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Value Chain market Assessment

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

Product 3.6 Value Chain and Market Assessment of Hot Pepper Production in Belize

May 2022

VALUE CHAIN AND MARKET ASSESSMENT OF HOT PEPPER (Capsicum *chinense*) PRODUCTION IN BELIZE

Conduct of Value Chain and Market Assessments for Resilient Rural Belize

Contract Number: CO002/14/2020/2021

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Table of Contents

Index of tables

Index of Figures

List of Acronyms and Abbreviations

BAHA	Belize Agricultural Health Authority
BBS	Belize Bureau of Standards
CATIE	Tropical Agriculture Research and Higher Education Center
CVA	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
MAFSE	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
CARDI	Caribbean Agriculture Research and Development Institute
GCF	Green Climate Fund

Executive Summary

Belize is a small tropical country with a relative abundance of 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 in its rural areas which accommodate 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) the Green Climate Fund (GCF), to develop a program entitled "Resilient Rural Belize" (RRB) Program. The RRB Program contracted the Tropical Agriculture Research and Higher Education Centre (CATIE) to conduct the value chain analysis and market assessment, focusing on eight preselected commodities, namely, sweet pepper, tomato, hot pepper, pineapple, 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 hot 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 make recommendations for value chain upgrading strategies including improved production and quality of hot pepper.

The fresh fruit hot pepper market in Belize is estimated at 33,398 pounds valued at BZ $121,234. The processing market is at 634,565 pounds valued at BZ $729,748. The main consumers of fresh fruit hot peppers in Belize are households, restaurants, hotels, and fast-food establishments. The largest processors of hot pepper in Belize are Marie Sharp's Fine Food Limited and Hot Mama's.

Hot pepper is grown in all the districts in the country. The Stann Creek District is the leading producer of hot pepper followed by Belize, Corozal, and Orange Walk Districts. In the Stann Creek

District, the main producers of hot pepper are members of cooperatives. In the other producing districts farmers produce individually.

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.

The strengthening of the Hot Pepper Value Chain requires strengthening of the cooperatives who are some of the main producers of hot pepper. 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. Important also, farmers need the knowledge to farm as a business in most cases during the study most farmers do not have records of the cost of production or knowledge if they are operating at a profit or loss.

1. Introduction

Belize is a coastal tropical country that lies on the north-eastern 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 by vulnerabilities and threats like those of Small Island Developing State (SIDS). Impacts from threats such as Climate Change on Belize's agricultural sectors has prompted the adoption of many strategies such as Climate Smart Agriculture (CSA) to the population based in the rural areas and whose livelihoods are mainly in the agriculture sector.

Agriculture is extremely important to Belize's development, as it provides employment, foreign exchange earnings, and is key to food and nutrition 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 earners. In 2020, the highest contributor to the economic output in agriculture in Belize was the non-traditional sector with grains and legumes being the highest contributor (MAFSE, 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 vegetables, roots & tubers category based on economic value were sweet pepper, Irish potato, tomatoes, plantain (bunches), cabbage, onion, and hot peppers ranking from first to seventh places, respectively (MAFSE, 2019).

The Stann Creek District is the leading producer of hot pepper followed by Belize, Corozal and Orange Walk Districts respectively. Despite this, there is no previous study recorded on the value chain analysis and market assessment of hot pepper. 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 hot pepper in Belize and by extension improving the social and economic situation of small-scale local farmers and improving food security in Belize.

While sweet pepper, Irish potato, tomatoes, plantain, cabbage, and onions have managed to generate over $ 1 million in economic output, income generated and production for sweet peppers and tomatoes have decreased. The commodity that saw the biggest increase was onion, which accounted for an estimated 55% increase at 1.8 million BZD.

This Value Chain Analysis and Market Assessment (VCMA) for hot pepper (Capsicum *chinense*) 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 the 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 Stann Creek District which encompasses the village of Cowpen. The objectives of this VCMA are to (i) map and describe the hot 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) discuss market potential; (iii) identify challenges and opportunities for the hot pepper value chain; and (iv) identify and recommend adequate policy interventions based on findings to strengthen the hot pepper value chain in Belize.

2. Methodology

The Value Chain Market Assessment (VCMA) for hot 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 (RRB) Project when the consultancy was initiated. The target area in the Stann Creek District is home to the main hot pepper producers. This includes the village of Cowpen (Table 1).

2.2 Data Collection

Collection of current and relevant data was done in two steps– Collection of secondary data through desk research and Collection of primary data using targeted interviews.

Table 1. Population of the Target Village in the Stann Creek District (Statistital Institute of Belize, 2010)

Village	Total	Males	Females	No. of HH	Avg. HH Size
Cowpen	1042	565	477	282	3.8

Secondary data collection

There is no pre-existing value chain analysis for hot pepper in the country. Raw data and information about supplies, production, transformation, and marketing were accessed from various sources, such as the Ministry of Agriculture Food Security and Enterprise (MAFSE), the Belize Agricultural Health Authority (BAHA), the Statistical Institute of Belize (SIB), Belize Bureau of Standards (BBS), Resilient Rural Belize (RRB) Project personnel, Marie Sharp's Fine Food Products and the online portal of the Food and Agricultural Organization (FAOSTAT). Research and studies published on hot pepper production within the last five years in other countries were targeted to identify innovations and technologies that could strengthen the hot pepper value chain in Belize. The market trends of hot pepper and cultivation of hot pepper 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.

Primary data collection

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 conducted while being mindful of the Covid-19 regulations. Electronic and telephone communications were also carried out.

a. Personal Interviews: face-to-face interviews were conducted with leader farmers of cooperatives and 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 hot pepper is grown, processed, and marketed, as well as labour requirements, sources of raw materials, buy and sell prices, fluctuations in demand throughout the year, sources of financing, and contractual relationships with clients.

b. Telephone Interviews: telephone interviews were carried out with persons that could not accommodate a personal interview. There are two intermediaries that collect fruit from the Copen village, only one was available for an interview. They provided information on the way they conduct business with the farmer in order to supply retailers at the markets in Belmopan and Belize City.

c. 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 the main agrochemicals they supply to the hot pepper growers. They requested that their information remain confidential.

Limitations of the Study

While farmers were willing to cooperate in the study, in general, they had limited records of their production costs and yields. So, they could not verify if they operated at a profit or loss. Hence this study must depend mainly on the national statistics provided by the Ministry of Agriculture to the Statistical Institute of Belize and the processor.

The national statistics presented to the value chain actors at the workshops was queried as to the accuracy of the data. Efforts in obtaining accurate data and interpreting the data has been challenging for this study. Addressing this issue is part of the general action plan and

recommendation offered in this report: reliable information generation should enhance the collaboration among actors of the hot pepper value chain.

2.3 Validation of Value Chain Map by Stakeholders

To validate the data and information collected during the desk and primary research, a workshop was carried out in Trio 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 NGOs.

The Objectives of the workshop were:

- Present the results of the Value Chain and Market Analysis for hot 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.

Table 2. Hot Pepper VCMA double entry matrix with priorities derived by workshop participant

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

The VCMA workshop consisted of the presentation of the hot 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 hot 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 value chain 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. As many as 6 challenges/problems were identified and prioritized– shown in the first column. Participant determined that training and technical assistance was the most important issue for them, follow by finances, improved seed, and marketing. Also prioritized were input purchase and infrastructure problems (mainly includes roads improvement and storage facilities for post-harvest practices). Purchase of inputs was not prioritized by participants

2.4 Vetting of findings with RRB team

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 Program. During these meetings, further recommendations were made to improve the final document and to meet its objectives.

2.5 Linking the Value Chain and Market Analysis with the Climate Vulnerability Assessment

The validation workshop of the VCMA was carried out together with the CVA, no official discussion or information has been obtained to include in this report. However, during the CVA workshop in terms of climate change most farmers expressed major concern on unexpected draughts during periods of the year. These have affected the fruit size and quite common is the cracking of the fruit. The majority of the hot pepper fields are not irrigated, while others have a rudimentary system. However, farmers expressed interest in learning about irrigation which they believe will contribute to better production year-round. 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 it is not traditionally included in VCMA studies. Section 8 on this report shows the findings concerning the suitability and climate adequacy changes projected on two scenarios.

3. History of Hot Pepper Value Chain in Belize

The hot pepper is the fruit of several species of the genus Capsicum which contain high levels of the compound called capsaicin, C18H27NO3. Taxonomically, Capsicum is a member of the Solanaceae family and therefore hot pepper is related to the tomato, eggplant, and white potato. The genus Capsicum is divided into two groups: the sweet or mild flavoured varieties primarily used as vegetables and the hot peppers, often called chillies, that are used for sauces and seasonings.

For the region, most of the hot peppers belong to Capsicum *chinense* Jacq. Capsicum *chinense* Jacq., includes some of the hottest hot peppers in the world such as the Naga, Habanero, Datil, and Scotch Bonnet. The centre of origin of C. *chinense* is believed to be the geographic area in the Tropical Americas covered by northern South America (Northern Brazil-Guyana-Venezuela), Central America and the Caribbean Antilles (Adams et al. 2007). Chilli peppers were part of the Mayan diet and nowadays, hot peppers can be used raw in salads, marinades and food garnishes or used together with other ingredients to produce a hot sauce, also canned, pickled, made into jellies and relishes, dried or smoked.

The original habanero pepper grown in Belize was orange or light yellow, according to the description provided by the website of the major processor of hot pepper in Belize: "*In 1980, Marie Sharp came up with some recipes for sauces, jams, jellies while experimenting with fresh habanero peppers, vegetables, and fruits from the farm…In 1981, she decided to run a family business. Marie Sharp cross pollinated the flavorful habanero with the Jamaican Red pepper to get the bright red habanero that we have in Belize today…The factory in Stann Creek, Belize, has seen huge growth*" (https://www.mariesharps.bz/about/ visited March 2022). The value chain of hot pepper in Belize is attached significantly to the future and marketing strategies of Marie Sharp´s company. The name of "Marie Sharp's Hot Sauce" has become the most widely distributed Belizean product worldwide.

Hot pepper is produced in all the districts in Belize with the Stann Creek District being the largest producer, see Figure 1, followed by Belize, and the Cayo Districts (MAFSE, 2021). In Figure 2, the production trend for the Stann Creek District has been on a constant downward trend since 2018. In consultation with producers, they attribute this trend to seeds of poor quality, rising prices of inputs and the price paid by the processor is not feasible. Marie Sharp's Fine Foods Limited is the main processor in the Stann Creek District and is providing a secure market for the processing of hot peppers in this area and has a capacity of processing 600,000 pounds per year. The

varieties of preference for processing are West Indian Red, Orange Habanero and Maruga. Habaneros are the hottest chili peppers and rate around 200,000 - 300,000 Scoville Units. Hot Mama's Belize Ltd. is another processor in the Cayo District with more than 20 years in the market, it was not possible to interview them during the field research given COVID-19 restrictions.

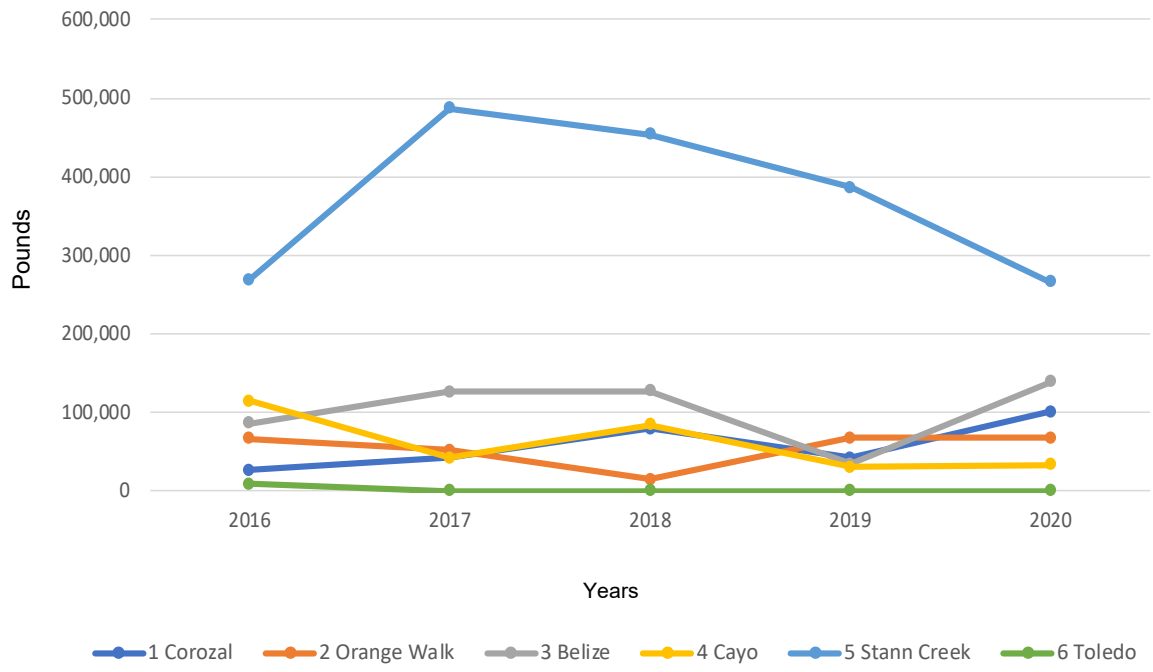

Figure 1. Total Annual Production of Hot Peppers in Belize from 2016 to 2020

The production trends in the other districts are very much constant and most of their production is for the fresh fruit market and prefer to grow the local Orange Habanero. This variety is orange in colour, small, flat, hot, and tastier that other varieties. They supply the local markets, restaurants and tourist resorts in Belize City and major towns. This is the variety of preference for the fresh fruit market. In Figure 1 apart from the Stann Creek District that show a constant downfall in production, the Covid 19 pandemic which started to affect our country in March of 2020 did not seem to have a drastic effect for the other districts. 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 produces including hot pepper. Households became the major consumers of hot pepper.

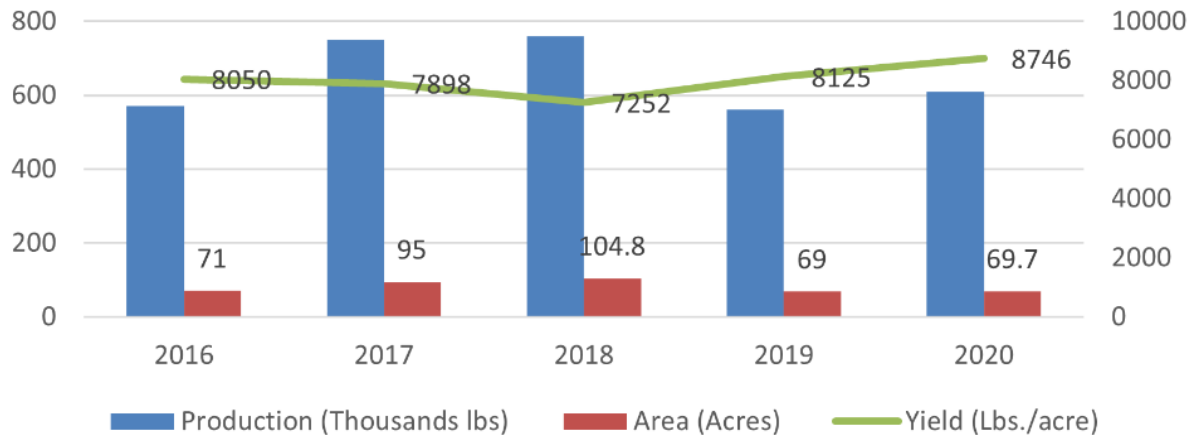

Figure 2. Total area harvested, production and yield of Hot Pepper in Belize (2016 to 2020)

In 2020 a slight increase of production is recorded in the northern districts, this can be attributed when the airport was opened for tourism and certain tourist resorts, major restaurants and supermarkets were allowed to operate.

Derived from Table 3, average yield per acre for the 2016 to 2020 period was 8,014 pounds/acre. During the same period, Belize averages 82 acres harvested and 650,423 pounds of production. In communication with farmers that produce for processing, a claim was made of a yield of 20,000 pounds/acre with a density of 8,000 plants per acre. Although, that reported yield is double of the national average (8000 pounds/acre), farmers generally agree that with better seed quality, irrigation systems and technical support they can increase their yields. The literature review found references to yields around 20 000 pounds/acre under fully irrigated drip system, but not in Belize.

Orange Walk district have report greater than national average yields for 4 of the 5 years considered for this analysis. Table 3 shows each district yield generated from official data on production and harvest acres. Consistently, Cayo District is reporting lower yields that national average, and Orange Walk consistently is reporting greater than average (except for 2017).

Table 3. Hot Pepper yields in Pounds per acre by District (2016 to 2020)

District	Annual Average Yield of Hot Pepper per District (Pounds)					
	2016	2017	2018	2019	2020	Average
Corozal	8,250	9,806	3,955	10,821	7,923	8,151
Orange Walk	22,217	8,666	15,000	16,875	16,875	15,927
Belize	6,179	7,000	7,727	4,929	9,300	7,027
Cayo	7,139	7,000	6,510	4,860	6,448	6,391
Stann Creek	8,240	8,047	8,535	8,026	7,996	8,212
Toledo	5,068	0	0	0	0	N.A.

3.1 Hot Pepper production for the domestic market

Hot Pepper production in Belize for the domestic market, like fresh fruit, targets households, and the tourism industry, primarily the food suppliers in local restaurants and hotels in the country. It was estimated that an average of 33,398 pounds per year is directed to the fresh domestic market. This accounts for 5% of the national average consumption from 2016 to 2020. Processing accounts for 95% (634,565 pounds). of the national average consumption. Domestic market is supplied with production especially from Orange Walk, Cayo and Belize Districts, and no export of fresh hot pepper have officially been reported, nor illegal importation.

Farmers sell majority of their fresh produce by pound 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. Farmers that produce for processing send the hot pepper in bulk, in trucks that can transport 200 to 3000 pounds of fruit to the processing plant.

There are two production cycles of hot 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 Stann Creek District who supply the largest quantity of hot peppers mainly for processing. Farming in open field depending on rainfall has one production cycle which runs from November to February (MOA, 2007). Notably, farmers in the Cayo District grow majority of their sweet peppers under covered structured with irrigation. Therefore, the production of hot pepper is less technical (in this

place) and the official data official put this district with lower than the country's average yield. Production under covered structures and irrigation, normally is associated with higher-than-normal yields, therefore opening a window for yield improvement of hot pepper production.

3.2 Hot Pepper Demand in Belize

Table 4 shows the yearly total consumption of fresh hot peppers in Belize for the past 5 years. In Belize between 2016 and 2020 an average of 667,963 pounds of hot pepper was consumed. The estimated weekly consumption of hot pepper in Belize is estimated at 2,569 pounds. Fresh hot pepper is not imported into Belize, except for processed hot pepper in bottles. In 2020 only 9 152 pounds of hot pepper was imported according to the official data: it is hypothesized the reduction of 50% of imports is due to covid-19 pandemic impact on Belize economy, mostly on its devastated effect on the tourism sector of the country.

Table 4. Yearly consumption of Fresh Hot Pepper in Belize (2016 to 2020)

Year	Pounds (Pounds) of Hot Pepper/Year				
	Consumption	Production	Imports	Illegal entry	Weekly Consumption
2016	598,396	571,538	26,858	0	11,508
2017	765,532	750,320	15,212	0	14,722
2018	778,238	760,050	18,188	0	14,966
2019	578,933	560,638	18,295	0	11,133
2020	618,719	609,567	9,152	0	11,898

As showed in Figure 3, consumption of hot pepper in the country have been mostly covered with national production. Imports of hot pepper to the country during the last 5 years on record, does not represent more than 5% of the total consumption.

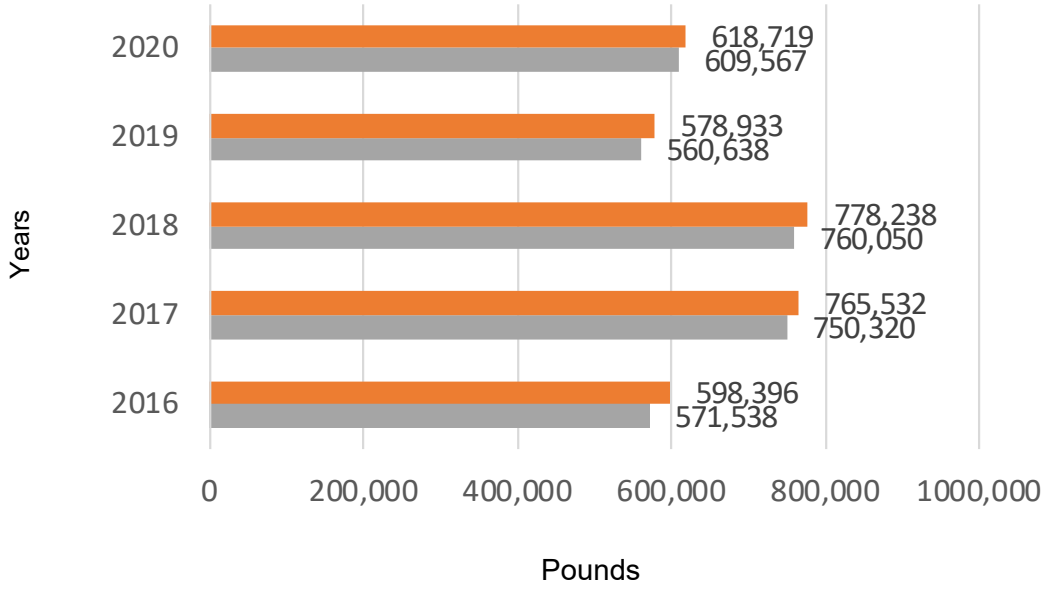

Figure 3. Annual Hot Pepper Production and Consumption (pounds) in Belize from 2016 to 2021

Additional data on processed hot pepper in Belize, at this moment, depends entirely on will of the industry to share. Projection of sales, plans to expand, changes of taste, are essential information that could indicate where the hot paper processing industry is moving and the implication of it to producers. The consulting team communicated with the industry on several occasions. Although the industry promised to provide data, when writing this report, data was not provided.

3.3 Quality Standards of Hot Peppers Production in Belize

The Belize Bureau of Standards (BBS) 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 Programme is an opportunity to revise and introduce standards for the agricultural sector.

To date, there are no established national standards for hot peppers in Belize. To establish a level playing field, it will be useful to ensure that standards and other elements for Quality Systems[1] are introduced and applied in all aspects of the hot pepper value chain. [1]

[1] Quality Systems are made up of high-level institutions providing services in standardization, metrology (such as calibration), conformity assessment (such as inspection, testing, and certification) and accreditation to ensure that products and services meet the requirements of customers as well as pursuing other objectives such as industrial development, trade competitiveness in markets of interest, food safety, health, the environment, climate change, among others

Notwithstanding the absence of national standards for hot peppers, the CARICOM Regional Standard Specification for Grades of Fresh Agricultural Produce for hot pepper (CRS 24: Part 4: 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 hot peppers inclusive of requirements of other relevant export markets of interest. The regional standard requirements include but not limited to the following:

a) of similar varietal characteristics.
b) mature, fresh, firm, clean, intact green stalks.
c) free from pests, damages, blemishes, foreign odor, or taste.
d) grade classification across two classes I and II.
e) tolerance levels across grade classifications.
f) size classification.
g) packaging and labelling.
h) contaminants in relation to heavy metals and pesticide residues; and
i) hygiene and sanitation requirements.

Currently, individual farmers selling to processors apply their own requirements of quality, and at times no standards at all. This is a challenge for the processor because the quality standards of the producers do not match his. Marie Sharp's Fine Foods Ltd. procurement and processing of hot peppers is governed by the company's own standards and quality requirements. Such standard is shown in *Annex1 - Marie Sharp's Fine Foods Limited fruit delivery systems and standards, fruit acceptance standards for Hot Pepper*. However, farmers are showing certain disregard to adhere to the standards. Fresh hot pepper produced by farmers not meeting Marie Sharp's Fine Foods Ltd requirements are not accepted which requires hot pepper grade/quality for industrial processing. This underpins the need to ensure that standards and quality systems are embedded in the value chain at all levels thereby not only improving efficiencies and competitiveness but ensuring that the buyers and sellers needs are fulfilled. Aside from serving national needs, the application of national standards for hot pepper will also create export opportunities for fresh produce.

4 Value Chain Mapping

The Hot Pepper Value Chain in Belize consists of input suppliers, producers, intermediaries (Collectors), processors, retailers, and consumers. Other actors are classified as supporter and enablers, and they provide financial and technical services or provide support to in developing policies to strengthen the value chain. Presented below in Figure 4 is the map of the hot pepper value chain in Belize.

4.1 Value Chain Map

Figure 4 shows the value-chain map developed by the consulting team based on the workshop and secondary data. This map constitutes a first of its kind elaborated for the whole country with the participation of many stakeholders in the production of hot pepper in Belize.

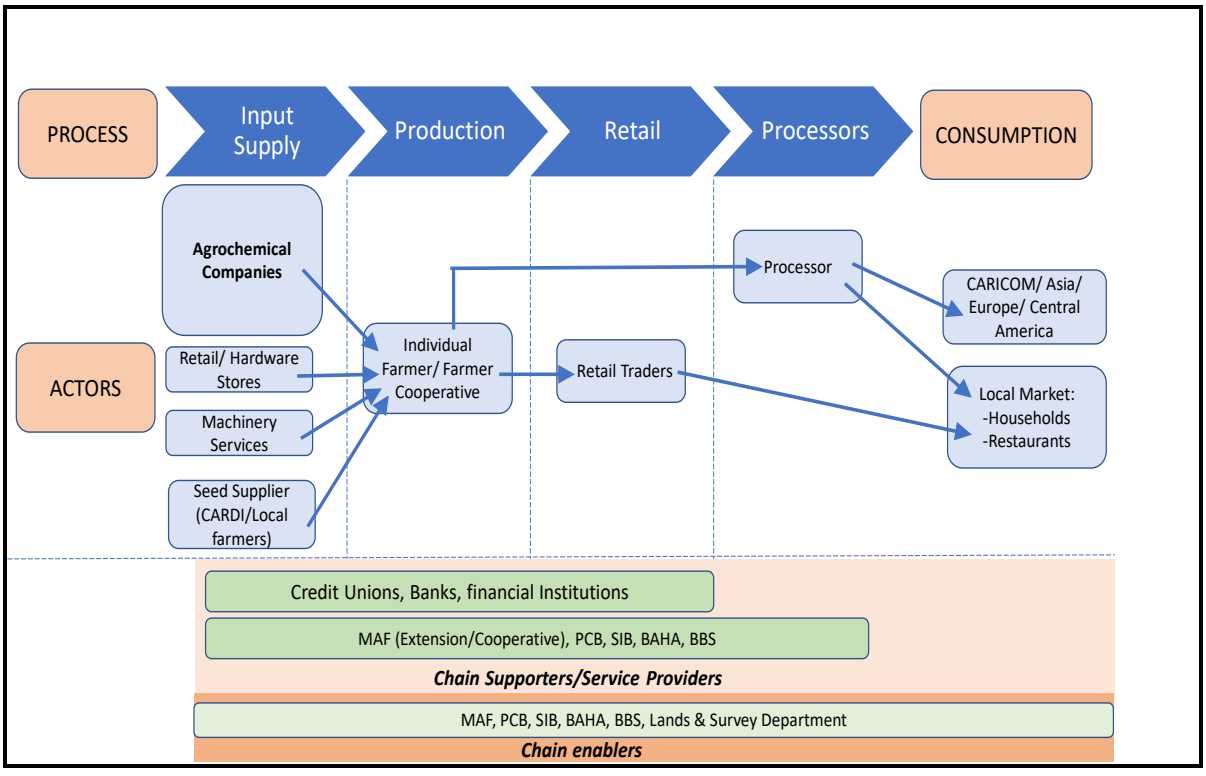

Figure 4. Value Chain Map for Hot Pepper in Belize

4.2 Description of the Hot 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 seeds suppliers, machinery services providers, farm equipment companies, fuel service stations, and hardware stores.

The main agrochemical suppliers in the Toledo District for hot pepper are:

- 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).

- Circle R Limited.: It is a cooperative that provide customers with outstanding products and services for your farm, mill, or family. For more than 25 years Circle R Products has gone the extra mile to provide its customers with excellent products and services. Whether you're running a farm, a mill or a family, Circle R Products stands on the foundational promise "done right" (Circle R Products, 2022).

In terms of seeds for hot pepper, farmers collect their own or purchase from the Processor or from the Caribbean Agriculture Research Development Institute (CARDI).

- Caribbean Agriculture Research Development Institute (CARDI): His work is focus on a Strategic Program that include value chain services, institutional strengthening, partnerships and strategic alliances, and policy advocacy. Key deliverables under those strategic programs will enable the Institute to contribute, in the short term, to increases in food supply to the

region, and in the medium term, to the stability of the agricultural sector, food and nutrition security and reduction in hunger and poverty. Such successes will, in time, enable CARDI to assist the sector in becoming a significant driver to the sustainable development agenda of the region (CARDI, 2022).

Producers/Farmers

The producers of hot pepper value chain can be divided at:

- Processing industry: The main producers for processing are in the Stann Creek District.

- Fresh fruit market: The main producers for fresh fruit market are in Orange Walk, Cayo and Corozal Districts, although some of those are producing for the processing industry.

There are individual farmers and farmers that belong to Cooperatives. In Cowpen Village, majority of the hot pepper farmers belong to the Cooperativa Chileros del Sur Cowpen, started officially in 2020 (RRB, 2019). Currently, this cooperative has 18 members, all males. This group is in the process of regulating their legal situation to become a cooperative.

Production is led by males; women participation was not identified in this linkage of the value chain. This is consistent with the data from CIAT (2018), which identifies that in Belize, 23,400 people (16% of the labour force) are employed in agriculture. Of that total, 9.4% are women, working mainly in the agro-processing sector, important to note that this was not observed in this case.

For many of these farmers, profit obtained from hot pepper production is not their only income source as many of them do other crops and livestock. Farmers use their family labour and other members of the cooperatives for harvesting using hired labour only at the peak of production.

Importers

Officially, there is no importation of fresh fruit hot pepper, but exist importation of hot pepper products in bottles or cans, mainly from Mexico, the USA or CARICOM countries.

- The Observatory of Economic Complexity (OEC, 2022) shows that Belize imported sauces (they are not made primarily with hot pepper) at 2020 (US$ 11.8 Millions), 2019 (US$ 9.46 Millions), 2018 (US$ 6.38 Millions), and 2017(US$ 6.93 Millions).

- Marie Sharp´s: Their products include sauces, jams, and jellies. They use raw materials (habanero peppers, fruits, vegetables, and spices) produced in Mayan mountains in Stann Creek Valley, Belize. The origin of the raw materials supports the slogan “Proud Products of Belize” (Maries Sharp´s, 2022).

- Belize Agricultural Health Authority (BAHA): The data requested from BAHA on the illegal importation/confiscation of hot pepper is non-existent. Also, no confiscations have been documented between 2016 to 2020 (BAHA, 2021).

- The Belize – Country Commercial Guide shows that peppers are in the list of “Prohibited and Restricted Imports”. This mean that fresh peppers and peppers 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).

Intermediaries (Collectors)

Intermediaries are middlemen who collect and purchase hot pepper locally and who sometimes develop long term relationships with farmers.

In the case of Cowpen and Roseville Villages two transporters collect fruit every Sunday or Monday and each collect an average of 1500 pounds to deliver at the processing plant. The transportation costs from these villages to the processing plant is Bz. $175 for 2000 pounds of pepper or Bz. $0.11/pound.

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, grocery stores and supermarkets in the major towns and city.

- Marie Sharp´s as the mayor processor of hot pepper has distribution at 21 countries (Japan & Hawaii, USA, Africa, Taiwan, Canada, Singapore & Malaysia, Guatemala, South Korea, El Salvador, Germany, Honduras, United Kingdom, Mexico, Norway, Sweden, Costa Rica, Switzerland, Lebanon, Kuwait, and Australia).

- Walmart is one of the main retailers that distribute fresh and processed products. They have different business formats, at least 4 formats in each country (Discounts, Warehouses, Supermarkets and Supercentres). In addition, it works as a business that buys fresh vegetables, to pack them and sell them.

- Grocery stores and supermarkets prefer to sell hot pepper processed because it has a longer shelf life. In addition, the losses in the sale of fresh hot pepper are reduced (handling loss and due to maturation).

Consumers

The producers of hot pepper value chain can be divided at “fresh fruit market” and “processing industry”. So, consumers are also divided from those two groups:

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

- Processing industry: The main users of processed hot 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 and souvenirs.

Processors

Marie Sharps' Fine Foods Limited is the major processor of hot pepper, that has the capacity to process 600,000 pounds per year or 50,000 pounds per month.

In the workshop held in late April 2022, the processor (Marie Sharp´s) mentioned that for 2022 they project to process 1,000,000 pounds of hot peppers and will buy at a price of Bz$1.25 per pound.

Potential effect of processors controlling the market:

- Processors can define the purchase price of fresh hot pepper.
- They define the quality or the physical characteristics that must have of hot pepper, because they are the preferred ones in the industrialization processes.
- They are influencing the amount of land that will be allocated to produce hot pepper that will be processed.
- The number of intermediaries will increase. Besides, processors could have a good relationship with intermediaries (collectors), because they need to increase the amount of hot pepper that will be processed in 2022.

The role of women in the hot pepper value chain

The face of sauces made with hot pepper is led by Marie Sharp's, a woman. This means that the female gender is being valued throughout the hot pepper value chain. Although the male gender dominates the agricultural production of hot pepper.

Maria is a world-renowned businesswoman, and she is using that image to reduce gender-based violence in Belize. She began that work when she heard that 50% of Belizean women are victims of domestic violence. Additionally, Marie Sharp launched a new brand of hot sauce "Pure Love," made with habanero and pineapple. This sauce has messages that help combat domestic violence suffered by women, the messages were designed with the support of the United States Embassy. The label development process was done in a participatory manner in schools, which increased the positive impact on society.

4.3 Profit Margins and Share Benefits along the value chain

Cost of production and prices across the value chain were obtained by interview with a farmer in Cowpen Village, Stann Creek District. Table 5 shows an analysis of the profit margins and share benefits along the value chain for fresh ~~fruit~~ hot peppers using average prices for the last 5 years of records.

The farmer for the fresh fruit market sells a pound of hot pepper to the collector for Bz$1.50. With total input cost of Bz$ 0.71, his margin is approximately 50% around Bz$0.79 per pound. Sometimes farmers do direct selling to the local market and consumers who buy small amounts on a weekly basis.

Table 5. Profit Margins and Share Benefits along the value chain for Fresh Fruit Hot Pepper in Bz$ per pounds average for the 2016-2020 period

Fresh Hot Pepper (Lb) marketing costs and benefit shares of actors				
Description	**Actors**			
	Farmers	**Collectors**	**Retailers**	**Horizontal Sum**
Purchase Price (Bz$)	0.00	1.50	2.00	3.50
Total Input Cost (Bz$)	0.71	0.25	0.20	1.16
Sale Price (Bz$)	1.50	2.00	3.63	7.13
Market Margin (Bz$)	1.50	0.50	1.63	3.63
% share of margin	41.3	13.8	44.9	100.0
Profit Margin (Bz$)	0.79	1.75	3.43	5.97
% of share of profit	**13.2**	**29.3**	**57.5**	**100.0**

Price – 5 yr average

The second major actor in the chain is the collector buying between 50 to 100 pounds to distribute along their routes of sale. Similarly, collectors selling the pound of hot peppers to retailers for Bz$2.00 are making a margin of 50% since it is estimated that their total input cost is Bz$ 0.25. Clearly, collectors will still need to invest buying the product from the farmer for around Bz$ 1.50, and measuring margin considering all costs, means that his/her margin from is 25% with respect to selling price. The retailer has the lowest cost of inputs and again can be attributed to the small amounts they buy on a weekly basis and sell on a unit basis mainly 10 to 12 peppers for Bz. $1.00.

If margins are defined from the final price paid by consumers in the retailing store, then, together, the collectors and retailers take 86.8% out of the total profit margin. The retailer's profit margin constitutes the highest share (57.5%) followed by the collector (29.3%). The farmer share profit in this analysis is 13.2% (Figure 5).

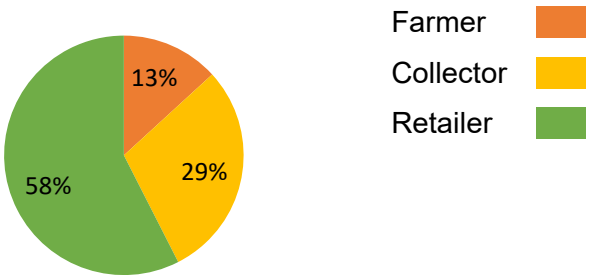

Figure 5. Share of profit of actors for the Hot Pepper fresh fruit market in Belize

The value chain main two commercialization channels force individual analysis for both channels. Considering that most of national production of hot pepper is directed to the processors demands, what happens to the price of hot pepper throughout the value chain is paramount to understand who is benefiting and for how much. However, there has not been an institutional effort by authorities to nail down the references needed to find those margins. It was clear for the consulting team that key information on processing cost and investment for the processing of hot pepper is not publicly available. What is presented below is an empirical exercise using data generated from 2016 to 2020 and personal interviews for a specific location and farmer.

Cost of production and prices across the value chain for hot peppers for processing were obtained by interviews with key persons in the cooperative from Cowpen and Roseville Village and the processor in the Stann Creek District. After triangulation for consistency, it was viable to generate the profit margins analysis. Table 6 shows an analysis of the profit margins and share benefits along the value chain for hot pepper for processing in Belize.

The data shows that for the farmer the cost of inputs is about 57.5% of the selling price, significantly higher than the inputs cost of the fresh fruit hot pepper. Our analysis assumes that farmers pay transportation services to bring the fruit (hot pepper) to the processing plant, because they do not sell the hot pepper to an intermediary. This additional cost, transportation to the processing plant, is apparently what explains the difference between input cost of both

commercialization channels. Farmers selling a pound of hot pepper to the processor add Bz$0.45 of value added (See Table 6).

Table 6. Margins and Share Benefits along the value chain for processed hot pepper in Bz$ per Pounds by using averages for the period 2016-20

Description	Actors		
	Farmers	Processors	Horizontal Sum
Purchase Price (Bz$)	0	1.06	1.06
Total Input Cost (Bz$)	0.61	0.14	0.75
Sale Price (Bz$)	1.06	1.25	2.31
Market Margin (Bz$)	1.06	0.19	1.25
% Share of margin	84.8	15.2	100
Profit Margin (Bz$)	0.45	0.05	0.50
% of share of profit	90	10	100

**Prices - 5 yr. average - Assumption based on 2022 price paid to pepper farmer*

For the processor, the cost of running the processing operation is about Bz$0.14, therefore it adds Bz$0.05 of value added to the pound of hot pepper, assuming a selling price of Bz$1.25, and a purchase price from the farmer of Bz$1.06, as shown in Table 6.

Figure 6 shows farmer and processor shares of the value added created with the processing of one pound of hot pepper. Using a reference price of Bz$1.25 for pound of processed hot pepper, the value added is about Bz$0.50/Pounds, 90% added by the farmer and 10% by the processor.

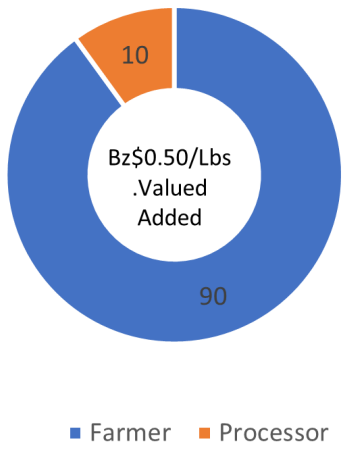

Figure 6. Share of valued added of farmers and processor for one pound of hot pepper that is processed

Profits are not possible to estimate without farther information on investment, taxes, and capital financing by the farmer and the processor company. However, a proxy on profits can be articulated using the value-added concept since it is expected that the value-added will be distribute between returns to capital and labour. Thus, it is argued that financially speaking, a pound of processed hot pepper translate into Bz$0.05 for the processor and Bz$0.45 for the farmer.

Our profit analysis should be interpreted with caution. Without knowing the investment cost and specific financial position of the processor, it is impossible to assess the profit patterns. Similarly, taxes and financial arrangements will affect the profits estimated. We advocate for the purpose of understanding the business relationship between farmer and processor, reviewing the commercialization margin. Thus, for each pound sold by the processor on an average price of Bz$ 1.25, the value-added was estimated in Bz$0.19 with an estimated profit of 0.05 Bz$ per pound (Table 6). Similarly, for each pound a farmer sells to the processor for an average price of Bz$ 1.06, the farmer value-added is around Bz$ 0.45. Note that the processor's business depends on the operation scale, it requires volume. It is understood by processors that when the operation scale is expanded, the margin to increase the price for raw materials, like hot pepper, will also expand. This is a direct implication of gains from economies of scale which have been the reasoning behind the promotion of processing and agroindustry in general.

5 Market Analysis

Hot Pepper can be cultivated in any district of Belize and is available year-round. The main hot pepper varieties for the fresh fruit market is mainly the local orange habanero. For processing are the West Indian Red, Orange Habanero, and Maruga. In times of shortage, they would buy the local orange habanero.

5.1 Market Size

As shown in Table 4 the estimated weekly consumption of hot pepper in Belize is 33,398 pounds per week. Between 2016 and 2020 it is estimated that an average of 634,565 pounds of hot

pepper was processed for bottling and exported to CARICOM countries, USA, Europe, and Asia. Also, the processed product is sold in country. For the local consumption the amount produced may be sustainable to maintain a reasonable market price but for processing there is a great opportunity for farmers to invest but there is an urgent need to improve production practices and alternative agro products[2] that can reduce the cost of inputs and increase the profit margins.

Due to logistical advantages that favour Belize (i.e., proximity), the US market of hot pepper brings opportunities, however, competition is fierce with many countries supplying various hot pepper types to all major markets. The decision for Belize lies between focusing on niche markets or, instead, not to focus on the fresh hot pepper market but on the processing of sauces and other value-added products. Marie's Sharp success story should encourage the country: the RRB's approach of working with the value chain approach should be very useful and appropriate to move toward this goal. The best opportunities are likely to be in niche markets where specific varieties are in demand.

5.2 Market Channel

A significant amount of the hot pepper produced by the Cooperative in the case of Cowpen Village is sold to the processor, individual producers sell to collectors, then to retailers and finally to consumers. The main marketing channels identified from the point of production to consumers through intermediaries for hot pepper in Belize are as follows:

[2] Alternative agro-products: Products that apply the basic principle of sustainable agriculture, "maintenance of a balance between the demands for food production and the preservation of our natural environment". These should be linked with sustainable agriculture, that focuses on producing sustainable agricultural products without compromising the ability of current or future generations to meet their needs.

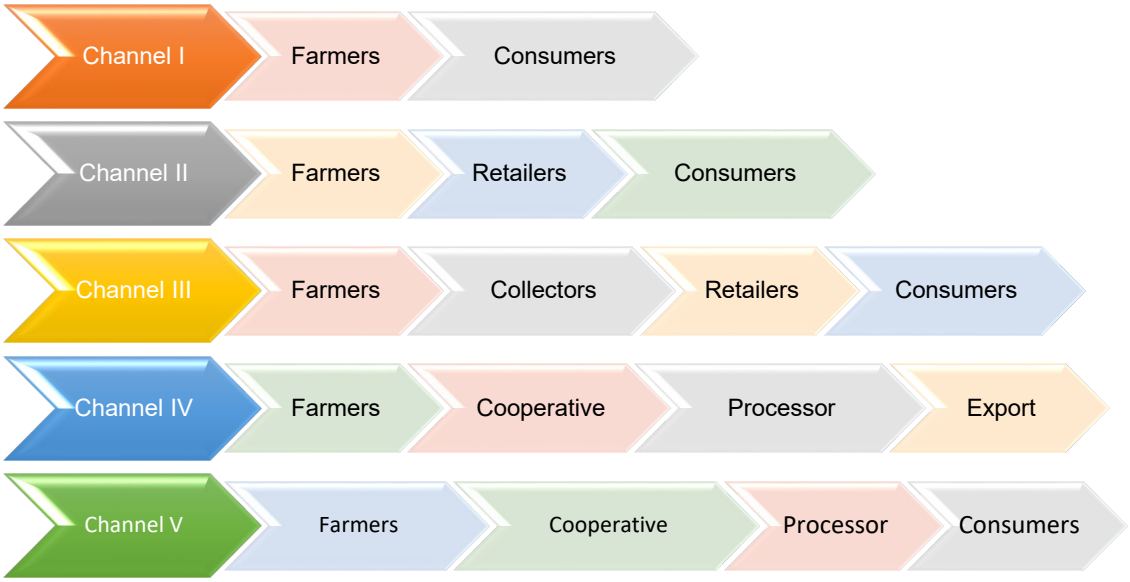

Figure 7. Main Marketing Hot Peppers Channels

5.3 Price trend of Hot Pepper in Belize

The average price for fresh fruit hot pepper in Belize for the producer is Bz $1.50/lb. and the retailer at Bz $3.63/lb. (Figure 8). In this market, it has been reported a stable price for producers but not for consumers. Retail prices have fluctuated from 3.06 (2018) to 4.30 Bz$ (2019). Monitoring future fluctuation of retail prices could help to identify structural changes in the demand for hot pepper: our data will not be sufficient to determine reason of the observed fluctuation.

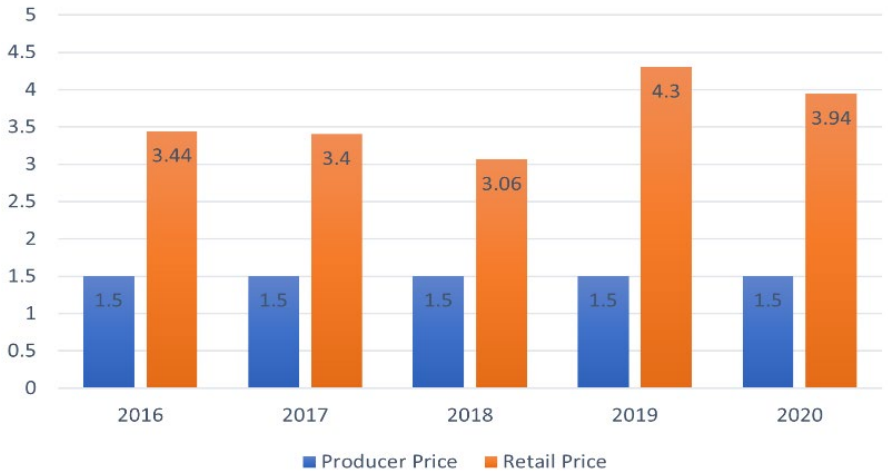

Figure 8. Price trend for fresh fruit market for Hot Pepper production in Belize (2016 to 2020) at Producer's Price (SIB, 2021)

On the other hand, the average price for a pound of hot pepper intended for processing saw an increment of 15% from 2018 to 2019 (Figure 9). Such increment could explain partially the increase on retail price observed for the fresh market in 2019 and 2020.

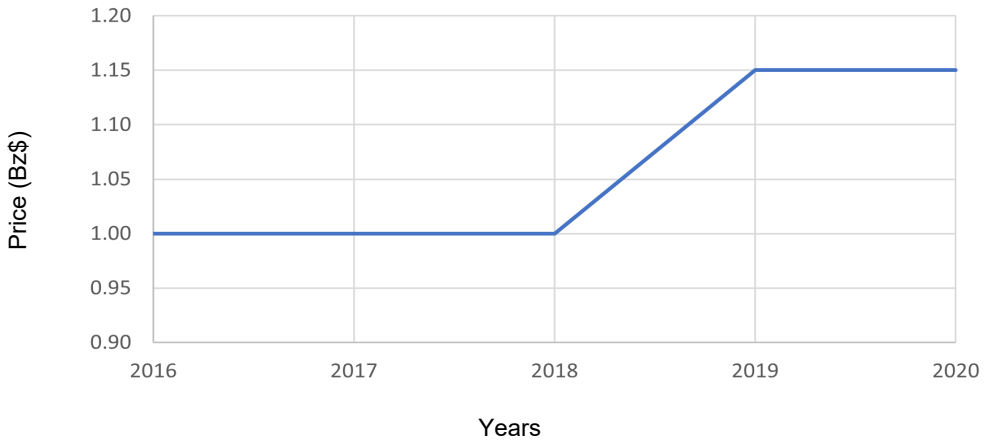

Figure 9. Price for hot pepper for processing in Belize (2016 to 2020) at processor price

The evidence indicates that there is a connection between price fluctuations in the markets for fresh hot pepper and processed hot pepper. The connection could have been more obvious, but the covid-19 pandemic changed the trends of these. On the other hand, Marie's Sharp rejection policy places significant weight on the volume that could be available for the fresh market. As suggested by participants in the value chain workshop, demand from the processor has been very stable and consistent. Farmers argue that without controlled environments, (e.g., greenhouses) constant supply of raw material to the processor is almost impossible, and therefore they may be forced to sell in the fresh market to recuperate their investment.

6 Supply Chain

The supply chain considers the production, importation, profitability, and cost of production across the value chain. The total production of hot pepper in 2020 in the country was estimated at 607,167 pounds, valued at BZ $777,173.76 (SIB, 2020). The main suppliers of hot pepper in Belize are farmers.

6.1 Amount Supplied

Table 7 shows the yearly supply of hot pepper for fresh fruit consumption and processing for the last five years. There is no importation of fresh fruit hot pepper in Belize. The main suppliers of hot pepper in Belize are individual producers and those organized in co-operatives.

Table 7. Annual supply of Hot Peppers (pounds) (2016 to 2020)

District	Total Annual Production (Pounds)				
	2016	2017	2018	2019	2020
Corozal	26,400	43,500	79,100	42,200	100,620
Orange Walk	66,650	51,998	15,000	67,500	67,500
Belize	86,500	126,000	127,500	34,500	139,500
Cayo	114,510	42,000	84,625	30,375	33,272
Stann Creek	268,609	486,822	453,825	386,063	266,275
Toledo	8,869	0	0	0	0
Total	**571,538**	**750,320**	**760,050**	**560,638**	**607,167**

Hot pepper is grown in all the districts in the country. The Stann Creek District is the leading producer of hot pepper followed by Belize, Corozal, and Orange Walk Districts. The production by districts shows fluctuation and changes in production. Cayo District went from an estimated production of 114 510 pounds in 2016 to 33 272 in 2020, with no apparent explanation for the decline (Table 7). Stann Creek production history gives the district the role of leading producer area of the country and stability on the amount annually produced, at least 250 thousand pounds. In the Stann Creek District, the main producers of hot pepper are members of pre-cooperatives, which it is hypothesized to be behind his success in production. In the other producing districts farmers produce individually.

Table 8 registers fluctuations in the cultivation of hot pepper. There are challenges with the data available to pursue a detailed analysis, further effort should be allocated to collect accurate data. Our exercise to connect reported production, area harvested, and reported yields only demonstrate the inconsistency of data and the need for further clean-up of the information.

Table 8. Total area of Hot Pepper harvested (Ac) 2016 to 2020

District	Total Area Harvested (Ac.)				
	2016	2017	2018	2019	2020
Corozal	3.2	4.0	20.0	4.0	12.7
Orange Walk	3.0	6.0	1.0	4.0	4.0
Belize	14.0	18.0	17.0	7.0	15.0
Cayo	16.0	6.0	13.0	6.0	5.0
Stann Creek	33.0	61.0	53.8	48.0	33.0
Toledo	1.8	0.0	0.0	0.0	0.0
Total	**71.00**	**95.00**	**104.80**	**69.00**	**69.70**

6.2 Cost of Production

The Ministry of Agriculture estimates BZ$ 0.70 to produce a pound of hot pepper for the fresh fruit market and BZ$ 0.61 to produce a pound of hot pepper for the processing market. Anil Sinha and Joan Petersen (2011) calculated the cost of production of one acre of hot pepper in BZ$ 0.78. Table 9 recaps cost structure from three different production systems analysed for hot pepper production. Details of those cost structures transcript can be found in Annex 2: Cost of Production for Hot Pepper.

All three sources present similar cost structures. Cost of production of one acre of hot pepper increases with the intensity of plantation: a fresh hot pepper spacing-4' x 4' (3630 plants) system has an estimate cost of production of BZ$ 10 429, while the most intensive system (7000 plants) this cost is BZ$ 19 421. All systems use irrigation and corn barriers to protect the crop. The small producer can still be better represented by the first fresh hot pepper production system. The other two systems represent medium and large producers.

Table 9. Hot Pepper cost of production per one acre under different systems of production (Bz$)

	Fresh Hot Pepper* (3630 plants/acre)		Process Hot Pepper* (4840 plants/acre)		Hot pepper** (7000 plants/acre)	
Land preparation	$ 147.50	1%	$ 147.50	1%	$ 198.00	1%
Nursery Management	$ 657.79	6%	$ 906.33	7%	$ 1,643.00	8%
Field Management	$ 4,680.75	45%	$ 5,938.06	49%	$ 8,739.00	45%
Corn Barrier	$ 240.00	2%	$ 240.00	2%	$ 306.00	2%
Materials and Equipment	$ 3,343.01	32%	$ 3,343.01	27%	$ 6,002.00	31%
Sub-total COP	$ 9,069.04	87%	$ 10,574.89	87%	$ 16,888.00	87%
Contingency 15%	$ 1,360.36	13%	$ 1,586.23	13%	$ 2,533.20	13%
Cost of production	$ 10,429.40	100%	$ 12,161.13	100%	$ 19,421.20	100%
Labor	$ 2,328.21	22%	$ 3,318.27	27%	4839	25%
Cost of Production per Pounds	**$ 0.70**		**$ 0.61**		**$ 0.78**	
Yield in Pounds	15000		20000		25000	

*Uses cost of production structure from MAFSE (2021)

**Uses cost of production structure from Sinha & Petersen (2011)

Table 9 also shows percentages of the major categories of the cost structure with respect to the total cost of production. More than 45% of the cost of production occurs during the field management of the crop where the combination of fertilizer and insecticides have the same weight in cost of production than labour. Next, materials and equipment represent around 30% of the total cost of production. Irrigation is the biggest expenditure here.

Combining labour used in all the different sections of the cost structure we estimate how much is used to hire people for one acre of hot pepper production. Labour cost represents at least 22% of the total cost depending on the production system we are referring to. Hot Pepper production for processing reports the highest percentage, 27% of total production cost. The activity that requires more labour is harvesting and this activity represents at least 11% of the total cost of production.

The intensification of production seems to translate into a higher percentage of wages to be hired: a greater expenditure on labor.

Finally, the unit cost of producing a pound of hot pepper is a parameter to understand the possible margin of commercialization and negotiation that a producer has in the value chain. With prices of BZ$ 1.15 in the market for processing, the producer should be able to receive profits if his/her transportation cost is not high. Likewise, one might think that with a producer price of BZ$ 1.5 per pound, the producer would obtain profit depending on transport cost and the negotiation with the intermediary.

Traditionally, organized producers have been able to collaborate to reduce production costs, something that cooperatives like to implement. In the case of hot pepper, we see that coordinating group input purchases could have an impact on prices paid for the farmer for fertilizers and insecticides, two very important items among the cost structure. Likewise, it would be strategic to explore how to reduce irrigation costs since they represent an important component within the costs.

Missing from our cost of production analysis is the regional context of where hot pepper is produced. We recognize that finding cost differences in production among districts could be relevant for the decision-making process of where and how to support the hot pepper value chain. However, this was not possible given the lack of information by district.

7 Climate Change Vulnerability of the Hot Pepper Value Chain

While value-chain dynamics is commonly analysed and described in 3-, 5- or 10-years periods, and most experts will avoid market prospects or projections beyond the 10-years mark, any climate analysis is described in longer periods. Climate dynamics is rarely described in shorth-periods of years as experts understand the limited predictable value of 3-, 5-, or 10-years forecasting. In addition, climate forecasting, in general terms, will be useful for the decision-making process in the hot 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 likelihood of hot pepper business.

For this report, we bring in context findings produced by simulation, index, and modelling 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 read the CVA reports.

Two major sections of findings are presented below and put it context of the hot pepper value chain. First, we report changes on climate adequacy for the hot pepper production for the whole country of Belize. Using maps and color-coded to understand those changes, a general futuristic perspective to produce hot pepper can be described. Second, findings on climate suitability 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 hot pepper production, we identify losses and gains in suitability or adequacy in percentages of the adequacy from the base line data.

7.1 Hot 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 hot 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., cantered 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 in the CVA report) 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 and up to 1.5°C in Toledo. On the other hand, the RCP8.5 scenario shows larger increases in 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 10 shows the interaction between precipitation and temperature parameters for absolute and optimal ranges.

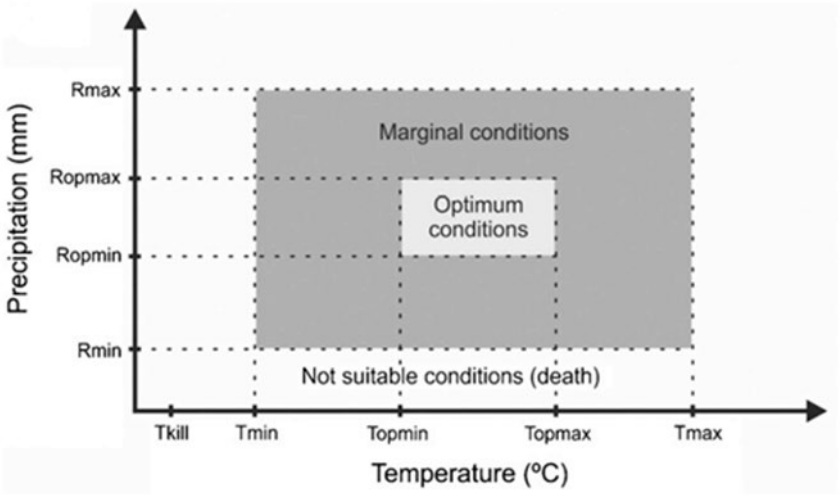

Figure 10. Interaction between precipitation and temperature parameters for absolute and optimal ranges

Below are the climatic parameters considered in the climate adequacy analysis for the hot pepper production, prioritized in the RRB project. As shown in Table 10, the optimum temperature and precipitation range for hot pepper growing in Belize is very appropriate for the climate conditions of the country basically implying that it could be possible to grow in the whole country.

Fifth, a reclassification of modelling 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 colour) corresponds to a scale greater than 80% in the adequacy scale resulting from modelling 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 colours correspond to the areas where gains would be experienced in climatic conditions for the crop analysed (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 10. Climate parameters considered in the climate adequacy analysis requested for the hot pepper value chain prioritized in the RRB project

Description of parameter used in the model	**Value used**
Gmin: Minimum duration of the growing season	120
Gmax: Maximum duration of the growing season	180
Gused: Used duration of the growing season	150
Tkmp: Temperature (°C) below which the species cannot survive	0
Tmin: Lower limit of the absolute temperature range (°C)	7
Topmin: Lower limit of the optimum temperature range (°C)	18
Topmax: Upper limit of the optimum temperature range (°C)	30
Tmax: Upper limit of the absolute temperature range (°C)	40
Rmin: Lower precipitation limit (mm) of the absolute range	400
Ropmin: Lower precipitation limit (mm) of the optimal range	600
Ropmax: Upper limit of precipitation (mm) of the optimal range	1500
Rmax: Upper precipitation limit (mm) of the absolute range	2000

Source. CVA report

Below are the climate adequacy maps for the hot pepper (Capsicum *chinense*) cultivation in Belize. Figure 11 shows maps describes the climate adequacy for cultivating hot pepper in Belize for the baseline (current conditions, year 2000) and both future scenarios (cantered in year 2050). The suitability for the crop is color-coded with green representing the situation when climate adequacy is very high for the hot pepper. For baseline the map confirms that the whole country of Belize is in the range of optimal climate conditions (at least for what concerns to temperature and precipitation). Either future scenario RCP2,6 or RCP8,5 alters that situation (Figure 11). Under both scenarios, climate adequacy to produce hot pepper does not see losses in adequacy (Figure 12).

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 behaviours that could translate into new infestation and/or pests for the crop.

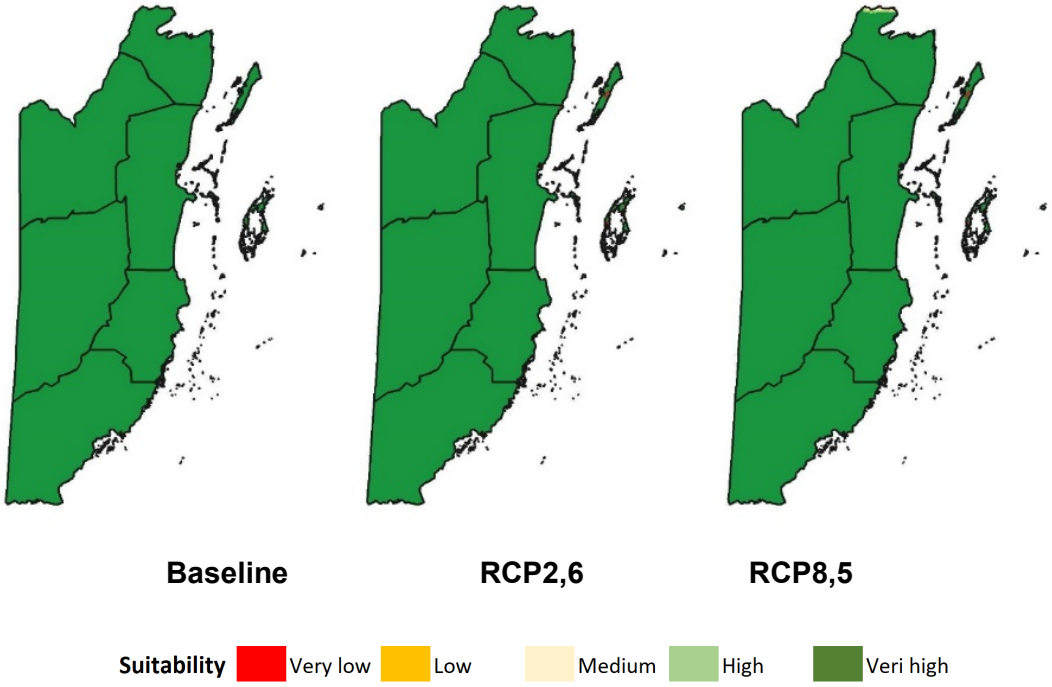

Figure 11. Mapping climate adequacy for growing Hot Pepper (C. frutescens) under two climate change scenarios with reference to year 2050

Baseline Vs RCP 2,6 **Baseline Vs RCP 8,5**

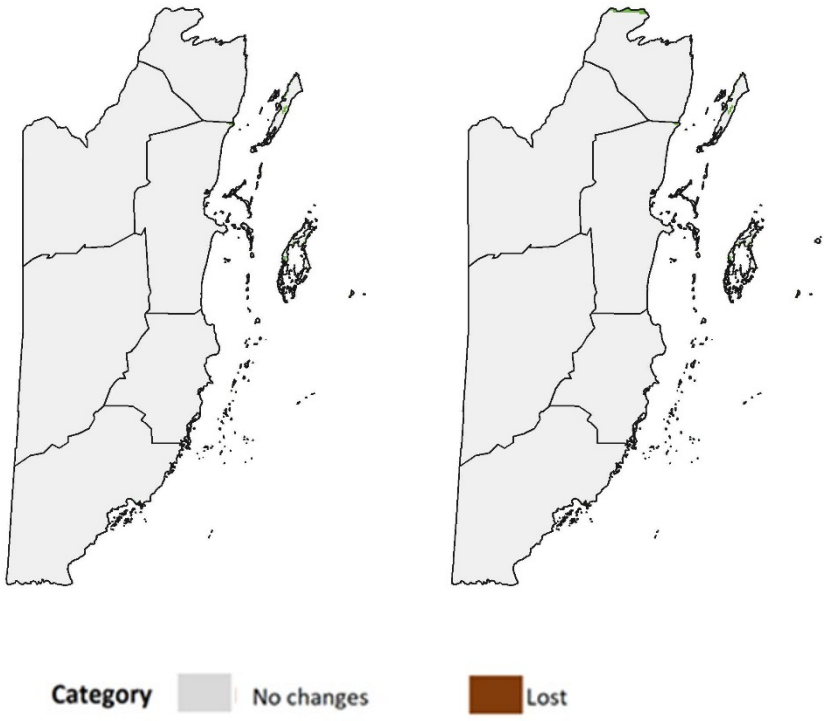

Figure 12. Gain and losses in climate adequacy under two scenarios of climate change for Hot Peppers production in Belize

7.2 Change in climate adequacy for hot pepper growing in the 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 program in Belize RRB) and it is on 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 Programme in Belize (RRB) are shown in Figure 13

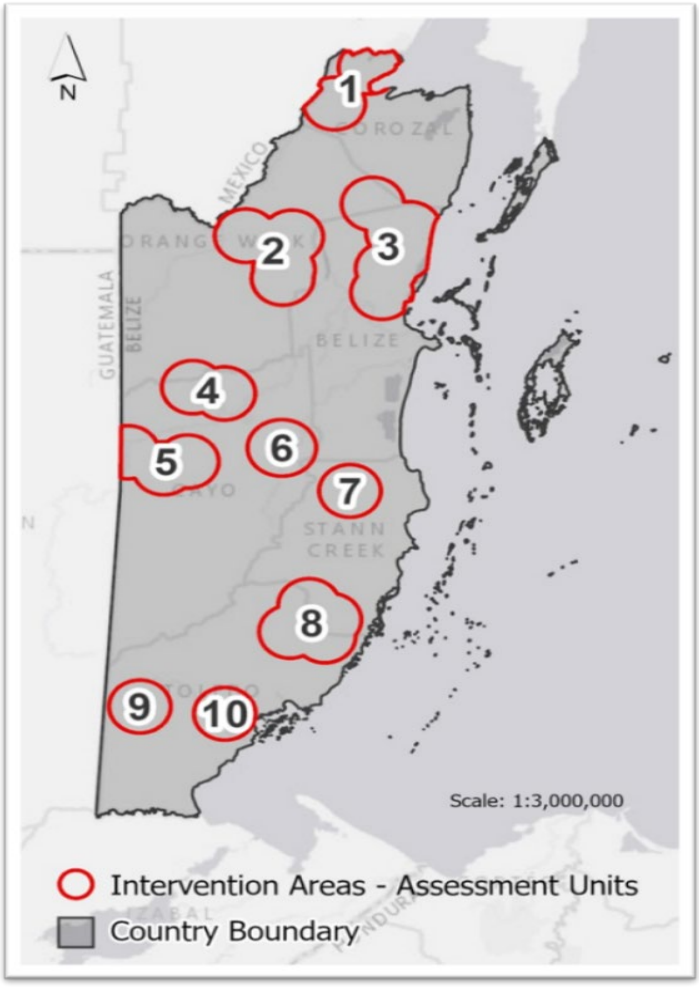

Figure 13. Mapping Intervention Areas-Assessment Units of the Resilience Rural Belize Program

Table 11 shows changes in climate adequacy between baseline and future scenarios for Hot Pepper 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 can confirm that all intervention areas will continue to exhibit very high adequacy for growing hot pepper. There are no losses of adequacy projected for 2050 scenarios.

Table 11. Changes in climate adequacy between baseline and future scenarios for Hot Pepper (C. frutescens) 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										
No Suitable										
Lost										
No changes	100	100	100	100	100	100	100	100	100	100
	RCP 8,5									
Gain										
No Suitable										
Lost										
No changes	100	100	100	100	100	100	100	100	100	100

8 Constraints and Opportunities

The production of hot pepper is being given priority by the Government of Belize through the Resilient Rural Belize (RRB) Program. This is positive for the Hot Pepper 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 Hot Pepper Value Chain.

Table 12. Challenges and Opportunities for Hot Peppers 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. For the hot pepper, a potential reduction in fertilizers and insecticides could help significantly in reducing the cost of production. • 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. • The prices of inputs (i.e., fertilizer and pesticides) may not change rapidly enough but application efficiency could be tremendous. Training on the ABC of efficient use could reduce the total bill paid by farmers.
	Seed Quality and Availability: • Seed prices are high	• Opportunity for collaboration and strengthening of relationships between farmers, agronomists, and local extension services for training on Good Agriculture Practices. • Facilitate importation of seeds and establish local seeds banks to supply farmers.

Chain links	Constraints	Opportunities
		• 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.
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. • Information sharing on alternatives inputs (i.e., organic fertilizers) could be promoted by local extension service.
	Annual Production Plan • Especially for fruit destined for processing an annual planting plan is very important to meet supply and demand of the processor.	• Annual Production Plan (APP) should be encouraged to those seeking to secure market for processing hot pepper. • Training in APP and/or technical assistance to organize an annual production plan for a constant supply of fruit. • Informal contracts are one step closer to formal (commercial) contracts and promoting APP could accelerate the qualitative shift in the way the value chain operates. The interest of processors like Marie Sharp´s on supporting the implementation of APP should be explored. • Small scale producers of hot pepper may not see immediate benefits of implementing an annual production plan because they may be using collectors to get to the processing plant. However, it is possible to think that those producers may benefit of coordinating their small-scale operations with a “group” annual production plan, which will bring the possibility to coordinate transportation and sell directly to the processor.

Chain links	Constraints	Opportunities
Harvest and Post-Harvest	**Climate Vulnerability** • Farmers depend on the seasonal rainy season and not much emphasis on climate change.	• Share information on climate change and technical assistance on irrigation systems for hot pepper production. • 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.
	Road Conditions • Poor road conditions between distribution and collection centre.	• 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. • Identify funding and storage facilities affordable and appropriate for the farmers. • 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. One of several of these factors together with minimum post-harvesting facilities, constrain operation at several of the value-chain analysed. 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. Although, land ownership, or lack of it to be more exact, could seriously restrict the impact of the suggested infrastructure-business plans.

Chain links	Constraints	Opportunities
	Poor Quality Standards • Need for post-harvest facilities.	• It should be explored why there is not a quality premium paid for those farmers following the quality standards. If the farmer does not perceive the benefit, it will be difficult for him to adhere to standards. Either there is no quality premium possible to offer or the standards are not clear to farmers. • 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.
Marketing and Distribution	• Quality standards are not followed throughout the whole the value chain • Rejected produce by the processor	• Processors have quality standards farmers have to adhere to. Technical assistance for farmers to better understand the standards and what agronomic practices need to be improved to meet these standards. • Organized groups or cooperatives need to understand and request the development of standards for the fresh market or support the industry standard. • Conduct a study that demonstrates how much rejection could be reduced with best practices and adherence to the quality standard.
	Poor Business Practices • Poor record-keeping results in a poor	• 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.

Chain links	Constraints	Opportunities
Marketing and Distribution	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.	• Good business practices training should also be given to the cooperatives. It was argued that cooperatives need to improve their relevance to 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 hot 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 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

Chain links	**Constraints**	**Opportunities**
		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 13. 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 [3]	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 [4]	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 [5]: such as eutrophication, water toxicity, groundwater pollution, air pollution, soil and ecosystem degradation, biological imbalances and reduced biodiversity.

[3] 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/
[4] https://www.conservation.org/docs/default-source/publication-pdfs/cascade_modulo-4-como-enfrentar-el-cambio-climatico-desde-la-agricultura.pdf
[5] 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)[6]	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 [7]	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.

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

9 Conclusion

Situation of the value chain. Hot Pepper is grown in all the districts in the country. The Stann Creek District is the leading producer of hot pepper followed by Belize, Corozal and Orange Walk Districts. Main producers of hot pepper are part of a pre-cooperative. The Stann Creek is the lead district in production for the processing market. Strategically, the influence of Marie's Sharp processing business in the whole value chain is paramount. Projection of sales, plans to expand, changes of taste, are essential information that could indicates where the hot pepper processing industry is moving and the implication of it to producers. The segmented market where Marie's Sharp is moving shows signs of continued growth and the company have demonstrated its capacity to compete internationally. All that make this value chain future promising and one important to continue supporting.

Also, 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. Clearly, processing of hot pepper still requires improved in production and other segments of the value chain. In the case of hot pepper, 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.

Volumes and quality control. The hot pepper value chain includes pre-cooperatives with weak managerial and productive skills. All farmers require technical assistance and training in Good Agricultural Practices as well as training in basic farm business management. There is a need for a national seed policy and certification and development of hot pepper seed banks, to curtail importation from other countries. The productivity at the farm level was reported to be low -in some cases critically low- resulting from lack of improved genetic material, low use of fertilizers, inappropriate pest and disease management, and limited knowledge of good agriculture practices. This particularly is the case for small scale producers which may not be selling to the processor directly and focus more on the fresh market. Standards for the fresh market are not existent and those for the processing plant of Marie's Sharp are getting traction among farmers. For a value chain oriented to regional and international markets, relatively high and rigid sanitary and quality standards (traceability, cold chain, etc.) are prerequisites. Belize's hot pepper value chain seems on track of expanding demand of raw materials! RRB's value chain approach came

at a very convenient time since expansion of the processing volume only will be obtainable if all stakeholders can visualize this opportunity and take actions.

Impact of covid-19 and the business environment. The unforeseen impact of covid-19 on logistics for carrying out the studies was overwhelmed. Carrying out interviews and workshops in pandemic requires extra planning and most important the flexibility to adapt. It came as no surprise that many of the products analysed show unexpected consequences under the pandemic since 2020. Sanitary restrictions on the mobilization of people and vehicles produced a contraband reduction for several crops mainly from Mexico, for example. Therefore, our findings need to be put in the context of an abnormal business environment that should serve as a warning on our end-market assessment. Consumers will need to learn again the market conditions after pandemic. Would consumers return to pre-pandemic taste and preferences? For now, what is safe to conclude is that Belize's end-market for vegetables saw what the world without contraband looks like, and it is up to consumers to tell us what consequences, if any, this has for their preferences and habits of consumption.

Managing expectations. It is well understood the length of time it takes for value chain approaches to become viable -if it doesn't break up 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 smallholders, their organizations, and development agencies, given rapidly globalizing markets for agricultural products where these enterprises meet with both new opportunities and increased competition. 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.

Weak organizational processes are the standard not the exception – Farmers' organizations have yet to consolidate their governance, management, and overall organizational structures. First-tier organizations may benefit of formal relations with their members specially with strong communication and coordination procedures for production and marketing. Systems for monitoring and evaluating performance are also needed. Finally, avoiding confusion on the division of responsibilities between the board of directors and community-based leaders or

administrators could improve the decision making and increase accountability. These and other barriers must be eliminated with appropriate business training.

Strengthening cooperatives. A common believe is that many cooperatives in Belize are born for the wrong reasons – mostly to take advantage of an opportunity brought up by a project. When the project disappears, so is the reason for gathering in the cooperative. This is currently reported and should be corrected with the 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.

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 require 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 12. Similarly, priority among value chains should also understand as a necessary step toward the efficient use of resources. To maximize the impact of the program, the hot 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

In general, an argument can be made the following list includes major challenges for achieving the best hot 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 sight as the new norm.** Covid-19 had everyone focusing on the short-sight of event, losing the potential of the studies to reflect long-sight strategies. For example, having no tourism made people ignore the opportunities that linking farmers to tourism supply chain represent on the long run. Similarly, many people that lost their jobs, move to micro farming– affecting the normal agricultural supply in many of the products studied. Of course, this is just a logical attitude under a crisis mood, but it could carry out 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 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 also return. 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** of official sources is a serious limitation for any VCMA analysis. When data of production, yields and acre-harvested do not match, it is possible that Belize´s agencies in charge of collecting the data will need to revisit the way that they are producing the data. 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 extensionist and technicians understood what 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

12.1 Annex 1. Marie Sharp's Fine Foods Limited fruit delivery systems and standards, fruit acceptance standards for Hot Pepper

Marie Sharps Fine Foods Ltd.
IFS FSQMS

Yellow Habanero Pepper Specifications

General Appearance Criteria	
Color	Brightly colored; Yellow
Visual	Fresh in appearance
Sensory	True to type
Shape	Have a typical habanero shape
Maturity	Yellow mature peppers
Size	

Pesticide Usage	• Provide peppers that have not been sprayed or treated with any harmful pesticides or any other chemical spray not certified by the Belize Pesticide Control Board or the supervising authorities and /or regulatory bodies. • Maintain a full record of the chemicals used, when they were used and their concentrations when used and make these records available to the Company upon request.

Harvesting	Peppers should not be harvested more than 24 hours prior to arrival at the receiving area.
Packaging & Transport	Provide peppers that have been transported in clean mesh bags which have adequate ventilation may be used. Clean Onion bags may be used. Transport the peppers in a vehicle that is clean and free from chemicals or any other possible contaminant.
Shelf Life	Yellow Habanero is acceptable for up to 7 days after receival if stored in the chill room. It is usually processed before 24 hours
Receival Conditions	Peppers must be yellow, fresh, bright, headless (no stalk), and free of rotten parts, leaves, twigs and other foreign material. ➢ Stem completely removed. ➢ Peppers should have no disease ➢ No chemical residue ➢ No insect bites or scaring. ➢ All peppers must be free of holes. ➢ Free of cracks or have any soft spot.

Consignment Criteria	
Tolerance per Consignment	10% by number or weight of peppers satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting, pronounced irregularities or any other deterioration rendering it unfit for consumption.

Document ID: 00934 SPC Yellow Habanero Pepper (Controlled Copy)
Revision Date: 02-Mar-2018 / Number: 00
Date Effective: 02-Mar-2018
Revised by: Quality Manager *Approved by: General Manager* 1

Marie Sharps Fine Foods Ltd.
IFS FSQMS

Red Habanero Pepper Specifications

General Appearance Criteria	
Color	Brightly colored; Red
Visual	Fresh in appearance
Sensory	True to type
Shape	Have a typical habanero shape
Maturity	Red mature peppers
Size	

Pesticide Usage	• Provide peppers that have not been sprayed or treated with any harmful pesticides or any other chemical spray not certified by the Belize Pesticide Control Board or the supervising authorities and /or regulatory bodies. • Maintain a full record of the chemicals used, when they were used and their concentrations when used and make these records available to the Company upon request.

Harvesting	Peppers should not be harvested more than 24 hours prior to arrival at the receiving area.
Packaging & Transport	Provide peppers that have been transported in clean mesh bags which have adequate ventilation may be used. Clean Onion bags may be used. Transport the peppers in a vehicle that is clean and free from chemicals or any other possible contaminant.
Shelf Life	Red Habanero is acceptable for up to 7 days after receival if stored in the chill room. It is usually processed before 24 hours
Receival Conditions	Peppers must be red, fresh, bright, headless (no stalk), and free of rotten parts, leaves, twigs and other foreign material. ➢ Stem completely removed. ➢ Peppers should have no disease ➢ No chemical residue ➢ No insect bites or scaring. ➢ All peppers must be free of holes. ➢ Free of cracks or have any soft spot.

Consignment Criteria	
Tolerance per Consignment	10% by number or weight of peppers satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting, pronounced irregularities or any other deterioration rendering it unfit for consumption.

Marie Sharps Fine Foods Ltd.
IFS FSQMS

Green Habanero Pepper Specifications

General Appearance Criteria	
Color	Brightly colored; Green
Visual	Fresh in appearance
Sensory	True to type
Shape	Have a typical habanero shape
Maturity	Green mature peppers
Size	

Pesticide Usage	• Provide peppers that have not been sprayed or treated with any harmful pesticides or any other chemical spray not certified by the Belize Pesticide Control Board or the supervising authorities and /or regulatory bodies. • Maintain a full record of the chemicals used, when they were used and their concentrations when used and make these records available to the Company upon request.

Harvesting	Peppers should not be harvested more than 24 hours prior to arrival at the receiving area.
Packaging & Transport	Provide peppers that have been transported in clean mesh bags which have adequate ventilation may be used. Clean Onion bags may be used. Transport the peppers in a vehicle that is clean and free from chemicals or any other possible contaminant.
Shelf Life	Green Habanero is acceptable for up to 7 days after receival if stored in the chill room. It is usually processed before 24 hours
Receival Conditions	Peppers must be green, fresh, bright, headless (no stalk), and free of rotten parts, leaves, twigs and other foreign material. ➢ Stem completely removed. ➢ Peppers should have no disease ➢ No chemical residue ➢ No insect bites or scaring. ➢ All peppers must be free of holes. ➢ Free of cracks or have any soft spot.

Consignment Criteria	
Tolerance per Consignment	10% by number or weight of peppers satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting, pronounced irregularities or any other deterioration rendering it unfit for consumption.

12.2 Annex 2. Cost of Production for Hot Pepper

Here are included three different estimates of cost of production for hot pepper. The first is the estimation of 1 acre of hot pepper when planted with 7,000 plants/acre using plastic mulch in Belize. Source for this is Anil Sinha and Joan Petersen (2011). Then, two more cost structures were facilitated by GARY RAMIREZ from MINISTRY OF AGRICULTURE (MAFSE) for year 2021.

APPENDIX 1 - Cost of production of 1 acre (0.4 ha) of hot pepper when planted with 7,000 plants/acre (17,290 plants/ha) using plastic mulch in Belize BZ$ 1.00 = EC$ 1.34 = US$ 0.49

	Unit	Quantity	Unit Cost EC$	Total Cost 1 acre (0.4ha)	Total (EC$)
1. Land preparation					
1.1 Ploughing	hr	1.5	$60.30	$90.45	
1.2 Harrowing and rotovating	hr	1	$53.60	$53.60	
1.3 Cambering	hr	1	$53.60	$53.60	
Sub-total					**$197.65**
2. Nursery management					
2.1 Materials					
2.1.1 Seedling trays – 50 holes (amortised) 50%	no	161	$4.53	$729.20	
2.1.2 Seeds	oz	1.75	$60.30	$105.53	
2.1.3 Germinating mix	Bale, 4 cu ft	4	$120.60	$482.40	
Sub-total					**$1,317.13**
2.2 Fertilisers and pesticides					
2.2.1 Polyfeed 12-43-12	lb	2	$3.66	$7.32	
2.2.2 Rotaprid 72 WG	pk	1.15	$40.20	$46.23	
Sub-total					**$53.55**
2.3 Labour cost					
2.3.1 Preparing mix and sowing seed	hr	9	$5.36	$48.24	
2.3.2 Irrigation (foliar, insect control, watering)	hr	42	$5.36	$225.12	
Sub-total					**$273.36**
3. Field management					
3.1 Fertilisers					
3.1.1 Manure	lb	3500	$0.20	$703.50	
3.1.1 14-36-12	lb	440	$0.91	$400.93	
3.1.2 18-18-18	lb	440	$0.84	$371.45	
3.1.3 Polyfeed Vegetative (12-43-12)	lb	32	$3.66	$117.06	
3.1.4 Polyfeed Flowering (19-19-19)	lb	42	$3.16	$132.82	
3.1.5 Polyfeed Fruiting (20-5-30)	lb	40	$3.78	$151.15	
3.1.6 K-Mag (0-0-22-11Mg-22S)	lb	440	$0.52	$229.94	
Sub-total					**$2,106.86**
3.2 Herbicides					
3.2.1 Lubaflua	L	0.5	$46.90	$23.45	
Sub-total					**$23.45**
3.3 Insecticides					
3.3.1 Indicate 5	L	1.25	$27.81	$34.76	
3.3.2 Adherent	L	1.25	$20.77	$25.96	

APPENDIX 1 - cont'd

3.3.3 Regent	L	0.45	$696.80	$313.56	
3.3.4 Pegasus	L	0.4	$273.36	$109.34	
3.3.5 Acaramik 1.8 EC	L	1.5	$268.00	$402.00	
3.3.6 Actara	g	340	$1.23	$419.15	
3.3.7 Rotaprid 70 WG	g	250	$0.78	$194.30	
Sub-total					**$1,499.07**
3.4 Fungicides					
3.4.1 Phyton	L	1.5	$167.50	$251.25	
3.4.2 Glider	L	3	$38.53	$115.58	
3.4.3 Diligent	g	1800	$0.07	$120.60	
3.4.4 Antracol	g	2250	$0.05	$120.60	
Sub-total					**$608.03**
3.5 Labour cost					
3.5.1 Transplanting and fertilisation (14-36-12)	hr	100	$5.36	$536.00	
3.5.2 Granular fertiliser application (18-18-18 + K-Mag)	hr	35	$5.36	$187.60	
3.5.3 Foliar fertilisation+insecticide +fungicide applications	hr	100	$5.36	$536.00	
3.5.4 Manual weeding	hr	10	$5.36	$53.60	
3.5.5 Herbicide applications	hr	30	$5.36	$160.80	
3.5.6 Irrigation system set up	hr	15	$5.36	$80.40	
3.5.7 Irrigation operations	hr	20	$5.36	$107.20	
3.5.8 Plastic mulch spreading	hr	10	$5.36	$53.60	
3.5.9 Harvesting	hr	500	$5.36	$2,680.00	
3.5.10 Fruit cleaning (pedicels debris, etc)	hr	20	$5.36	$107.20	
Sub-total					**$4,502.40**
4. Barrier crop (corn) 3 rows					
4.1 Corn seed (1600 plants)	lb	5	$1.34	$6.70	
4.2 Fertiliser 14-36-12	lb	200	$0.91	$182.24	
4.3 Insecticide (Sevin)	L	1	$53.60	$53.60	
4.4 Labour – planting	hr	6	$5.36	$32.16	
4.5 Labour – fertilising	hr	6	$5.36	$32.16	
Sub-total					**$306.86**
5. Materials and equipment					
5.1 Irrigation system				$4,020.00	
5.2 Knapsack sprayer (amortised)		4	$43.55	$174.20	
5.3 Harvesting crates (amortised)		30	$1.88	$56.28	
5.4 Sticky traps		33	$8.04	$265.32	

APPENDIX 1 - cont'd

5.5 Plastic sheeting for mulch	Rolls	3	$402.00	$1,206.00	
5.6 Nursery				$280.74	
Sub-total					**$6,002.54**
6. Transportation					
6.1 Fuel	gallon	60	$15.41	$924.60	
Sub-total					**$924.60**
TOTAL					**$17,815.49**
7. Contingency	%	15			**$2,672.32**
TOTAL COST OF PRODUCTION					**$20,487.81**

LINE ITEM	**UNIT**	**TOTALS**
Total production cost/0.4 ha (1 acre)	EC$	$20,487.81
Total marketable yield (TMY) /0.4 ha (1 acre)	kg	11,363.64
Cost of production/kg	EC$	1.80
Selling price (SP) (wholesale)/kg	EC$	2.95
Total revenue (SP*TMY)	EC$	33,500.01
Net profit (loss)		**$13,012.20**

HOT PEPPER COST OF PRODUCTION - 1 Acre (3630 plants) Fresh Fruit Spacing-4' x 4' (Irrigation Production System)

SOURCE: GARY RAMIREZ - MINISTRY OF AGRICULTURE (MAFSE)

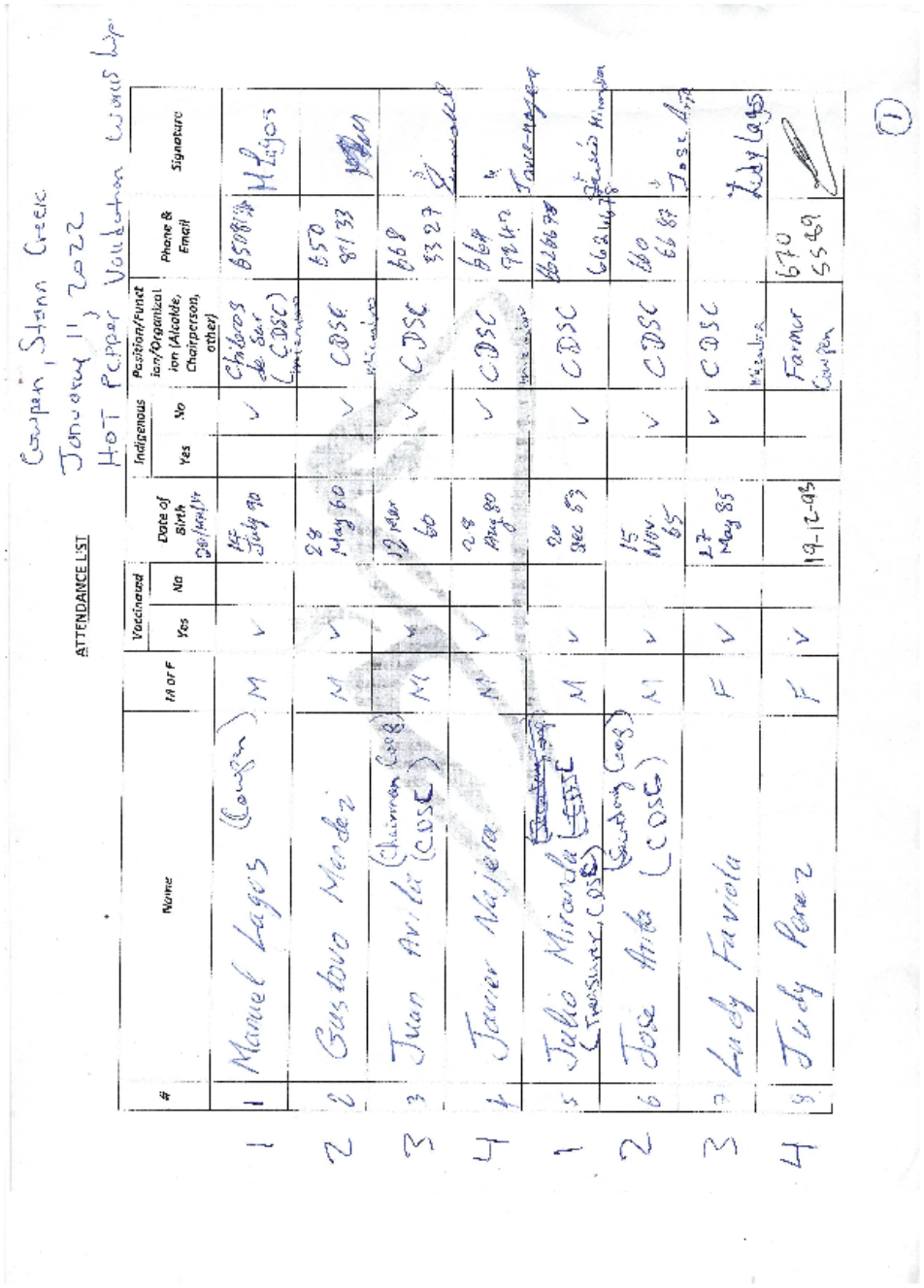
HOT PEPPER COST OF PRODUCTION - 1 Acre (3630 plants) Fresh Fruit Spacing-4' x 4' Irrigation Production System						
INPUTS AND MATERIALS	**Unit**	**Quantity**	**Unit Cost**	**Total cost 1 acre**	**TOTAL**	**Comments**
1. LAND PREPARATION						
Ploughing	hr	1.5	$ 45.00	$ 67.50		
Harrowing	hr	1	$ 40.00	$ 40.00		
Cambering	hr	1	$ 40.00	$ 40.00		
	TOTAL LAND PREPARATION			**$ 147.50**	**$ 147.50**	
2. NURSERY MANAGEMENT						
Materials						
Planting trays - 50 holes	tray	73	$ 2.92	$ 213.16		
Seeds	oz	1	$ 45.00	$ 45.00		
Germinating mix 5 Cu ft	bale	2	$ 110.00	$ 220.00	$ 478.16	
Fertilization and Insect Control						
Polyfeed 12-43-12 (2 kg)	lbs	3	$ 21.00	$ 14.32		3 application (1 lb/application)
Confidor 52 gr	pk	1	$ 56.20	$ 56.20	$ 70.52	1 application (13 g/4 gal H_2O)
Labour cost						
Preparing mix and sowing seeds	hr	3	$ 10.89	$ 32.67		3 persons Total hr: 3
Irrigation (foliar, insect control, water)	day	42	$ 1.82	$ 76.44	$ 109.11	1 person Total hr: 0.5
	TOTAL NURSERY EXPENSES			**$ 657.79**		
3. FIELD MANAGEMENT						
Fertilizers						
14-36-12 (50 KG)	lb	227	$ 64.00	$ 132.00		1 application (1 oz/plant)
18-18-18	lb	227	$ 66.00	$ 136.13		1 application (1 oz/plant)
Polyfeed vegetative (12-43-12) (25 kg)	lb	20	$ 173.75	$ 63.18		4 application (5lb/apl)
Polyfeed flowering (19-19-19) (25 kg)	lb	30	$ 114.00	$ 62.18		3 application (10 lb/apl)
Poly feed fruiting (20-5-30) (25 kg)	lb	28	$ 132.25	$ 67.33		4 application (7 lb/apl)
KMAG (25 kg)	lb	227	$ 118.25	$ 488.05	$ 948.87	1 application (1 oz/plant)
Herbicides						
Gramoxone	liter	2.43	$ 11.25	$ 27.34		3 application (0.81 liter/acre)or (6 cup bayer/4-5 gal water)
Fusilade(fluazifop--butyl)	liter	1.50	$ 12.50	$ 18.75	$ 46.09	3 application (0.5 liter/acre)(3-4 cup bayer for 4-5 gal water)
Insecticides						
Indicator 5	liter	1	$ 23.00	$ 23.00		1 Bayer cup in 16 liters of water
Adherent	liter	1	$ 24.89	$ 24.89		Sticker - 1 Bayer cup per knapsack
Regent-100 m1	liter	0.36	$ 55.37	$ 0.20		3 application (0.12 lt/acre)or (24 ml/4 galwater)
Pegasus - 1 liter	liter	0.32	$ 154.14	$ 49.32		2 application (0.16 lt/acre)
New Mectin	liter	1.22	$ 373.25	$ 455.37		2 application (0.61 lt/acre)
Actara-13 gr (rotated with confidor)	gram	324	$ 12.95	$ 322.75		2 application (162 gm/acre)
Confidor-52 gr	gram	200	$ 58.80	$ 226.15	$ 1,101.69	2 application (100 gm/acre)
Fungicides						
Phyton	liter	1.2	$ 125.65	$ 150.78		3 applicaton (0.4 lt/acre)
Knight 72 SC	liter	2.73	$ 37.25	$ 101.69		3 application (0.91lt/acre)
Ridomil - 750 gram	gram	1620	$ 55.00	$ 118.80		2 application (0.81kg/acre)
Antracol-750 gram	gram	1830	$ 28.17	$ 68.73	$ 440.01	3 application (0.61 kg/acre)
Labour Cost						
Transplanting and Fertilization (14-36-12)	hr	48	$ 3.63	$ 174.24		6 person
Granular Fertilization (18-18-18 & KMAG)	hr	22	$ 3.63	$ 79.86		2 person
Foliar Fertilization+Insect+Fungicide ($3.63/hr)	day	11	$ 21.78	$ 239.58		2 person - Total hrs:3
Weed control- manual	hr	47	$ 3.63	$ 170.61		2 person
Weed control - chemical ($3.63/hr)	day	3	$ 36.30	$ 108.90		2 person - Total hrs:5
Irrigation set up	day	1	$ 25.00	$ 75.00		3 person
Harvesting (12 days)	hr	357	$ 3.63	$ 1,295.91	$ 2,144.10	6 person
	TOTAL FIELD MANAGEMENT			**$ 4,680.75**		
4. Corn Barrier (3 row)						
Corn seed (1600 plants)	lb	5	$ 1.00	$ 5.00		
Lannate	lt	1	$ 40.00	$ 40.00		1 application (1 lt/acre)
Fertilizer 18-18-18	lb	200	$ 66.00	$ 120.00		2 application (1 oz per plant)
Labour-Planting	day	1	$ 25.00	$ 25.00		1 person
Labour -Fertilizing	day	2	$ 25.00	$ 50.00	$ 240.00	1 appliction at planting; 2nd at green height
	TOTAL CORN BARRIER			**$ 240.00**		
5. MATERIALS AND EQUIPMENTS						
Irrigation				$ 2,791.50		
Knap snack sprayers (amortized)	only	4	$ 32.50	$ 130.00		
Harvesting Crates (amortized)	only	10	$ 1.40	$ 14.00		
Sticky traps	only	33	$ 6.00	$ 198.00		
Nursery				$ 209.51		
	TOTAL CAPITAL COST			**$ 3,343.01**	**$ 3,343.01**	
5. TRANSPORTATION						
Fuel (20 miles/gallon)(6 gal/R trip) Total:12	gallon	72	$ 8.50	$ 612.00	$ 612.00	Estimated
	GRAND TOTAL			**$ 9,069.04**	**$ 9,069.04**	
6. Contingency	**%**	**15**		**$ 1,360.36**		
	TOTAL COST OF PRODUCTION			**$ 10,429.40**		

HOT PEPPER COST OF PRODUCTION - 1 Acre (4840 plants) Procees Pepper Spacing -3'x 4'

SOURCE: GARY RAMIREZ - MINISTRY OF AGRICULTURE (MAFSE)

HOT PEPPER COST OF PRODUCTION - 1 Acre (4840 plants) Procees Pepper Spacing -3'x 4'						
INPUTS AND MATERIALS	**Unit**	**Quantity**	**Unit Cost**	**Total cost 1 acre**	**TOTAL**	**Comments**
1. LAND PREPARATION						
Ploughing	hr	1.5	$ 45.00	$ 67.50		
Harrowing	hr	1	$ 40.00	$ 40.00		
Cambering	hr	1	$ 40.00	$ 40.00		
	TOTAL LAND PREPARATION			**$ 147.50**	**$ 147.50**	
2. NURSERY MANAGEMENT						
Materials						
Planting trays - 50 holes	tray	97	$ 2.92	$ 283.24		
Seeds	oz	1.5	$ 40.00	$ 60.00		
Germinating mix 5 Cu ft	bale	3	$ 110.00	$ 330.00	**$ 673.24**	
Fertilization and Insect Control						
Polyfeed 12-43-12 (2 kg)	lb	4	$ 21.00	$ 19.09		3 application (1 lb/apl)
Confidor 52 gr	pk	1	$ 56.20	$ 56.20	**$ 75.29**	1 application (13g/4 gal H_2O)
Labour cost						
Preparing mix and sowing seeds	hr	3	$ 14.52	$ 43.56		4 persons Total hr: 3
Irrigation (foliar, insect control, water)	day	42	$ 2.72	$ 114.24	**$ 157.80**	1 person Total hr: 0.75
	TOTAL NURSERY EXPENSES			**$ 906.33**		
3. FIELD MANAGEMENT						
Fertilizers						
14-36-12 (50 KG)	lb	303	$ 64.00	$ 176.00		1 application (1 oz/plant)
18-18-18	lb	303	$ 66.00	$ 181.50		1 application (1 oz/plant)
Polyfeed vegetative (12-43-12) (25 kg)	lb	28	$ 173.75	$ 88.45		4 application (7lb/apl)
Polyfeed flowering (19-19-19) (25 kg)	lb	39	$ 114.00	$ 80.84		3 application (13 lb/apl)
Poly feed fruiting (20-5-30) (25 kg)	lb	36	$ 132.25	$ 86.56		4 application (9 lb/apl)
KMAG (25 kg)	lb	303	$ 118.25	$ 651.45	**$ 1,264.80**	1 application (1 oz/plant)
Herbicides						
Gramoxone	liter	2.43	$ 11.25	$ 27.34		3 application (0.81 liter/acre)or (6 cup bayer/4-5 gal water)
Fusilade(fluazifop--butyl)	liter	1.50	$ 12.50	$ 18.75	**$ 46.09**	3 application (0.5 liter/acre)(3-4 cup bayer for 4-5 gal water)
Insecticides						
Indicator 5	liter	1	$ 23.00	$ 23.00		1 Bayer cup in 16 liters water
Adherent	liter	1	$ 24.89	$ 24.89		Sticker - 1 Bayer cup per knapsack
Regent-100 m1	liter	0.36	$ 55.37	$ 0.20		3 application (0.12 lt/acre)or (24 ml/4 galwater)
Pegasus - 1 liter	liter	0.32	$ 154.14	$ 49.32		2 application (0.16 lt/acre)
New Mectin	liter	1.22	$ 373.25	$ 455.37		2 application (0.61 lt/acre)
Actara-13 gr (rotated with confidor)	gram	324	$ 12.95	$ 322.75		2 application (162 gm/acre)
Confidor-52 gr	gram	200	$ 58.80	$ 226.15	**$ 1,101.69**	2 application (100 gm/acre)
Fungicides						
Phyton	liter	1.2	$ 125.65	$ 150.78		3 applicaton (0.4 lt/acre)
Knight 72 SC	liter	2.73	$ 37.25	$ 101.69		3 application (0.91lt/acre)
Ridomil - 750 gram	gram	1620	$ 55.00	$ 118.80		2 application (0.81kg/acre)
Antracol-750 gram	gram	1830	$ 28.17	$ 68.73	**$ 440.01**	3 application (0.61 kg/acre)
Labour Cost						
Transplanting and Fertilization (14-36-12)	hr	80	$ 3.63	$ 290.40		6 person
Granular Fertilization (18-18-18 & KMAG)	hr	29	$ 3.63	$ 106.48		2 person
Foliar Fertilization+Insect+Fungicide ($3.63/hr)	day	11	$ 32.67	$ 359.37		3 person - Total hrs:3
Weed control- manual	hr	63	$ 3.63	$ 227.48		2 person
Weed control - chemical ($3.63/hr)	day	3	$ 50.82	$ 152.46		2 person - Total hrs:7
Irrigation set up	day	1.5	$ 25.00	$ 112.50		3 person
Harvesting (15 days)	hr	476	$ 3.63	$ 1,727.88		6 person
Fruit cleaning (peduncle,debris etc)	day	15	$ 3.63	$ 108.90		2 person
	TOTAL FIELD MANAGEMENT			**$ 5,938.06**	**$ 3,085.47**	
4. Corn Barrier (3 row)						
Corn seed (1600 plants)	lb	5	$ 1.00	$ 5.00		
Lannate	lt	1	$ 40.00	$ 40.00		1 application (1 lt/acre)
Fertilizer 18-18-18	lb	200	$ 66.00	$ 120.00		2 application (1 oz per plant)
Labour-Planting	day	1	$ 25.00	$ 25.00		1 person
Labour -Fertilizing	day	2	$ 25.00	$ 50.00	$ 240.00	1 appliction at planting; 2nd at green height
	TOTAL CORN BARRIER			**$ 240.00**		
5. MATERIALS AND EQUIPMENTS						
Irrigation				$ 2,791.50		
Knap snack sprayers (amortized)	only	4	$ 32.50	$ 130.00		
Harvesting Crates (amortized)	only	10	$ 1.40	$ 14.00		
Sticky traps	only	33	$ 6.00	$ 198.00		
Nursery				$ 209.51		
	TOTAL CAPITAL COST			**$ 3,343.01**	**$ 3,343.01**	
5. TRANSPORTATION						
Fuel (20 miles/gallon)(6 gal/R trip) Total:15	gallon	90	$ 8.50	$ 765.00	**$ 765.00**	**Estimated**
	GRAND TOTAL			**$ 10,574.89**	**$ 10,574.89**	
6. Contingency	**%**	**15**		**$ 1,586.23**		
	TOTAL COST OF PRODUCTION			**$ 12,161.13**		

12.3 Annex 3. List of participants in the workshop of validation for the value chain



Cowpen, Stann Creek
January 11, 2022
Hot Pepper Validation Workshop.

ATTENDANCE LIST

#	Name	M or F	Vaccinated		Date of Birth DD/MM/YY	Indigenous		Position/Function/Organization (Alcalde, Chairperson, other)	Phone & Email	Signature
			Yes	No		Yes	No			
9.	Victor Castillo (DFC)	M	✓		18.07.71	✓		Sr. Credit officer DFC	630-5624 victor.castillo@dfcbelize.org	
10	Jorge Manzanero Sr.	M	✓		30.08.69		✓	Processor Marie Sharp fine foods	606-8745	
11.	Fernando Majil	M	✓		30.05.68		✓	Consultor	fernando majil@gmail.com	
12.	Elvis Chi	M	✓		07.10.83		✓	RRB	670 9490	
13.	Nerie Sanz	F	✓		3.10.68		✓	RRB	674 4866	
14.	Carlos Quintaniya	M	✓				✓	CDSC Miembro		Carlos Quintaniya
15.	Heidy Cob (Extension officer MOAgric. Cowpen Area, Hot Peppers)	F	✓		7/12/92		✓	MOA Gob	631-0228	
16.	Edwardo Leiva (Cooperative officer SCD)	M	✓		29/3/71		✓	Coops Gob.	6830279	
17.	Emir Majil	M	✓		1/3/97		✓	Assistente del Consultor	6365605	

(2)

Cowpen, Stann Creek
January 11, 2022
Hot Pepper Validation work shop.

ATTENDANCE LIST

	#	Name	M or F	Vaccinated		Date of Birth DD/MM/Yr	Indigenous		Position/Function/Organization (Alcalde, Chairperson, other)	Phone & Email	Signature
				Yes	No		Yes	No			
1	18	Carlos Hernandez	M	✓		09/10/97		✓	other (BECAGRO)	621-8477 695-9765	
2	19	EDGAR Tuyuc	M	✓		01/11/80			MAF Lab	670 7816	
3	20	Pedro Caravantes	M	✓		28/11/62		✓	C DSC miembro	66159 20	PC