumption of Sweet Pepper in Belize				
2016	**2017**	**2018**	**2019**	**2020**
4,046,059	3,592,365	2,995,228	2,068,844	2,259,269

5.2 Market Channel

A significant amount of the sweet pepper produced is sold to the collectors, then to retailers and finally to consumers. In Nago Bank, when prices are high, individual farmers sell their produce to the Cooperative (RRB, 2019) A few individual importers sell directly to consumers or to retailers; these retailers then sell to consumers.

The main marketing channels identified from the point of production to consumers through intermediaries for sweet peppers in the Belize are as follows.

Figure 5. Main Marketing Sweet Pepper Channels

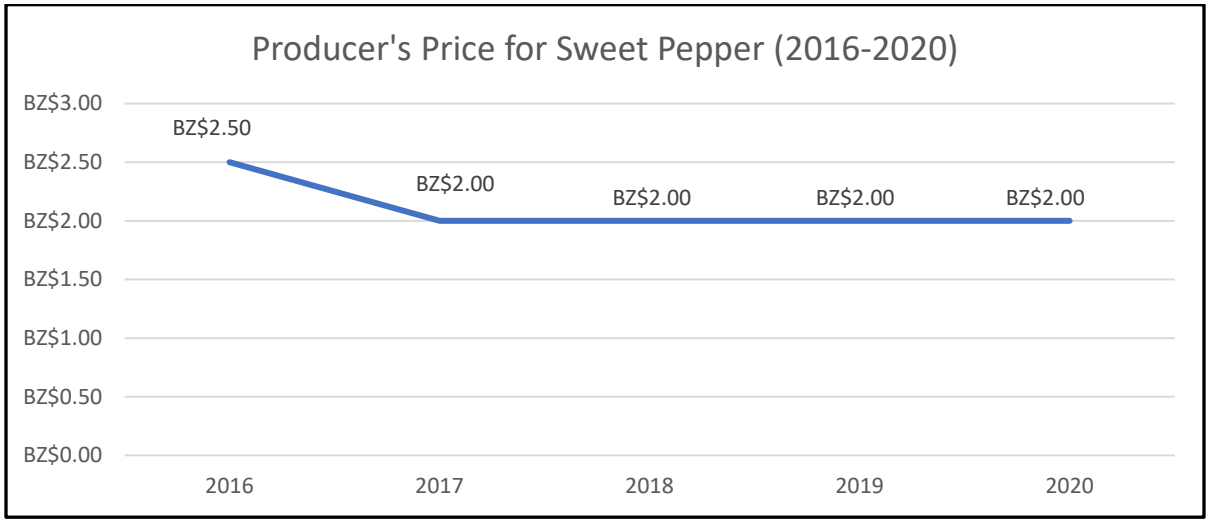


Sweet Pepper Consumers include households and restaurants, hotels and fast food businesses and supermarkets. Sweet pepper production in Belize is exclusively for the domestic market.

5.3 Price trend of Sweet Pepper in Belize

The price for sweet pepper in Belize was very stable. Figure 6 shows the price trend of sweet peppers in Belize for 2016 to 2020 at the Producer's price. This price information was sourced from SIB, however, all discussions with farmers suggest that producer price fluctuates between BZ$1.25 and BZ$1.50. The profit margin calculations in this report is based on farmer information and not on the information from SIB.

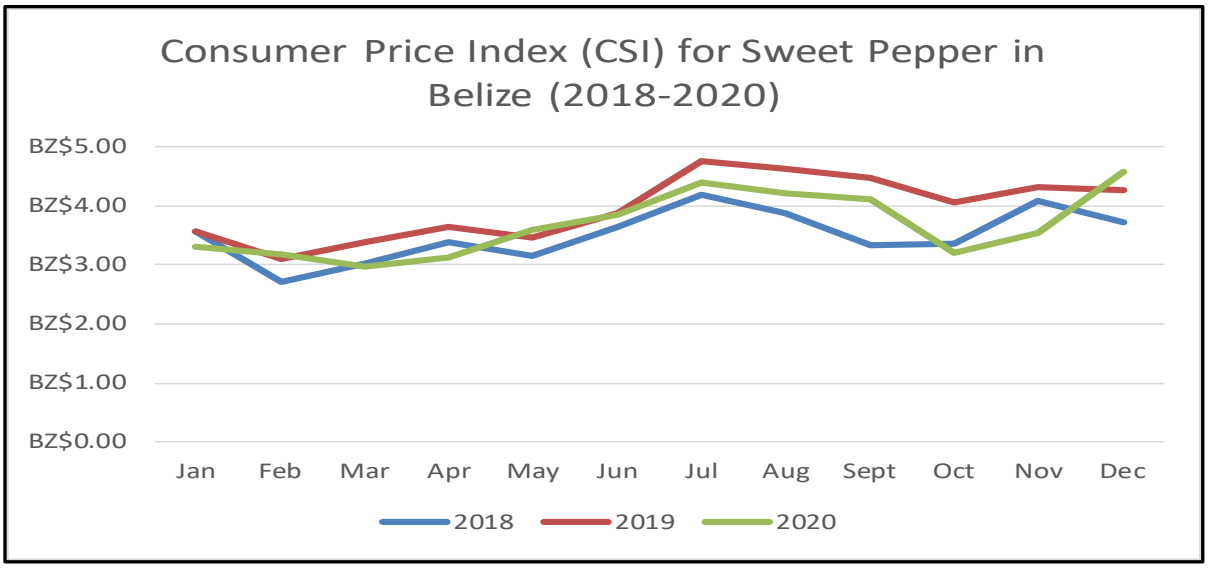
Figure 6. Price trend for sweet pepper production in Belize (2016 to 2020) at Producer's Price (SIB)



Consumer prices were sourced from SIB. The five-year average for 2020 is $3.72 per pound. Figure 7 shows the consumer price trend for 2018 to 2020. There are three marked periods in the year when consumer prices dip: February, May and October. Also, marked increase in price is seen in April and July.

There is seasonal price variability in the sweet pepper value chain in Belize. Price is based on weight; there is no tier in prices based on size or quality. Sweet peppers sold are mostly green and none of the yellow varieties are sold locally. It appears that the peppers imported from the US are the colorful red bell peppers used by restaurants mainly for esthetics in their cuisine

Figure 7. Consumer Price Trend for Sweet Pepper (2018 to 2020)



Farmers and most actors, especially the collectors and retailers, hesitate to share price information. Pricing information along the value chain is not readily available from the MOA or other national entities.

6. Supply Chain

The supply chain takes into account the production, importation, profitability and cost of production across the value chain.

The total production of sweet pepper in 2020 in the country was an estimated 2,250,776 pounds valued at BZ $4,501,552.00 (SIB, 2021). The main suppliers of sweet pepper in Belize are farmers and through legal importation from the United States. The imported sweet peppers account for 0.5 % of the total consumption. The last official record of confiscation of illegally imported sweet peppers into Belize was in 2015 when 107 pounds of sweet peppers were confiscated.

6.1 Amount Supplied

Table 5 shows the yearly supply of sweet peppers and total consumption for the last five years. The contribution of imported sweet pepper for consumption is negligible. However, farmers in the Belize District are adamant that illegal importation is significant. The main supplier of sweet pepper in Belize is the national farmer. Data in Table 6 indicates a marked decrease in acres planted and harvested for sweet peppers in all districts except for the Corozal District which registered an increase in 2020.

Table 5. Annual supply of sweet pepper (lbs) (2016 to 2020) (SIB 2021)

Year	Consumption	Production	Imports	Illegal entry
2016	4046,059	4030,981	15,078	0
2017	3592,365	3571,785	20,580	0
2018	2995,228	2966,760	28,468	0
2019	2068,844	2038,759	30,085	0
2020	2259,269	2248,756	10,513	0

Table 6. Total area harvested (SIB 2021)

District	Total Area Harvested (Ac.)				
	2016	2017	2018	2019	2020
Cayo	37.00	42.00	18.25	22.00	17.00
Belize	101.20	103.00	92.00	73.00	73.00

District	Total Area Harvested (Ac.)				
	2016	2017	2018	2019	2020
Stann Creek	6.00	7.00	7.80	7.20	5.14
Toledo	3.65	3.30	8.00	7.00	3.80
Orange Walk	7.00	8.00	3.00	3.00	3.00
Corozal	33.80	23.00	23.00	14.00	32.00
Total	**188.65**	**186.30**	**152.05**	**126.20**	**133.94**

6.2 Domestic Production

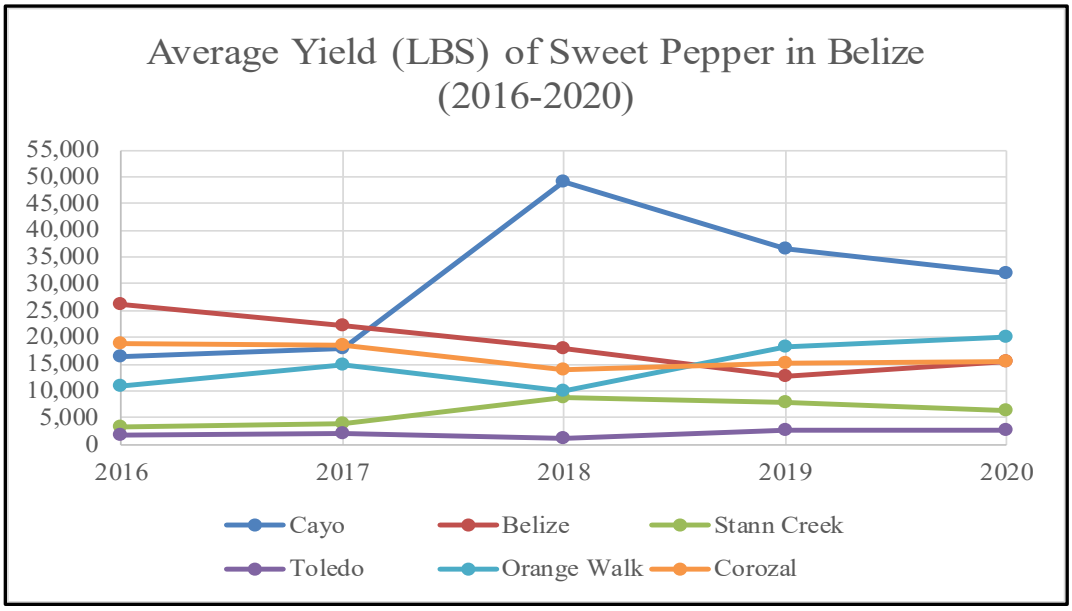
Table 7 shows the production of sweet pepper by Districts. Belize District is the largest producer, followed by the Cayo District. Figure 8 shows the total yield of sweet pepper production in each district.

In both districts, most of the pepper producers are members of a cooperative that plant sweet peppers and other vegetables such as tomatoes. In the rest of the districts, the farmers operate individually

Table 7. Total Annual Sweet Pepper Production (Lbs) in the Districts (2016 to 2020) (SIB 2021)

District	Total Annual Production (Lbs)				
	2016	2017	2018	2019	2020
Cayo	606,018	756,000	896,750	800,700	544,000
Belize	2636,000	2293,000	1643,000	930,000	1137,000
Stann Creek	19,950	27,260	68,900	57,315	32,856
Toledo	35,813	6,025	16,110	7,650	10,700
Orange Walk	100,000	63,500	21,000	30,000	30,000
Corozal	633,200	426,000	321,000	213,094	494,200

Figure 8. Graph showing Average Yield of Sweet Pepper in Belize per District (2016-2020)



Source: SIB

6.3 Cost of Production

The estimated cost to produce one pound of sweet pepper is BZ$ .80 based on interviews with farmers and consultation with others in the industry. Farmers do not keep all records and therefore cannot provide concrete data on the cost structure. The Belize District MOA estimates BZ$ .14 to produce a pound of sweet pepper (Table 8). More attention needs to be given to this aspect due to the limited information and large discrepancies between cost of production.

Table 8. Recap of studies about cost of production of sweet pepper in Belize

	Sweet Pepper (One Acre - MAFSE)		SWEET PEPPER GROWN UNDER A MACRO TUNNEL (18ftx100ft, 560 plants)		Sweet Peppers with Fertigation (Belize District)	
Land Preparation	BZ$ 80.	1%	BZ$ 92.	2%	BZ$ 770.	5%
Seed	BZ$ 680.	11%	BZ$ 196.	5%	BZ$ 1,200.	8%
Fertilizer	BZ$ 684.	11%	BZ$ 580.	14%	BZ$ 836.	6%
Fungicide	BZ$ 338.	6%	BZ$ 198.	5%	BZ$ 1,716.	12%
Insecticide	BZ$ 611.	10%	BZ$ 520.	12%	BZ$ 2,445.	17%
Herbicide	BZ$ 180.	3%			BZ$ 169.	1%
Labour	BZ$ 700.	12%	BZ$ 1,127.	26%	BZ$ 1,005.	7%
Irrigation	BZ$ 2,803.	46%	BZ$ 695.	16%	BZ$ 5,288.	37%
Other materials			BZ$ 381.	9%	BZ$ 523.	4%

	Sweet Pepper (One Acre - MAFSE)		SWEET PEPPER GROWN UNDER A MACRO TUNNEL (18ftx100ft, 560 plants)		Sweet Peppers with Fertigation (Belize District)	
Miscellaneous Expenses	BZ$ 608.	10%	BZ$ 480.	11%	BZ$ 500.	3%
Operational Cost	BZ$ 6,076.	100%	BZ$ 4,269.	100%	BZ$ 14,451.	100%
Yield (Lbs)	19000		7280		105,000	
Cost per pound	**0.32**		**0.59**		**0.14**	

* SOURCE: GARY RAMIREZ - MINISTRY OF AGRICULTURE (MAFSE)
** SOURCE: Seven Miles Farmers Association, Cost of production for sweet peppers grown under a macro tunnel
*** SOURCE: Belize District Agric Dept, Cost of Production for 1 acre Sweet Peppers With Fertigation. Belize District , 2021

Table 8 shows two studies whose calculations are for acre, while another presents the cost structure for a macro tunnel system (18ftx100ft, 560 plants). The original details of those three studies recapped are part of *Annex 3. Cost Structure of Sweet Pepper Production in Belize. The* total production cost for cultivating an acre of sweet pepper is at least BZ$4,269. The cost per pound of sweet pepper has a minimum of BZ$ 0.14 in the Fertigation system and BZ 0.56 in the macro tunnel system. Cost structures in the studies are not homogeneous, so in the summary presented in Table 8 we have modified some of the items by redefining them in another category. Overall, we observed that the cost associated with irrigation is quite significant – between 16% and 46% of the total cost. On the other hand, labor represents between 7 and 25%. Among agrochemicals, insecticides absorb between 10 and 17% of the total cost of production. Adding all the other items of agrochemicals, between 30 and 36% in the total cost of production.

Clearly, the cost of production could tell us in which area or region of the country it is more competitive to produce sweet pepper. With the exception of Belize District, all districts lack a cost analysis according to their characteristics and environment. Having calculations by district, could help us to visualize what will happen when it becomes more expensive to produce in those regions and villages that lose the ability to produce sweet pepper as a direct result of climate change (See projections in the next section).

7. Climate Change Vulnerability of the Sweet Pepper Value Chain

While value-chain dynamics is commonly analyzed and described in 3-, 5- or 10-year periods, and most experts will avoid market prospects or projections beyond the 10 year mark, any climate analysis is described in longer periods. Climate dynamics is rarely described in short periods of years as experts understand the limited predictable value of 3-, 5-, or 10-year forecasting. In addition, climate forecasting, in general terms, will be useful for the decision-making process in the sweet pepper value-chain if it provides relevant information on how the future climate could affect production, productivity, accessibility of resources, or any other variable affecting the livelihood of sweet pepper business.

For this report, we bring in context of the sweet pepper value-chain findings produced by simulation, index, and modeling explained in detail on the CVA reports. Even with the explanation given here, those who want to understand methods and techniques used to obtain these findings should reference the CVA reports.

Two major sections of findings are presented below. First, we report changes on climate adequacy for the sweet pepper production for the whole country of Belize. Using maps and a color-code to understand those changes, a general futuristic perspective to produce sweet pepper can be described. Second, findings specifically for the 10 intervention areas of the RRB program are presented. Aiming to describe the uniqueness of each area and how this could bring similar or very different picture of the future for sweet pepper production, we identify losses and gains in suitability or adequacy in percentages of the adequacy from the base line data.

7.1 Sweet pepper value-chain and changes on climate adequacy for Belize

By comparing current climate conditions and future climate conditions, the climate vulnerability assessment team provide a first ever effort to understand possible changes in climate adequacy to produce sweet pepper in Belize. A brief description of the method used to develop the comparison is presented here.

First, current climate conditions (1970 – 2000) were defined as those referring to the historical average total annual precipitation and temperature (WorldClim 2.1). Secondly, future climate conditions were represented as the average of the weather conditions over the 30-year period

2041 – 2070 (i.e. centered in the 2050s), consistent with the definition of climate by the World Meteorological Organization. Again, focusing on the projected changes in precipitation and temperature.

Third, the results (comparisons) are based on an assemble of climate projections from a 21 climate models (see Materials and Methods) and two emission scenarios RCP2,6 and RCP8,5. Both scenarios (RCP2,6 and RCP8,5) show increases in the average temperature towards 2050. RCP2.6 shows average temperature values that exceed the baseline between 0.7°C in Belize and Corozal up to 1.5°C in Toledo. On the other hand, the RCP8.5 scenario shows larger increases in average temperature ranging between 1.6°C and 2.5°C above the baseline in Belize and Toledo, respectively.

Fourth, the R. EcoCrop package was used to construct an adequacy index based on the climatic requirements of the species; for this, the model uses two types of ranges, which are defined by a pair of parameters of each variable (temperature and precipitation). The first range is that defined by the minimum and maximum temperature, as well as the minimum and maximum precipitation, in which we can find the species (absolute range); that is, beyond those limits the conditions are not suitable for the development of the crop or the species. The second refers to the optimal ranges for both temperature and precipitation required by the species so that it can achieve its best performance. Figure 9 shows the interaction between precipitation and temperature parameters for absolute and optimal ranges

Figure 9. Interaction between precipitation and temperature parameters for absolute and optimal ranges

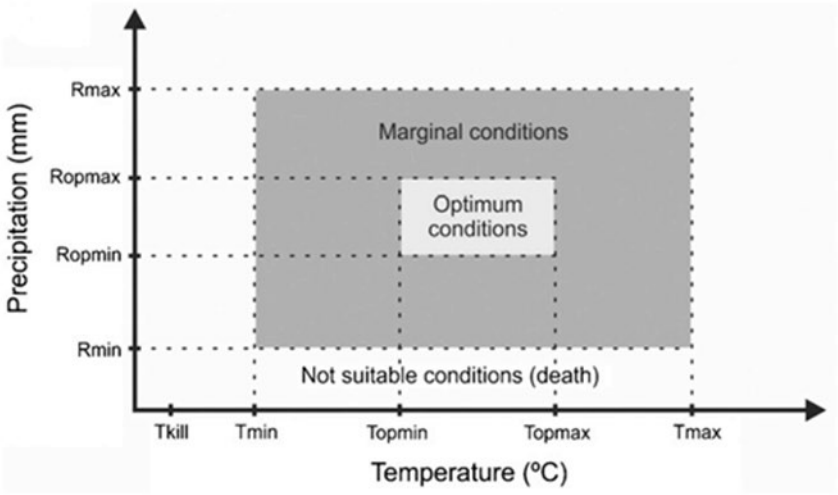


Table 9 shows climatic parameters considered in the climate adequacy analysis for the sweet pepper production, prioritized in the RRB project. The optimal range is defined by lower and upper limits for both temperature and precipitation. In the case of Belize, the optimal rage for sweet pepper is 17 to 30 °C and 600 to 1250 mm of temperature and precipitation, respectively. This wide-reaching range implies climate suitability for growing/cultivating sweet pepper.

Fifth, a reclassification of modeling results with EcoCrop was carried out. To process the suitability data, the results were reclassified into quintiles; thus, the value of less than 20% of the suitability range corresponds to the very low class, while the very high adequacy range (dark green color) corresponds to a scale greater than 80% in the adequacy scale resulting from modeling with EcoCrop. On the other hand, the comparison between the results of the adaptation according to the current climatology and the future scenarios were also reclassified in such a way that the strong green colors correspond to the areas where gains would be experienced in climatic conditions for the crop analyzed (it implies for example areas that pass from a category of low suitability to a higher category of adequacy); in contrast, brown was used to identify areas where adequacy categories are low when comparing the future versus baseline scenario.

Table 9. Climate parameters considered in the climate adequacy analysis requested for the sweet pepper value chain prioritized in the RRB project

Description of parameter used in the model	**Value used**
Gmin: Minimum duration of the growing season	60
Gmax: Maximum duration of the growing season	180
Gused: Used duration of the growing season	120
Tkmp: Temperature (°C) below which the species cannot survive	0
Tmin: Lower limit of the absolute temperature range (°C)	8
Topmin: Lower limit of the optimum temperature range (°C)	17
Topmax: Upper limit of the optimum temperature range (°C)	30
Tmax: Upper limit of the absolute temperature range (°C)	35
Rmin: Lower precipitation limit (mm) of the absolute range	500
Ropmin: Lower precipitation limit (mm) of the optimal range	600
Ropmax: Upper limit of precipitation (mm) of the optimal range	1250
Rmax: Upper precipitation limit (mm) of the absolute range	1700

Below are the climate adequacy maps for sweet pepper (Capsicum annuum) cultivation in Belize at a national level. The first Map in Figure 10 describes the climate adequacy for cultivating sweet pepper in Belize for the baseline (current conditions, year 2000), the other maps for future

scenarios (centered in year 2050). The suitability for the crop is color-coded with deep green meaning very high suitability and red very low suitability. As mentioned before, given the optimal range defined for the simulation, the entire country is under very high suitability category. And both future scenarios (RCP2,6 and RCP8,5) seem to not affect the suitability of the country.

Figure 10. Climate adequacy for sweet pepper cultivation in Belize and scenarios of climate change 2050

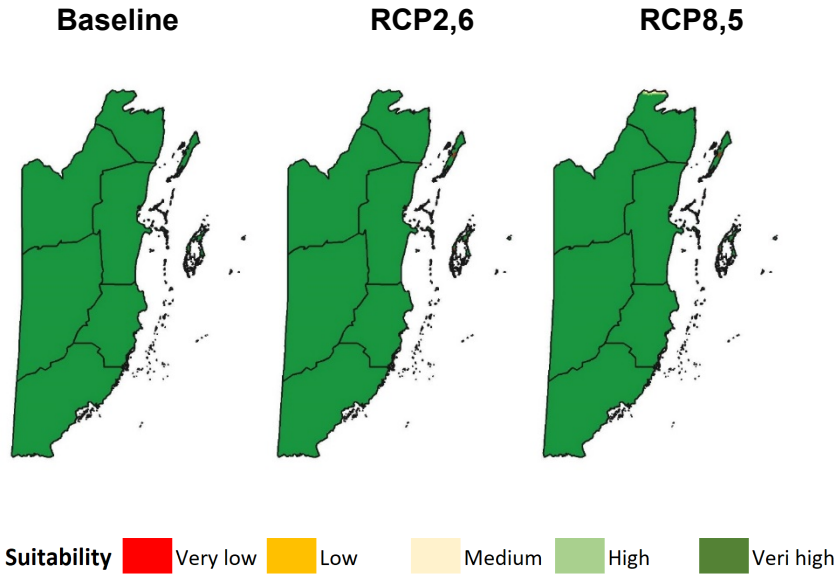
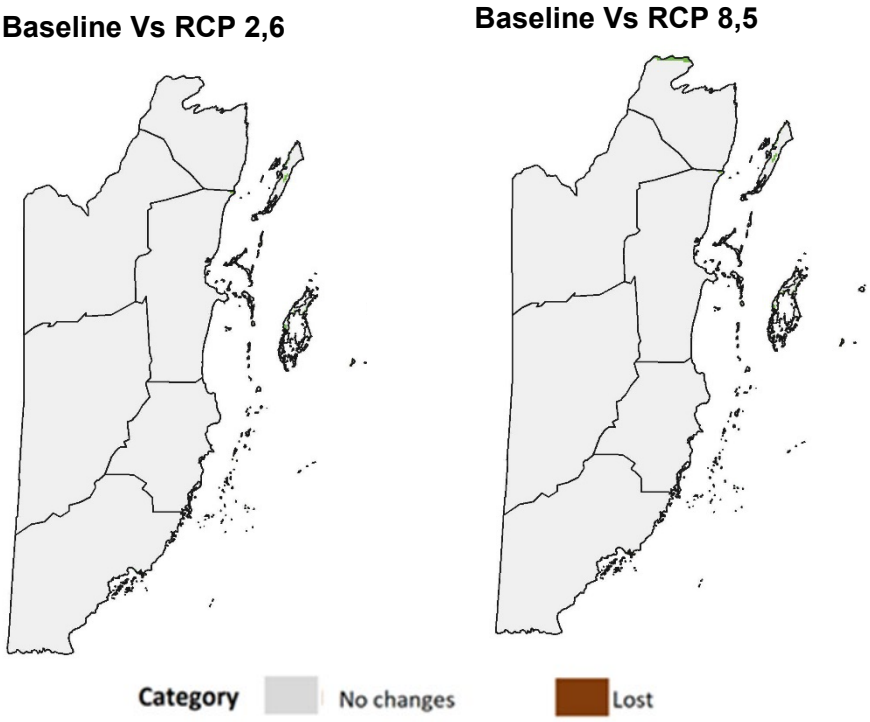


Figure 11 shows maps that describe the general losses and gains on adequacy comparing each scenario with the base-line climate adequacy for production of sweet pepper in the whole country. Areas presenting brown color are areas where drops of suitability are projected under future scenario. Gray color areas are projected to continue with the same suitability. Under both scenarios, climate adequacy for the production of sweet pepper do not forcast losses, confirming the country's present stable conditions in the suitability for production.

This situation could create the misleading conclusion that climate changes will not affect the sector. A couple of notes are pertinent in this respect. First, projecting two climate variables although the more relevant for the crop, do not equal to projecting climate change. Similarly, precaution is always appropriate with complex production systems. For example, climate changes may affect conditions for certain insects forcing new behaviors that could translate into new infestation and/or pests for the crop.

Figure 11. Gain and losses in climate adequacy under two scenarios of climate change for sweet pepper cultivation under two scenarios of climate change in Belize



7.2 Sweet pepper Value-chain and changes in climate adequacy for RRB's intervention areas

As much as the data for the whole country could tell us the story on sensibility and vulnerability for our target crop, the RRB defined 10 intervention areas (Assessment Units of the Rural Resilience Programme in Belize RRB) and it is in those areas where knowing how conditions will affect our value chain has been prioritized. We note, for our value chain, the future may play significantly different at RRB's intervention areas than at the national level. Assessment Units of the Rural Resilience Program in Belize (RRB) are shown in Figure 12.

All intervention areas are located in very highly suitable areas for sweet pepper production. As presented in Table 6 (supply section of this study), all districts report production, although Belize, Cayo and Corazal Districts are the most important sources of sweet pepper for the market.

Figure 12. Mapping Intervention Areas-Assessment Units of the Resilience Rural Belize Program

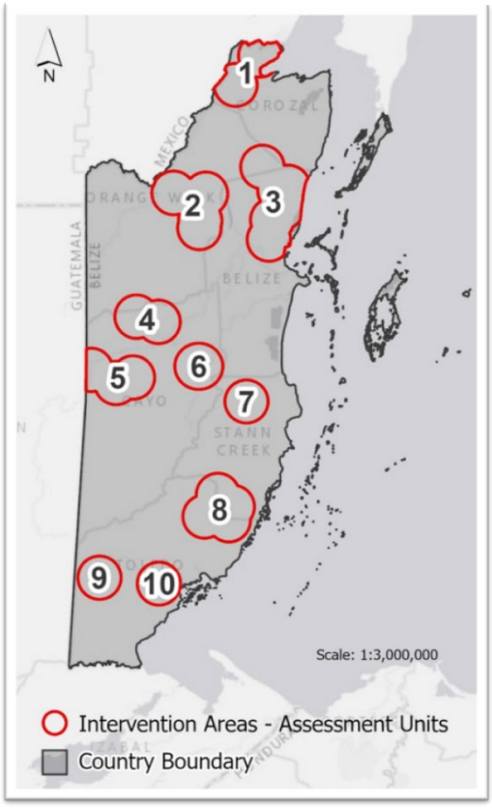


Table 10 shows changes in climate adequacy between baseline and future scenarios for sweet pepper (C. annuum) cultivation in Belize as a percentage of each RRB programme intervention area.

When intervention area is the focus of the comparison between scenarios, and not for the whole country of Belize, we are able to identify if any area of intervention gains or loses suitability. Given the assumptions of our model, it is confirmed that all intervention areas will continue to exhibit very high adequacy for growing sweet pepper. There are no losses of adequacy projected for 2050

Table 10. Changes in climate adequacy between baseline and future scenarios for Sweet Pepper cultivation in Belize as a percentage of each RRB program intervention

Change direction Percentage (%)	Intervention Areas- Assessment Units									
	1	2	3	4	5	6	7	8	9	10
	RCP 2.6									
Gain										
Not Suitable										
Loss										
No changes	100	100	100	100	100	100	100	100	100	100
	RCP 8,5									
Gain										
Not Suitable										
Loss										
No changes	100	100	100	100	100	100	100	100	100	100

*Source: CVA consultancy report *Draft with preliminary results*

8. Constraints and Opportunities

The production of sweet pepper is being given priority by the Government of Belize through the Resilient Rural Belize (RRB) Program. This in itself is very positive for the horticulture industry; therefore, all the challenges and opportunities need to be examined in detail to strengthen the value chain. Presented below are challenges and opportunities identified in the sweet pepper value chain.

Table 11. Challenges and Opportunities for Sweet Pepper Value Chain in Belize

Chain links	Constraints	Opportunities
Input Supplies	**High costs of inputs:** • Very high cost of fertilizers, seeds, and pesticides. • High cost of fuel	• Farmers´ s organizations, like cooperatives, could be engaged in buying volume and transferring cost saving to individual farmers. A potential reduction in fertilizers and insecticides cost could help significantly in reducing the production cost. • Substitution of organic fertilizers could be explored as a cheaper alternative to chemical fertilizers. This could be analysed together with an evaluation of the timing of applications as it is understood that organic fertilizers take longer to produce effects and the farmer will need to learn the new times for application. • Expenditure on fuel can be reduced if there is greater collaboration and planning for taking orders and delivering products between the actors. This strategy could be implemented by encouraging cooperatives and input providers to negotiate volume delivering to organized farmers by village. • The prices of inputs (i.e., fertilizer and pesticides) may not change rapidly enough but application efficiency could be tremendous. Training on the basic of efficient use could reduce the total bill paid by farmers.
	Seed Quality and Availability:	• Opportunity for collaboration and strengthening of relationships between farmers, agronomists, and local extension services for training on Good Agriculture Practices.

Chain links	Constraints	Opportunities
	• Seed variety suitable to Belize's climatic conditions is not readily available and when available, prices are very high • Seed quality is not guaranteed by the supplier.	• Facilitate importation of seeds and establish local seeds banks to supply farmers. • It is recommended to support seed providers in finding international reliable sources. Some providers may be so small that they will not be able to carry out the best seeds even if the farmer is willing to pay for them. • Guarantee of seed should be part of the input providers commercial strategy, if this is not currently something that those providers are doing, the practice of guarantee could be encourage by a) sharing information on those providers with good reputation and willing to guarantee their seeds, b) coordinating with seed providers workshops about care and maintenance of seed for both farmers and input providers.
Production	**Poor Knowledge on use of inputs** • Poor knowledge on use of pesticides application, fertilizer programs.	• Training on the proper use of agrochemicals and equipment. • The information given to the farmer must be calibrated/reviewed together with the input provider. The training and what the farmer learns whenever he/she buys inputs need to be correlated (same kind of information and specifications). • Information sharing on alternatives inputs (i.e., organic fertilizers) could be promoted by local extension service.
	High Cost of Planting Infrastructure • Production in the Maskall area is exclusively in the open field with increased pest pressure as acquiring a greenhouse is very costly.	• Possible opportunity from international funding to access grants for construction of greenhouses as a tool to mitigate climate change impacts in the Maskall area. • Sweet Pepper farmers in the San Antonio Cayo District already have extensive experience in growing sweet pepper under greenhouses, there is an opportunity for technology transfer between the two groups using the concept of "Escuela de Campo".

Chain links	Constraints	Opportunities
	Climate Vulnerability • Poor access to water suitable for irrigation • Sweet pepper production during drought conditions. • In the Maskall area which is closer to the coast the water becomes saline during the dry season.	• Share information on climate change and technical assistance on irrigation systems for sweet pepper production: appropriate technologies to collect and store rainwater should be an important component of such assistance. • Use the concept of "Escuela de Campo" to invite producers to learn about production under irrigation and the importance of not depending on the rainy season for their crops. • Practices for adapting to climate change are shown in Table 12 as guide of measures that can be explored for the Maskall sweet pepper production.
Harvest and Post-Harvest	**Road Conditions** • Poor road conditions between distribution and collection centre. • There is a loss of productivity due to the bruising of pepper.	• RRB could consult with the Government area representative to address this issue. What should be avoided is fast deterioration of the road improvements because lack of maintenance or poor monitoring. Here, communities should be mostly involved in providing monitoring. • Lack of infrastructure limit the development of value-chains – Year-round Road access, 24/7 electricity and secure telephone and internet connection were mentioned by participants. Improving infrastructure will decrease transaction costs and internal and external communication with significant gain in productivity and competitiveness. • However, the current issue of land titles for many farmers could limited the potential of financial services and functional land markets to play their part when the infrastructure issues get to be corrected. Business plans including infrastructure requirements are needed.
	Poor Quality and Loss of Commercial Product	• Identify funding and storage facilities affordable and appropriate for the farmers.

Chain links	Constraints	Opportunities
	• Need for post-harvest facilities. • Interviews with key farmers estimate that about 20% of their crop is lost mainly because the size or shape does not qualify for the market preference.	• If production increase the importance of the quality standard as a requirement for carrying out business with the processor will become even more relevant; the production of a quality manual adapted to the farmer's language and circumstances, should be useful for the future of the value chain. Current cooperatives may be able to work much easier with the Belize Bureau of Standards, however, they need coaching and technical support to sit at a technical table to discuss the standards. • Conduct a study that demonstrates how much rejection/lost in production could be reduced with best practices and adherence to the quality standard.
Marketing and Distribution	**Poor Business Practices** • Poor record-keeping results in a poor understanding of the cost of production • Lack of formal contracts with intermediary resulting in a late payment to the farmer for produce sold. • No official medium to learn about price information on the market.	• The farmer needs to think and act like a businessman/businesswoman. Essential also, farmers need the knowledge to farm as a business. In most cases, training on record-keeping, cost of production estimation, and knowledge about contracts and negotiation should be the basic content of the training on entrepreneurship for farmers. • Good business practices training should also be given to the cooperatives. It was argued that cooperatives need to improve their relevance to producer members who need to see clear examples of why belonging to a cooperative. Marketing of produce, collective negotiation, and saving on the cost of inputs, should be obtainable by strengthening the cooperatives. • Manuals and simple brochures easy to complete/read are necessary as well as make them available to sweet pepper producers. • Consistency of services that provide price information to the producer can be achieved using access technologies such as cell phones. Here, it will first be necessary to launch

Chain links	Constraints	Opportunities
		a pilot program to define the ideal format that reaches the producer and that is easy for him/her to interpret and use.
	Poor access to finance • Financial institutions require collateral such as land titles, however, many of the farmers are squatters and do not have land titles to use as collateral to access finance.	• Poor access to finance is normally a result of limited collateral value to offer to banks, however, access can be improved if the farmer can demonstrate administrative skills: bookkeeping, inventories, etc. NGOs and similar sources of financial support should be obtainable with better business practices. • Improving cooperative capitalization could translate into better financial access for the farmer. Undercapitalization at the cooperative level limits the capacity to provide advance payments or credit to members which are critical for planting and harvesting/collection. Training in financial management at the cooperative level could increase the capacity to provide those services to farmers. • Appropriate business training with an emphasis on investment and financial management for cooperatives should reduce the need to find often high-cost credit for the organization. Even if the cooperative has low capitalization, it should not mean that it needs to work with expensive capital: learning where to borrow and knowing how to manage the loans are essential to guarantee that the cooperative is working with the cheaper capital possible. • Land ownership should be encouraged as much as possible knowing that it could grant farmers access to credit and work capital. The Lands department officials may need to train and inform farmers on the process of acquiring land legally. It is recommended that a study be conducted encompassing the 10 intervention areas of the program seeking to explain why farmers do not formalize land ownership.

Table 12. Practices for adapting to climate change.

Climate constraint	Opportunity (Adaptation measure)	Description of the measure	Link to the problem (How it improves competitiveness)
Increase the management and sustainable use of water [2]	Use irrigation systems that provide the optimal amount of water. Carry out activities to conserve water sources, such as rivers and wells.	Use an irrigation system that considers the water requirement of the crop and evapotranspiration. The conservation of water sources includes EbA practices such as reforesting riverbeds and harvesting rainwater.	In Latin America, the agricultural sector consumes 70% of the available water, so it is recommended to optimize the use of water and protect hydrographic basins.
Efficient use of fertilizer [3]	Fertilizers must be optimized to reduce production costs and to reduce water and soil contamination problems (non-organic fertilizers).	Use the required amount. Place it in the right place, for the absorption of the plant. Don't fertilize when it rains.	Fertilizers have negative effects on the environment [4]: such as eutrophication, water toxicity, groundwater pollution, air pollution, soil and ecosystem degradation, biological imbalances, and reduced biodiversity.

[2] https://blogs.iadb.org/sostenibilidad/es/cinco-medidas-de-adaptacion-para-reducir-la-vulnerabilidad-al-cambio-climatico-del-sector-agricola-en-america-latina-y-el-caribe/
[3] https://www.conservation.org/docs/default-source/publication-pdfs/cascade_modulo-4-como-enfrentar-el-cambio-climatico-desde-la-agricultura.pdf
[4] https://obtienearchivo.bcn.cl/obtienearchivo?id=repositorio/10221/27059/1/Consecuencias_ambientales_de_la_aplicacion_de_fertilizantes.pdf

Climate constraint	**Opportunity (Adaptation measure)**	**Description of the measure**	**Link to the problem (How it improves competitiveness)**
Using bush as living barriers (EbA Practice)[5]	Live hedges of bushes are a practice to protect the crop from the wind and to capture carbon dioxide. In addition, nitrogen-fixing shrubs can be used to benefit the crop.	Living barriers can be used to separate cultivation areas because they can be monocultures that are planted in a staggered manner or different crops. Live barriers are also a barrier that prevents cross-contamination by pesticides, especially to avoid the presence of these in the products that are ready for harvest.	Climate change is related to the increase in greenhouse gases in the environment, so it is necessary to increase the number of plants that capture these gases (especially carbon dioxide).
Integrated pest management [6]	Pest control must be done through cultural, physical, and ethological practices, with an emphasis on biological control. Although the rational use of pesticides is also recommended.	Integrated pest management should be done based on the economic threshold and the identification of the main pests. This will allow deciding the type of management that the pest will receive.	Integrated pest management is important because climate change allows pests to increase their distribution.

[5] https://www.conservation.org/docs/default-source/publication-pdfs/cascade_modulo-4-como-enfrentar-el-cambio-climatico-desde-la-agricultura.pdf
[6] http://repositorio.iica.int/bitstream/handle/11324/3046/BVE17068958e.pdf?sequence=1

9. Conclusions

Sweet pepper value chain with poor perspective for the future. Sweet pepper is grown in all the districts in the country. The Belize District is the leading producer followed closely by the Cayo District. Main producers of sweet pepper are part of a cooperative. The Belize District produces sweet pepper in the open field and the Cayo District produce predominantly under covered structures. Imported sweet pepper account for only 0.5% of total consumption. There are no commercial agreements among actors of the value chain, cooperative members do not recognize the benefits of their membership, and post harvesting practices are limited among small and medium scale producers. However, limited demand is the main barrier for the sweet pepper value chain. End-market assessment: Current plans to intensify greenhouse production and, in general, protected production systems, would only aggravate the oversupplied market if markets are not sought: no transformation options have been identified.

Support services acting in the value chain. The Ministry of Agriculture, Food Security and Enterprises has in its policy to support and prioritize vegetable production as part of the larger agricultural strategy to conduct import substitution. Technical and financial services are provided by supporters and service providers along the value chain. Most farmers do not use financial institutions for financial assistance because they don't have sufficient collateral such as land as required by these financial institutions.

Cooperatives as main actors. The strengthening of the sweet pepper value chain requires strengthening of the cooperatives who are of the main producers of sweet pepper. Gains in cost efficiency and productivity could be articulated with training with cooperatives in transitioning from rainfall dependent systems to protected production systems. A common belief is that many cooperatives in Belize are created for the wrong reasons – mostly to take advantage of an opportunity brought up by a project. When the project disappears, so does the reason for gathering in the cooperative. This is currently reported and is being addressed with help from the institutions in charge of promoting cooperatives and should be explicitly included in the capacity building and training to farmers. Strengthening the value chain in Belize requires strengthening of pre-cooperatives who could play a major production role and promoter. It has been argued that members do not recognize clear, explicit benefit of their membership; therefore, farmer's organizations should emphasize actions that bring about financial sustainability. All farmers require knowledge of good agricultural practices such as the use of appropriate seed varieties,

good land preparation, integrated pest management, rational use of agrochemicals, efficient use of irrigation systems to conserve water, post-harvest technology, processing, and others.

Managing expectations is essential for RRB. It is well understood the length of time it takes for value chain approaches to become viable if it doesn't break down before reaching its goal. It could take 4 or 5 years despite, or at times because of, intensive, even if often disarticulated, interventions from government agencies, NGOs, development projects, and the like. The long duration of this process will increasingly become an obstacle for stakeholders, their organizations, and development agencies, under current circumstances. It is imperative to identify viable shortcuts to value chain development based on enabling political and legal frameworks, harmonized, and aligned development interventions, and the delivery of effective and well-articulated technical, business development, and financial services. Nothing of these could be achieved without promoting regular dialogue between local processors, investors, and government agencies, and producers.

Priorities for the whole value chain. When thinking of a value chain as a system, all stakeholders are interlinked, and all are mutually dependent. RRB must recognize that some interventions are prioritized differently for different actors/stakeholders. Interventions for the whole value chain requires extra effort to create consensus on priorities. Through workshops carried out for the VCMAs studies, a couple of challenges/needs were consistently prioritized and presented here in Table 11. Similarly, priority among value chains should also be understood as a necessary step toward the efficient use of resources. To maximize the impact of the program, the sweet pepper value chain should be prioritized given the market potential, the suitability for cultivation (even under climate change scenarios), and the value-added opportunities that cooperatives could help to create.

10. Final comments on limitations of the study

The following list includes major challenges for achieving the best sweet pepper value chain and market assessment.

1. It was observed that **women participating** as members, managers and leaders was limited during the workshops and in the interviews. Although suggested by some participants, covid restrictions do not seem to explain the gap in participation between men and women, nor between youth and adults. An explicit action plan for gender equity should be drafted, discussed, shared, and put in place with all members working with the value chain approach.

2. **Short sightedness as the new norm.** Covid-19 had everyone focusing on the short-sightedness of event, losing the potential of the studies to reflect long-sight strategies. For example, having no tourism make people ignore the opportunities that linking farmers to tourism supply chain represent in the long run. Similarly, many people that lost their jobs, moved to micro farming affected the normal agricultural supply in many of the products studied. Of course, this is just a logical attitude under crisis mode, however, it could imply serious limitations when a value chain approach is used to harnessing governmental intervention in the sector. Finally, Belize tourism sector meltdown under covid-19 pandemic works as a reminder of how important diversification is for Belize agriculture value chains targeted by the VCMAs studies. Among agriculture officers and extensionists, opportunities to connect farmers to the tourism supply chains were not at all present in discussions and workshops carried out for the VCMAs studies. Such inattentive situation, probably due to current emphasis on national consumers and effects of the Covid-19 pandemic, should not diminish the tourism sector as a source of diversification. It is expected that as the tourists return to Belize, opportunities to link farmers to the tourism supply chain will return as well. Here, challenges on quality and acceptance of standards that have been already identified in the VCMAs studies will be paramount.

3. We found that **data inconsistency** from official sources is a serious limitation for any VCMA analysis. When data of production, yields and acres-harvested do not match, it is possible that Belize´s agencies in charge of collecting data may need to revisit the way data is collected and produced. It is suggested that RRB brings this observation to SIB for further consideration.

4. Making sense of working with **value chain approaches**. During the process of carrying out the study, it was clear that not all agriculture extensionists and technicians understood what it is to work with a value chain approach. For some, the approach still works mostly to support farmers, which is a misunderstanding. The guiding principle is to support the whole chain by creating more options to create value. If the creation of value is under the scope of the farmer or with the processor, that is fine with the value chain approach. It was difficult to conduct value-chain workshops were farmers thought it was a space for them to present demands and discuss only issues concerning to them. RRB needs to consciously remind participants and partners the essential features of the value chain approach.

5. The major challenge for making sense while working with the value chain approach is exemplified by the **misrepresentation of what a middleman (collector) does** for the value chain. Ignored are the essential changes on space and time it brings to the value of products: relocating, holding them to times that are more convenient, assuming various risks by stocking inventories. Why is the bias against middleman so persistent? Part is explained by cultural perceptions as mere cheaters, part the misjudging of how difficult is to create value of space and time. Farmers having mastered the complexities of the production process have seldom also mastered the very different complexities of inventory management and numerous other services performed by middlemen in the process of relocating products in time and space. Value chain approaches demand integrating middlemen into the negotiation/concertation table where actions for the value-chain are being discussed; having the technical team understand this is paramount.

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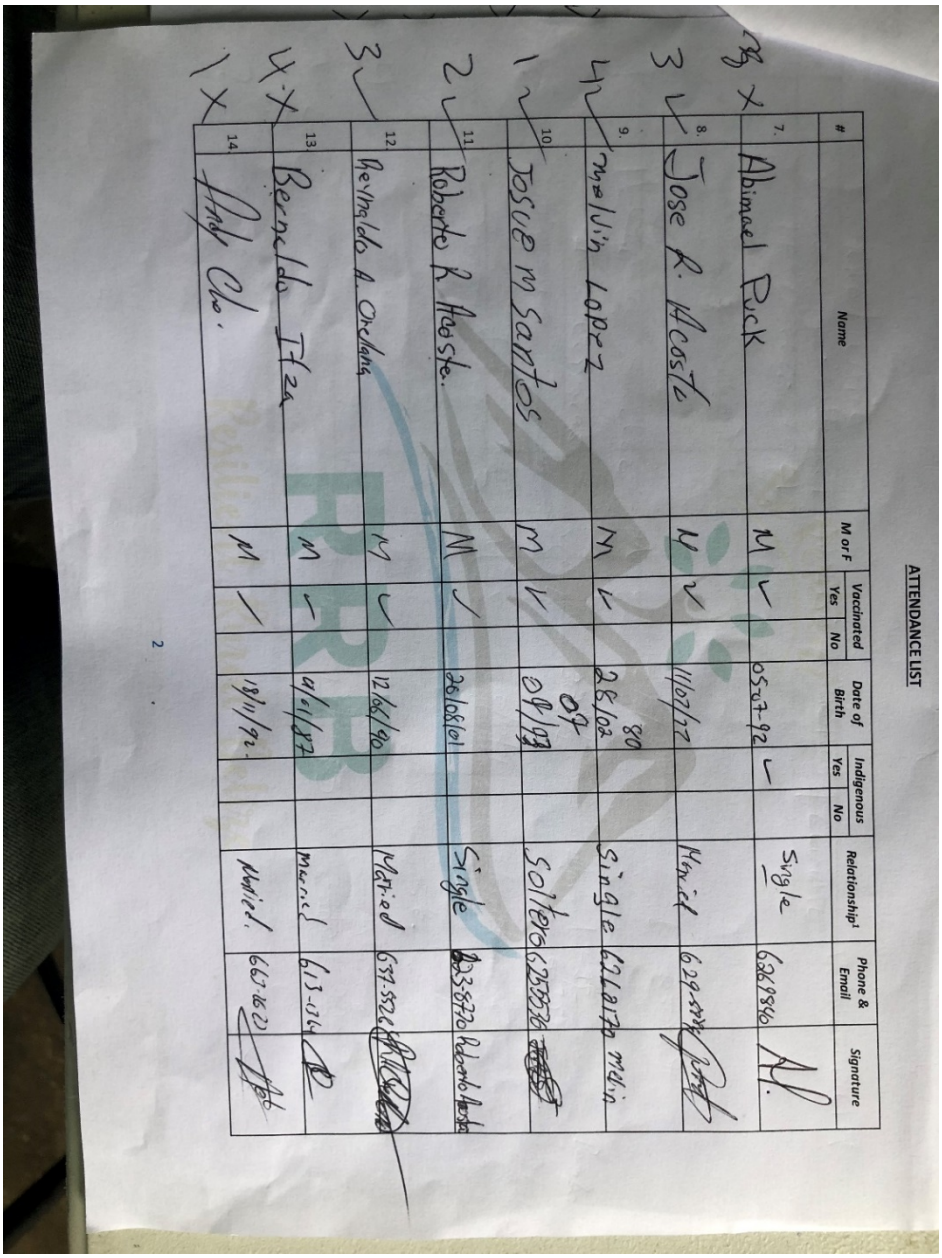
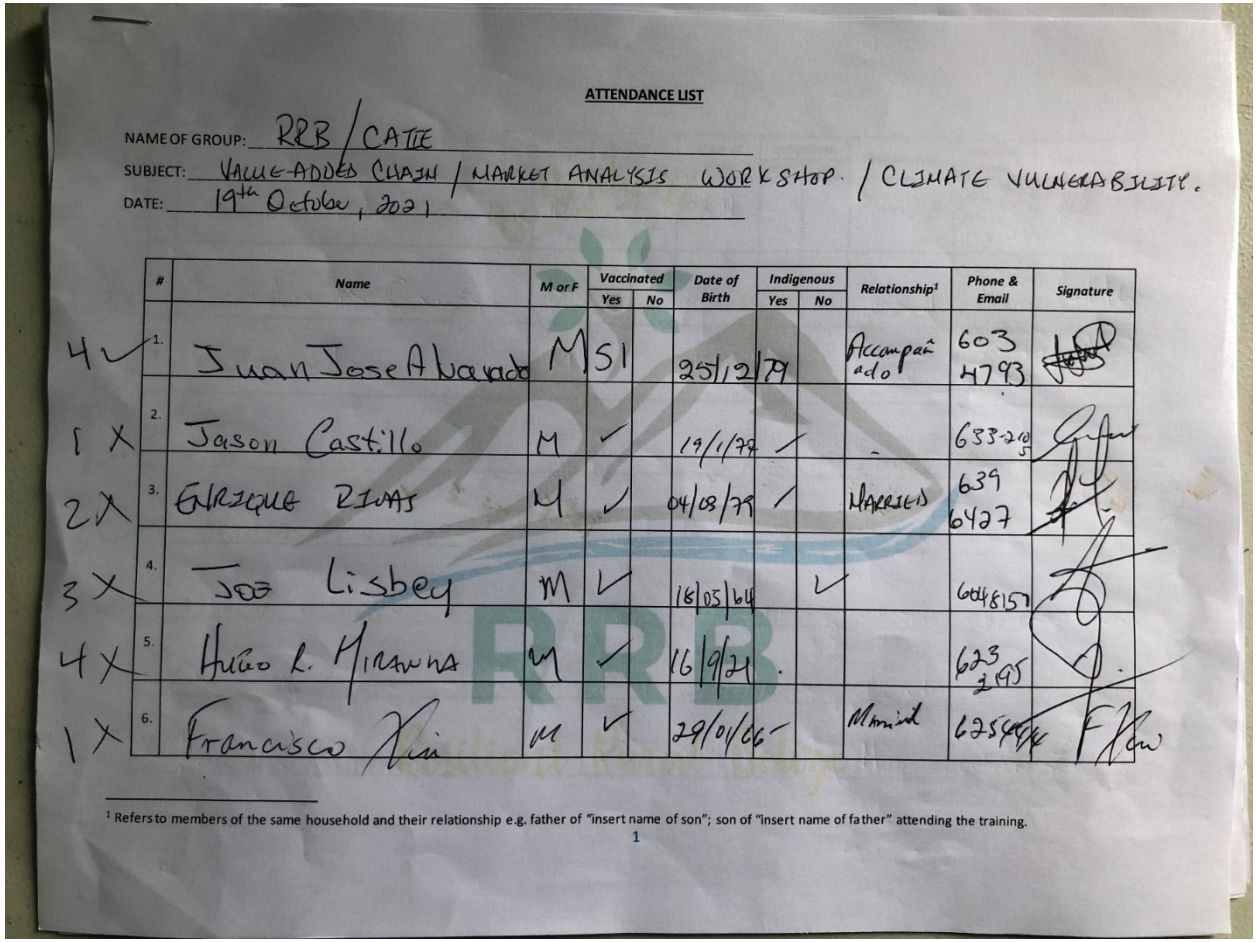
12. Annexes

12.2Annex 1. Participant's List for Value Chain and Market Analysis Workshop for Sweet Pepper



ATTENDANCE LIST

#	Name	M or F	Vaccinated Yes	Vaccinated No	Date of Birth	Indigenous Yes	Indigenous No	Relationship¹	Phone & Email	Signature
7.	Abimael Ruck	M	✓		05-07-92	✓		Single	6269896	
8.	Jose R. Waste	M	✓		11/07/77			Married	629-[illegible]	
9.	Rudolfo Lopez	M	✓		28/02/80			Single	622-[illegible]	
10.	Josue M Santos	M	✓		09/09/93			Soltero	623-[illegible]	
11.	Roberto R Waste.	M	✓		26/06/01			Single	633-8720 Roberto Waste	
12.	Reynaldo A Orellana	M	✓		12/06/90			Married	637-5526	
13.	Reynaldo Itza	M	✓		4/6/87			Married	613-0164	
14.	Andy Cho.	M	✓		18/11/92			Married	662-8621	



ATTENDANCE LIST

NAME OF GROUP: RRB / CATIE

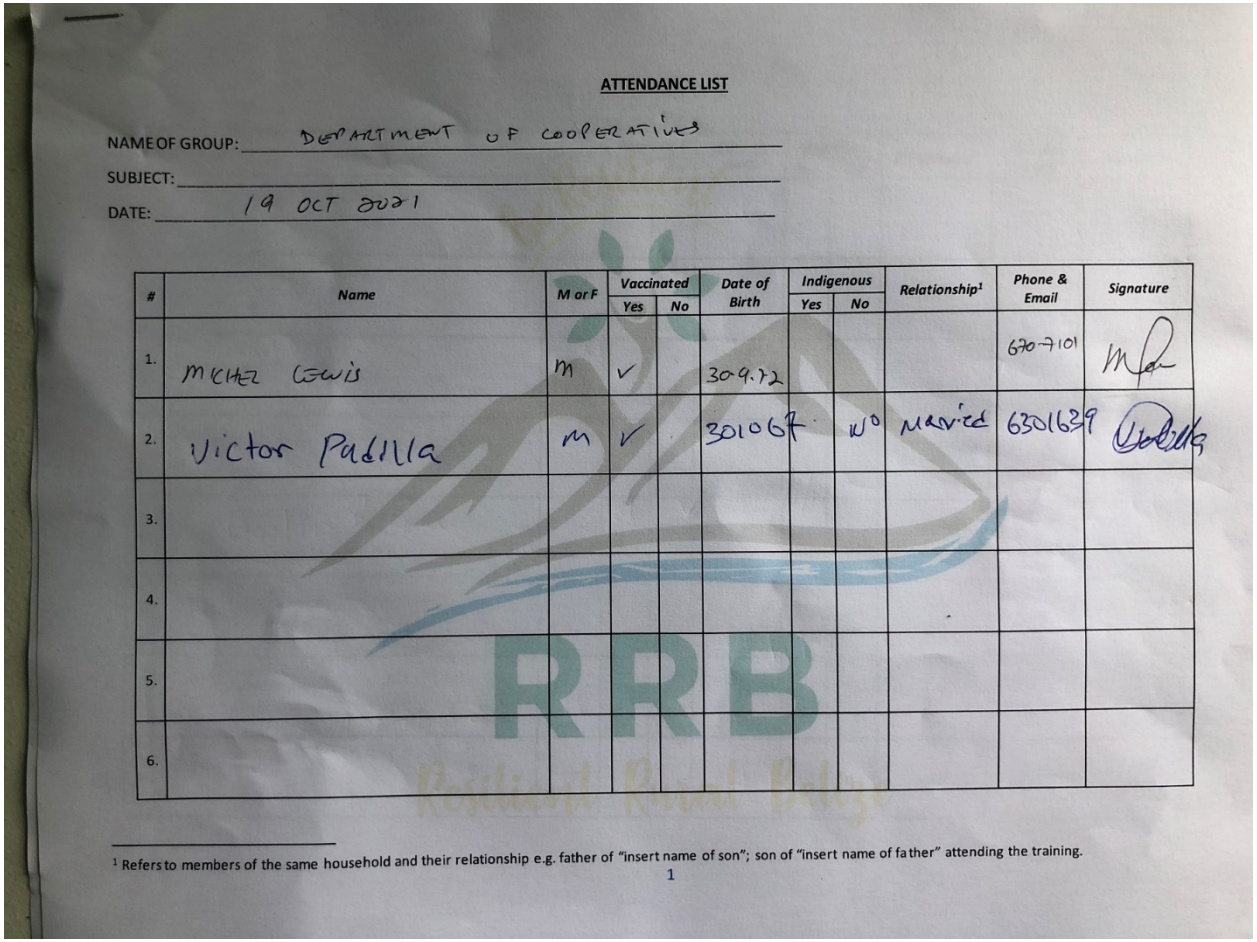
SUBJECT: VALUE ADDED CHAIN / MARKET ANALYSIS WORKSHOP / CLIMATE VULNERABILITY.

DATE: 19th October, 2021

	#	Name	M or F	Vaccinated Yes	Vaccinated No	Date of Birth	Indigenous Yes	Indigenous No	Relationship[1]	Phone & Email	Signature
4 ✓	1.	Juan Jose Alvarado	M	S1		25/2/79			Accompañado	603 4793	
1 X	2.	Jason Castillo	M	✓		19/1/77	✓		-	633-210 5	
2 X	3.	ENRIQUE RIVAS	M	✓		04/08/79	✓		MARRIED	639 6427	
3 X	4.	Joe Lisbey	M	✓		18/05/64		✓		6048157	
4 X	5.	Hugo L. Miranda	M	✓		16/9/21				623 2195	
1 X	6.	Francisco Xiu	M	✓		29/01/06			Married	625[illegible]	

[1] Refers to members of the same household and their relationship e.g. father of "insert name of son"; son of "insert name of father" attending the training.

1



ATTENDANCE LIST

NAME OF GROUP: DEPARTMENT OF COOPERATIVES

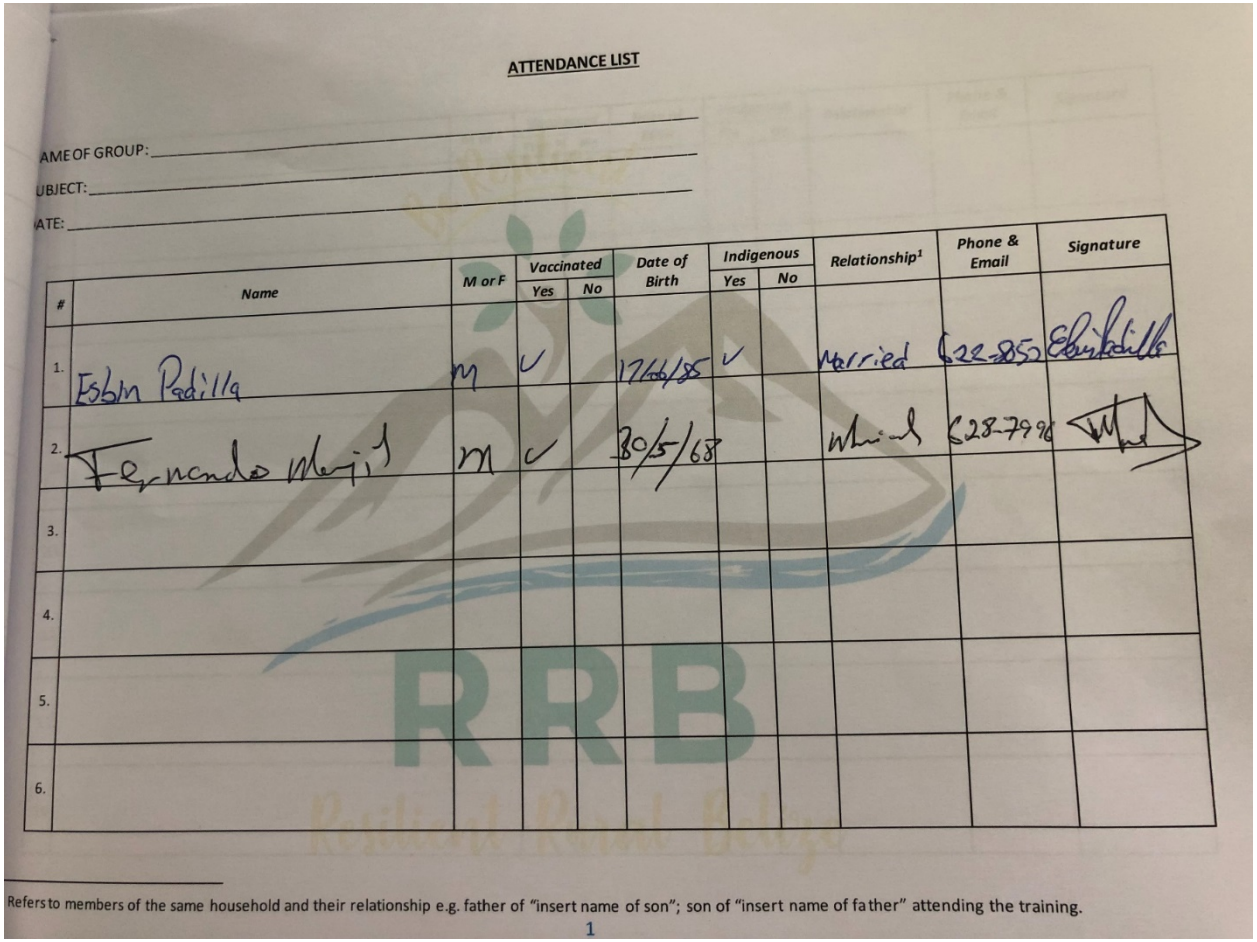
SUBJECT:

DATE: 19 OCT 2021

#	Name	M or F	Vaccinated		Date of Birth	Indigenous		Relationship[1]	Phone & Email	Signature
			Yes	No		Yes	No			
1.	MICHEL LEWIS	M	✓		30.9.72				670-7101	
2.	Victor Padilla	M	✓		30106[illegible]		NO	Married	6301639	
3.										
4.										
5.										
6.										

[1] Refers to members of the same household and their relationship e.g. father of "insert name of son"; son of "insert name of father" attending the training.

1



ATTENDANCE LIST

AME OF GROUP: _____

UBJECT: _____

ATE: _____

#	Name	M or F	Vaccinated		Date of Birth	Indigenous		Relationship[1]	Phone & Email	Signature
			Yes	No		Yes	No			
1.	Eslin Padilla	M	✓		17/06/85	✓		Married	622-855	Eslin Padilla
2.	Fernando Mejia	M	✓		30/5/68			Married	628-7998	
3.										
4.										
5.										
6.										

[1] Refers to members of the same household and their relationship e.g. father of "insert name of son"; son of "insert name of father" attending the training.

12.3Annex 2. Pictures of Participants at the Value Chain and Market Analysis Workshop for Sweet pepper.


RRB


RRB

12.4Annex 3. Cost Structure of Sweet Pepper Production in Belize

COST OF PRODUCTION 1 ACRE SWEET PEPPER
SOURCE: GARY RAMIREZ - MINISTRY OF AGRICULTURE

ACTIVITY	UNIT	UNIT COST	TOTAL
Land Prep:			
Ploughing	1 hr	$40.00	$40.00
Harrowing	1 hr	$40.00	$40.00
SUB TOTAL			**$80.00**
Seed	8 pks	$85.00	$680.00
Fertilizer			
14 - 36 - 12	2 bags	$36.00	$72.00
Amonium Nitrate	3 bags	$28.00	$84.00
K - Nitrate	5 bags	$79.00	$395.00
MAP	1 bag	$63.00	$63.00
Poly Feed (Triple 19)	1 bag	$70.00	$70.00
SUB TOTAL			**$1,364.00**
Fungicide			
Bravo	2 lt	$33.50	$67.00
Phyton	2 lts	$98.00	$196.00
Manzate	2 kg	$12.50	$25.00
Champion	2 kg	$25.00	$50.00
SUB TOTAL			**$338.00**
Insecticide			
Confidor	1 pks	$210.00	$210.00
Pegasus	1/2 lt	$75.00	$75.00
Regent	200 cc	$38.00	$76.00
Sevin	5 lbs	$10.75	$53.75
Karate	1 lt	$45.00	$45.00
New Mectin	250 cc	$85.00	$85.00
Indicate	3 lts	$22.00	$66.00
SUB TOTAL			**$610.75**
Herbicide			
Fusilade	2 lts	$60.00	$120.00
Paraquat	2 lts	$11.50	$23.00
Round Up	2 lts	$18.50	$37.00
SUB TOTAL			**$180.00**
Labour			
Nursery Mngt	2 days	$25.00	$50.00
Transplanting	5 days	$25.00	$125.00
Fertilizing	3 days	$25.00	$75.00
Weed Ctrl	3 days	$25.00	$75.00
Pest & Disease Ctrl	5 days	$25.00	$125.00
Harvesting	10 days	$25.00	$250.00
SUB TOTAL			**$700.00**
ACTIVITY	**UNIT**	**UNIT COST**	**TOTAL**
Irrigation			
T Tape	2 rolls	$635.00	$1,270.00
2" Main hose	1 roll	$570.00	$570.00
Connectors	50	$2.50	$125.00
Fittings			$200.00
Disc Filter	1	$300.00	$300.00
Fuel	40 gls	$8.46	$338.40
SUB TOTAL			**$2,803.40**
TOTAL			**$6,076.15**

Cost of Production for 1 acre Sweet Peppers With Fertigation

Capital Investment	***Unit***	***Cost***	***Total Cost***	***Amortized Cost***
Water pump HONDA gas	Unit	BZ$1,300.00	BZ$1,300.0	$ 1,300.00
1 roll Main Line 2'' hose	Unit	BZ$625.00	BZ$625.00	$ 62.50
Connectors	Unit	BZ$2.95	BZ$147.50	$ 14.75
2'' Air relife Valve	Unit	BZ$35.00	BZ$35.00	$ 3.50
Well	Ft (Depth 25 Ft)	45.00 hr	BZ$112.50	$ 5.62
Ventrui Fertigation Unit	Unit	BZ$570.22	BZ$570.22	$ 28.50
1 roll Drip Tape	Unit	BZ$650.00	BZ$650.00	$ 650.00
2'' Suction Hose	Ft	BZ$5.95	BZ$178.50	$ 17.85
2'' Check Valve	1 pc	BZ$35.00	BZ$35.00	$ 3.50
2'' Gate Valve	1 pc	BZ$35.00	BZ$35.00	$ 3.50
Crates	Unit	BZ$15.00	BZ$750.00	$ 75.00
2'' Filter	1pcs	BZ$350.00	BZ$350.00	$ 35.00
Miscellaneous	$500.00	BZ$500.00	BZ$500.00	
			Amortized Cost	***$ 2,199.72***
	Sub Total for Capital Investment		***BZ$5,288.72***	
Land Preparation				
Bush Hogging	Hr	$80.00	$160.00	
Land clearing/Tillage	Hr	$150.00	BZ$300.00	
Ploughing	Hr	BZ$75.00	BZ$225.00	
Harrowing	Hr	BZ$35.00	BZ$35.00	
Bedding	Hr	BZ$50.00	BZ$50.00	
		Sub Total	***BZ$770.00***	
INPUTS				
Seed	Anaconda	240.00/pk	BZ$1,200.00	
Fertilizer	14-36-12	$59.05	BZ$59.05	
Netting				
Polyfeed	18-18-18	13.00 2 Kg	BZ$78.00	
K-mag	Unit	42.50 100 LBS	BZ$42.50	
Polyfeed	12-43-12 2 kg	14.50 2 Kg	BZ$58.00	
Crop Finisher	20-5-30 2 kg	12.50 2 Kg	BZ$75.00	
Fuel	Gallons	11.64 per gallon	BZ$523.80	
		Sub Total	***BZ$2,036.35***	
Insecticide				
New Mectin	Lt	BZ$339.00	BZ$2,034.00	2034
Malathion	Lt	19.29 Lt	BZ$38.50	
Engeo	Lt	`198.50 Lt	BZ$397.00	
Avaunt	Lt	780.00 Lt	BZ$780.00	
Lannate	Lt	50.00 Lt	BZ$200.00	
		Sub Total	***BZ$3,449.50***	
Fungicidie				
Phyton	Lt	125.65 Lt	$251.30	
Bravo	Lt	34.24 Lt	$342.40	
Rodomil	pack	39.95 kg	$79.90	
Balear	Lt	BZ$32.00	$64.00	
Antracol	pack	35.00 k	$700.00	
Vondozem	pack	13.95 kg	$279.00	
		Sub Total	***$1,716.60***	
Herbicide				
Paraqua	Gallons	35.00 gal	$105.00	
Folilate	Lt	63.50 Lt	$63.50	
		Sub Total	***$168.50***	
Total Operational Cost		***BZ$13,429.67***		
Estimated Yield per Acre:				
	105,000 lbs			
	Misc 10%	***$1,342.97***		
	Interest 12%	***$1,611.56***		
Cost of producing 1lbs of Sweet Pepper				
	Total Cost Of P	***BZ$16,384.20***		

COST OF PRODUCTION FOR SWEET PEPPERS GROWN UNDER A MACRO TUNNEL 18ftx100ft (560			
ACTIVITY	**UNIT**	**COST $**	**SUB TOTAL $**
Land Preparation			
Soil Tilling	hrs	60	
Ridging	hrs	31.5	
			91.5
Inputs/Materials			
Seedlings	seedlings	196	
Poly string	Roll	30	
Stalks		60	
Sacks		291	
			577
Fertilizer			
18-18-18	bgs	210	
Magnesium Sulphate	lbs	6	
Polyfeed 20-5-30	lbs	352	
Polyfeed 19-19-19	lbs	12	
			580
Insecticides			
Newmectin	L	339	
Tryclan	kg	54	
Engeo	L	99.5	
Pegasus	L	27	
			519.5
Fungicide			
Phyton	L	126	
Antracol	Kg	35	
Glidder	L	37	
			198
Irrigation			
1" main hose	ft	30	
Hydrogol 16mm	ft	360	
Take off		20	
Filter 1"		110	
Venturi fertigator 3/4"		175	
			695
Labor			
Liming	hrs	3.5	
Irrigation Installation	hrs	17.5	
Transplanting	hrs	21	
Fertigating	hrs	224	
Fertilizer granular application	hrs	42	
Fungicide/Insecticide appllication	hrs	280	
stalking	hrs	31.5	
Trellising	hrs	210	
Pruning	hrs	87.5	
Manual weed control	hrs	42	
Harvesting	hrs	168	
			1127
Miscallaneous Expenses			
Land Rental	yearly	120	
Transportation		200	
Water Usage	Monthly	160	
			480
TOTAL			**4268**

NOTE: The cost of a prefabricated tunnel structure is $13,000 Bz.
The irrigation material can be utilized for 3yrs
The greenhouse plastice can last for 3 years before replacing
The greenhouse anti- insect screen can be used for 5 years before replacing
The prefab frame of the tunnel structure can last 10 years

The farmers from Seven Miles Farmers Association are presently harvesting an average of 13lbs/pla