Value Chain market Assessment

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

Product 3.4 Value Chain and Market Assessment of Tomato Production in Belize

May 2022

VALUE CHAIN AND MARKET ASSESSMENT OF TOMATO PRODUCTION IN BELIZE

Conduct of Value Chain and Market Assessments for Resilient Rural Belize

Contract Number: CO002/14/2020/2021

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List of Acronyms and Abbreviations

BAHA	Belize Agricultural Health Authority
BBS	Belize Bureau of Standards
CATIE	Tropical Agriculture Research and Higher Education Center
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
CVA	Climate Vulnerability Assessment
GCF	Green Climate Fund

Executive Summary

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

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

This study focuses on the structure and function of the tomato 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 tomato.

The tomato market in Belize is estimated at approximately 2,910,663 pounds valued at BZ $5,745,297.28 (based on 2020 data). The value chain is considered "rudimentary" given that the product is sold as fresh fruit and no processing is involved and no integration between actors exist. The main consumers of tomatoes in Belize are households, restaurants, hotels, and fast-food establishments.

Tomato is grown in all the districts of the country. The Belize District is the leading producer of tomato followed closely by the Cayo District. Main producers of tomato are part of a cooperative.

The Belize and Cayo Districts produce tomato in the open field. Imported tomatoes account for only 0.55% of total consumption.

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

The strengthening of the Tomato Value Chain requires strengthening of the cooperatives which are the main producers of tomato. 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 other activities. Important also, farmers need the knowledge to manage their farm as a business. During the study, it was observed that most farmers do not have records of cost of production or knowledge if they are operating at a profit or loss.

1. Introduction

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

Agriculture is extremely important to Belize's development, providing employment, foreign exchange earnings and is key to food security. Approximately, 172,000 hectares or 7.48 percent of Belize's total land area is suitable for agricultural use. An estimated 122,000 hectares or 5.31% of Belize's total land area is cultivated land (FAOSTAT, 2019). The agricultural sector employs an estimated 12.24% of the total population of Belize and an estimated 5.2% are females (FAOSTAT 2019). Primary industries in Belize include Sugar, Banana and Citrus Products which are normally the highest agricultural income earners. In 2020, the highest contributors to the economic output in agriculture in Belize was the non-traditional sector with grains and legumes being the highest contributor (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 tuber and vegetables category based on economic value were onion, potato, carrot, and sweet pepper ranking from first to fourth places, respectively (MAFSE, 2020). The Belize District is the leading producer of tomato followed by the Cayo and Corozal Districts, respectively. Despite this, there is no previous study recorded on the value chain analysis and market assessment of tomato. 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 tomato in Belize and by extension improving the social and economic situation of small-scale local farmers and improving food security in Belize.

This Value Chain Analysis and Market Assessment (VCMA) for tomato (Solanum lycopersicum) 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), 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 Belize District which encompasses Nago Bank, Maskall, Lucky Strike, Bomba and Rock Stone Pond. The objectives of this VCMA are to (i) map and describe the tomato value chain including the role and relationships between the different actors (producers, transporters, packers, processors, traders, retailers, and consumers) in the value chain; (ii) market potential; (iii) identify challenges and opportunities for the tomato value chain; and (iii) identify and recommend adequate policy interventions based on findings to strengthen the tomato value chain in Belize.

2. Methodology

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

2.1 Description of the Study Area

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

Table 1. Population of the Target Villages in the Belize District, 2020

Target Area Population and Number of Households, 2010				
Target Area	Total	Males	Females	No. of HH
Maskall	803	418	385	216
Rock Stone Pond	154	85	69	39
Lucky Strike	244	126	118	60
Nago Bank	135	81	54	45
Bomba	80	48	32	25

Source: SIB (2020)

2.2 Data Collection

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

Collection of secondary data through desk research

There is no pre-existing value chain analysis for tomato in the Belize District or in the country. Raw data and information about supplies, production, transformation, and marketing were accessed from various government departments such as the Ministry of Agriculture, Food Security and Enterprises (MAFSE), the Belize Agricultural Health Authority (BAHA), the Statistical Institute of Belize (SIB), Belize Bureau of Standards (BBS), Resilient Rural Belize (RRB) Project personnel and the online portal of the Food and Agricultural Organization (FAOSTAT). Research and studies published on vegetable production within the last five years in other countries were

targeted in order to identify innovations and technologies that could strengthen the tomato value chain in Belize. The market trends of tomato and cultivation of tomato across Belize, quality standards, restrictions on the production and/or the marketing of the products were also sought. The main actors in the value chain and relationships between the actors were also identified. The output of the desk research was an initial value chain map.

Collection of Data through Primary Research

Major players in and outside the value chain were identified based on the preliminary value chain map developed from findings from the desk research. Personal interviews were carried out but 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 various 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 tomato is grown, processed, and marketed, labour requirements, sources of supply 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 with people that could not accommodate a personal interview. The two intermediaries that collect the tomato at Maskall Village were interviewed; one distributes the produce to the market in Belize City and the other distributes to the Orange Walk Town market. The produce is collected every Thursday morning. A major restaurant in Belize City was also contacted and they provided information as to how they procure tomatoes, the amount they consume, and price purchased.

c) Electronic Interviews: Electronic interviews were done with people that could not accommodate a personal interview. Three of the major Agrochemical suppliers were contacted by email and they provided information about seed varieties, origins, and costs. These Agrochemical suppliers requested that their information remain confidential.

Limitations of the Study

While farmers were willing to cooperate in the study, in general none had records of their production costs and yields. So, they could not tell if they operated at a profit or loss. Hence this study must depend mainly on the national statistics provided by the Ministry of Agriculture and the Statistical Institute of Belize.

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 Maskall Village with actors from different levels of the value chain. These actors included input suppliers, producers, intermediaries and technical officers from the government departments and NGO's. Given that tomato and sweet pepper–are produced and marketed simultaneously by the farmers in the study area, the Value Chain Map and the workshop objectives are the same, as well as the problems identified. The statistic of production is what will differ in this study.

The Objectives of the workshop were:

- Present the results of the Value Chain and Market Analysis for Tomato 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. Tomato VCMA double entry matrix with priorities derived by workshop participants

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

The VCMA workshop consisted of the presentation of the tomato 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 tomato VCMA was conducted using historical data collected by the Ministry of Agriculture and from information gathered from farmers, input suppliers and other

focus groups. Participants were invited to validate the findings and the VC map as presented by the consultants through a group activity which allowed them to identify and prioritize needs that will help to improve or strengthen the value chain.

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 major challenges/problems were identified and prioritized. Training and technical assistance is of utmost priority while marketing and road infrastructure follow and finances and access to improved seeds was of least importance. Finally, input purchase problem was not prioritized by participants.

2.3 Finalization of the Report

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

2.4 Value Chain and Climate Vulnerability Assessment Synchronization

The validation workshop of the VCMA was carried out together with the CVA, with the idea to catch any comment or question about changes of climate that members of the value-chain of Tomato may have. During the CVA workshop in terms of climate change most farmers expressed major concern on unexpected draughts during periods of the year. Their concern comes from their perception that draughts have affected the fruit size and intense sunlight causes fruit burn. Farmers expressed interest in learning about irrigation which they believe will contribute to better production throughout the year. Also, of concern are unexpected draughts during periods of the year. These have affected their crops. Most farmers have hand dug wells which are shallow and during these dry spells, the water level reduces and become saline, so even though they have irrigation systems the water is not enough and of good quality to properly irrigate the crops. Although there are few incidences of floods in the area, the farmers did not rank flooding as a major concern.

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 Tomato Value Chain in Belize

Tomato is produced in all the districts in Belize with the Belize District being the largest producer as seen in Figure 1, followed by the Cayo and the Corozal Districts (MAFSE, 2021). In both the Belize and Cayo Districts, tomato production has been on a fluctuating downward trend since 2018. During interviews, farmers attributed the downfall in production to sporadic droughts and pest problems. It was also disclosed that farmers are collecting seeds from their existing crop to curtail on the cost of seeds which they suggest is very expensive. The suppliers currently provide hybrid varieties therefore collecting these for seeds could potentially contribute to a decrease in production and pest problems, citing de-hybridization issues. In August and September of that same year two tropical storms skirted the country coastline with heavy rainfall and caused floods in the Maskall area and many tomato fields were damaged.

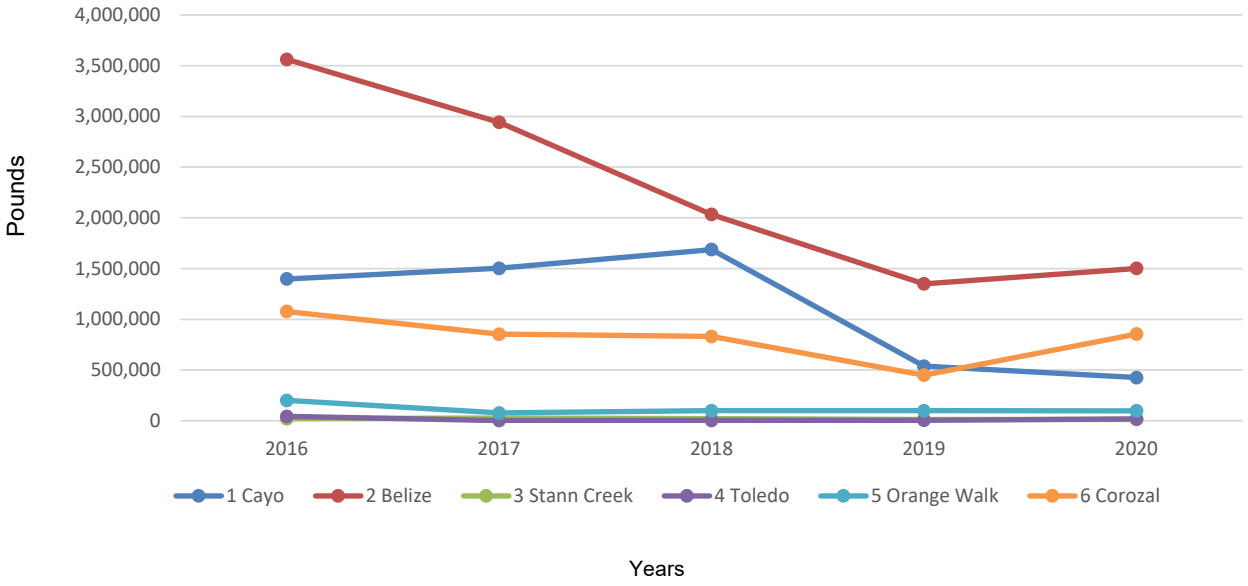

Figure 1. Total Annual Production of Tomato in Belize from 2016 to 2020

3.1 Tomato Production in Belize

In figure 2, the year 2019 shows the lowest production of 2.45 million pounds of tomato, while year 2020 shows the downward trend stopped even though it is a year where the effects of the pandemic should already be reflected in the data. The government decided to close all border entries, maritime ports and the airport. Immediately the tourism industry was affected, tourist resorts, major restaurants and supermarkets were also closed. This affected the consumption of many local produce including tomatoes. Households became the major consumers of tomatoes. In 2020 a slight increase of production is recorded at 2.91 million pounds, this can be attributed

when the airport was opened for tourism and certain tourist resorts, major restaurants and supermarkets were allowed to operate.

The current estimated average yield per acre for tomato is 20,000 pounds/acre, information from the Belize District Ministry of Agriculture department says that the estimated yield per acre should be 40,000 pounds/acre. Obviously, there is much room to improve the production efficiency.

Tomato production in Belize is exclusively for the domestic market, targeting households and the tourism industry, primarily the food suppliers in local restaurants and hotels in the country. Farmers or farmer groups sell majority of their produce in bulk directly to an intermediary supplier (Collector) who resells/distribute 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.

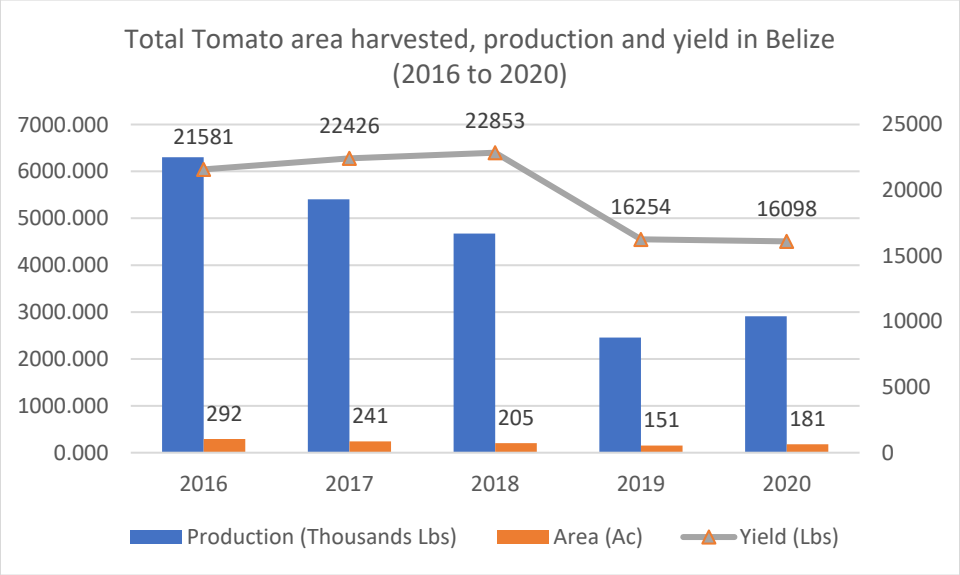

Figure 2. Total Tomato area harvested, production and yield in Belize (2016 to 2020)

There are two production cycles of Tomatoes in the country for farmers growing in the open field and with irrigation systems. The first production cycle is from January to June and the second is from July/August to December. This is especially practiced by farmers in the Belize District who supplies the largest amount of tomato to the country. Farmers in open fields depending on rainfall have one production cycle which runs from November to February (MOA, 2007). Over the years, the MOA has been urging farmers to produce tomato under covered structures to increase yield and reduce losses caused by heavy rainfalls and high pest pressure.

3.2 Tomato Demand in Belize

Data from the Belize Agricultural Health Authority (BAHA) shows that there has been a constant importation of Tomato from the USA and Trinidad and Tobago, between 2016 - 2020 a total of 30,420 pounds of tomato was imported. In Belize between 2016 and 2020 a total of 21,746,881 pounds of tomato was produced. Figure 3 shows the yearly production plus importation and total consumption of tomatoes in Belize for the past 5 years. The estimated weekly consumption of tomatoes in Belize is 73,800 pounds per week. Importation of tomato into Belize seems to be relatively small in comparison to what is produced locally. During the validation workshop, farmers expressed concerns on the amount of tomato coming into the country illegally from Mexico. They further expressed that 2020 saw significant reduction of illegal tomato into Belize given the current Covid 19 pandemic and the closure of the border with Mexico. Information from BAHA states that there was no confiscation of illegal tomatoes between 2016 to 2020 (BAHA, 2021).

One of the main reasons for decreased production in tomato is that in the Belize District, the major producer of tomatoes, farmers reuse seeds collected which has resulted in de-hybridization and consequently, decreased production. Secondly, a flood in late 2018 contributed to exacerbating the already decreasing production of tomatoes.

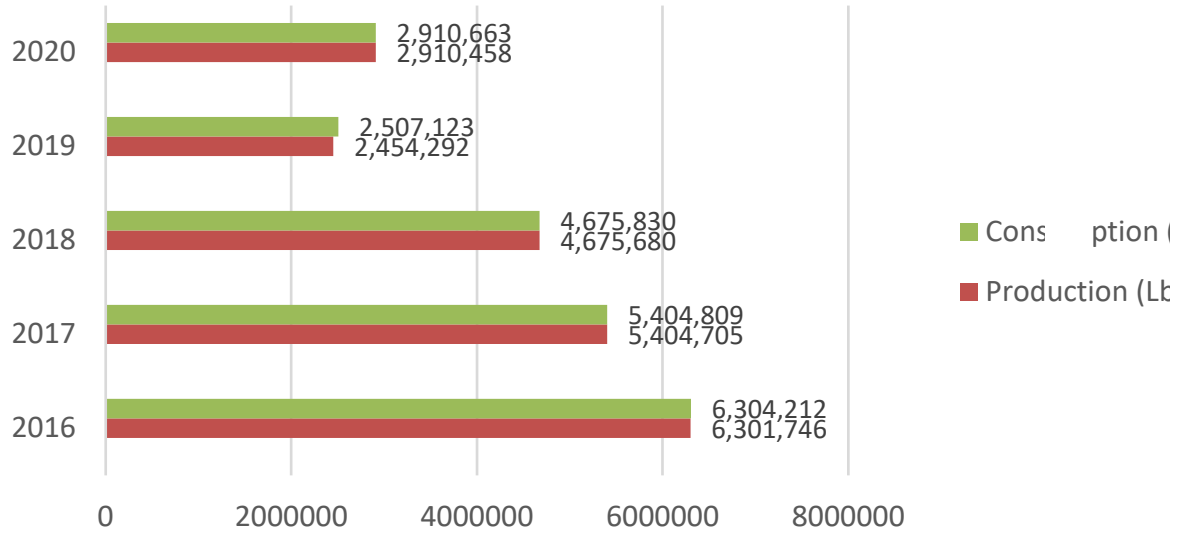

Figure 3. Annual Tomato Local Production (pounds) and consumption in Belize.

3.3 Quality Standards of Tomato Production in Belize

The Belize Bureau of Standards is tasked with developing, establishing, harmonizing, and promoting the use of relevant quality standards for key economic sectors/national development. By extension, developing standards for the agricultural sector pertinent to the 8-value chains identified under the IFAD RRB Programme is an opportunity to revise and introduce standards for the agricultural sector.

To date, there are no established national standards for tomato 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 tomato value chain.

Notwithstanding the absence of national standards for tomato, the CARICOM Regional Standard Specification for Grades of Fresh Agricultural Produce for Tomatoes (CRS 24: Part 10: 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 tomatoes of commercial varieties 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) Commercial classification namely round, ribbed, elongated and cherry tomatoes.
c) Firm, sound, clean, fresh, and mature.
d) Free from pests and diseases, damage caused by pests, abnormal external moisture, foreign smell, blemishes, cuts or broken skin, and taste.
e) Grade classification across three classes I, II and III primarily in relation to uniformity in colour and sizes.
f) Size classification ranges codes 1 to 8.
g) Colour classification.
h) Tolerance levels across size, colour, and grade classifications.
i) Packaging and labelling.
j) Contaminants in relation to heavy metals and pesticide residues; and

[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.

k) Hygiene and sanitation requirements.

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

4. Value Chain Mapping

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

4.1 Value Chain Map

National production of tomatoes competes with the supply provided by importers in Belize. The following map was validated in several meeting and a general workshop with producers and other actors of the supply chain.

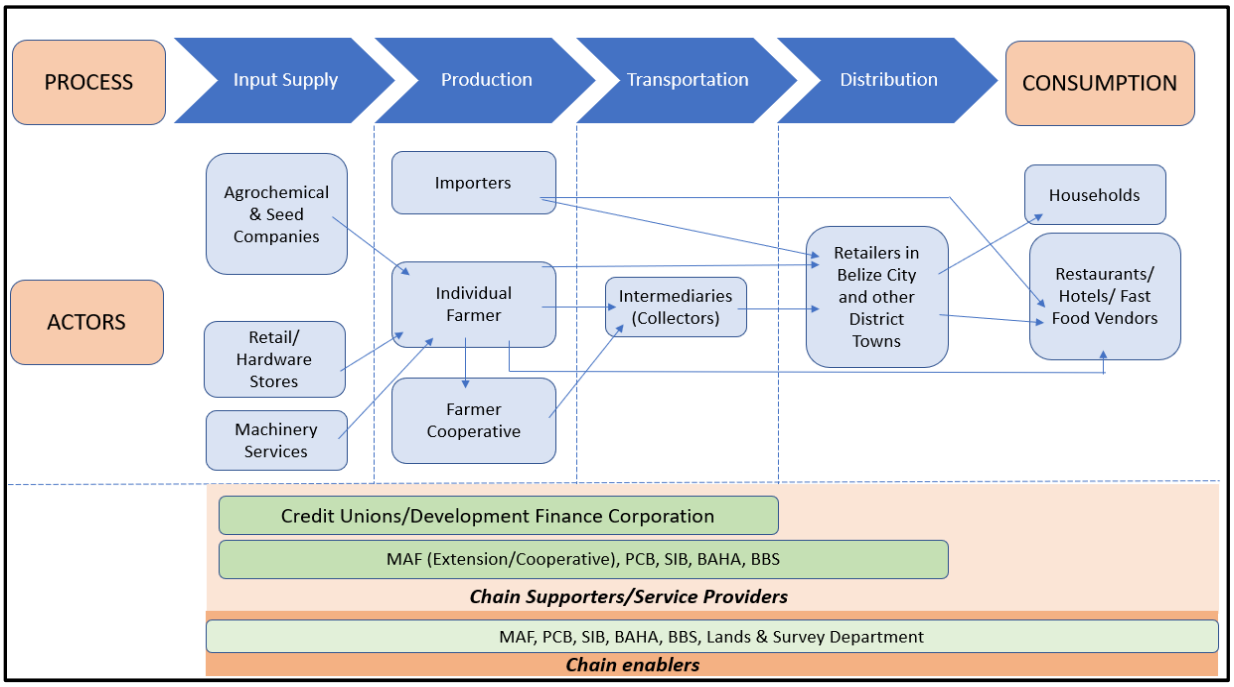

Figure 4. Value Chain Map for Tomato in Belize

4.2 Description of the Tomato 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 and seed suppliers in the Cayo and Belize Districts that dominate in the tomato value chain are Prosser Fertilizer and Agrotec Company Ltd., Agro-Vet Jiron & Sons, Brodies Ltd., Midwest Steel and The Seed Agent and Agro Supplies (Figure 5).

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

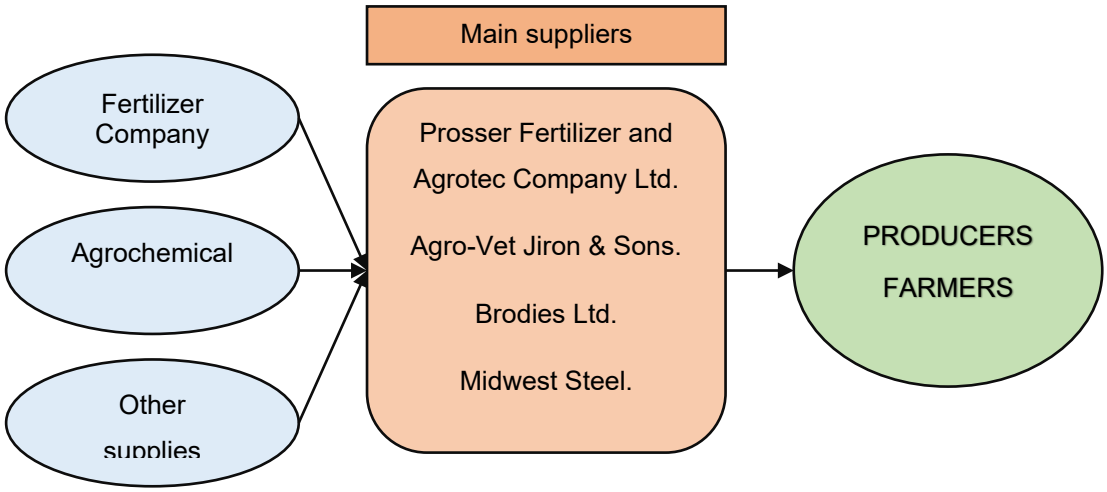

Figure 5. Value Chain Map for Tomato in Belize

Producers/Farmers

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

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

For many of these farmers, profit obtained from tomato production is not their only income source as many of them do other vegetables such as sweep peppers, melons, and others. In the Nago Bank Cooperative, some farmers plant an average of 5000 plants in the first cycle only and some wait for the second cycle, this is to prevent over production of Tomato by the cooperative. Many of the farmers use their family labour, especially women for harvesting but also use hired labour at the peak of production.

In this stage, the fundamental activity of the value chain is developed, and it is where the highest levels of risk are concentrated, because the success or failure of production and the generation of income for the producer depends on this phase. Tomato small, medium, and large-scale producers cultivate 1, 2.5, and 5 acres respectively. Mainly, farmer cultivates in open field, which limits their ability to obtain stable yields in terms of volume and quality and makes them more vulnerable to weather conditions. Tomato production is carried out under irrigation and for the local markets.

The participation of women in this stage can be distinguished into two categories: 1) The individual producers: they produce tomato in a family way and participate in the activities of soil preparation, planting, crop management and harvesting. The level of empowerment is low, and although they support the generation of family income, they mostly do not participate in decision-making regarding production. 2) The associated producers in cooperatives, who have a higher level of empowerment and have decision-making power over the benefits of production. In this case they also have access to information, credit, and technical assistance. However, the knowledge gap between men and women vegetable producers continues. Most of the women have general agricultural knowledge, so the men oversee buying supplies and distribution channels.

Importers

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

Data requested from BAHA on the illegal importation/confiscation of Tomatos is negligible or non-existent. No confiscations have been documented between 2016 to 2020 (BAHA, 2021).

At the country level, in Figure 6, the import trend in thousands of dollars of tomato from United States and Mexico is observed since 2010, imports from the Mexico not done since 2013. United States continued to send tomato each year in smaller quantities. exporting to Belize in 2019 only one ton of fresh tomato (Table 3).

However, farmers in the Belize District argue that the national figure is not a true picture and does not reflect the actual amount brought in illegally from Mexico.

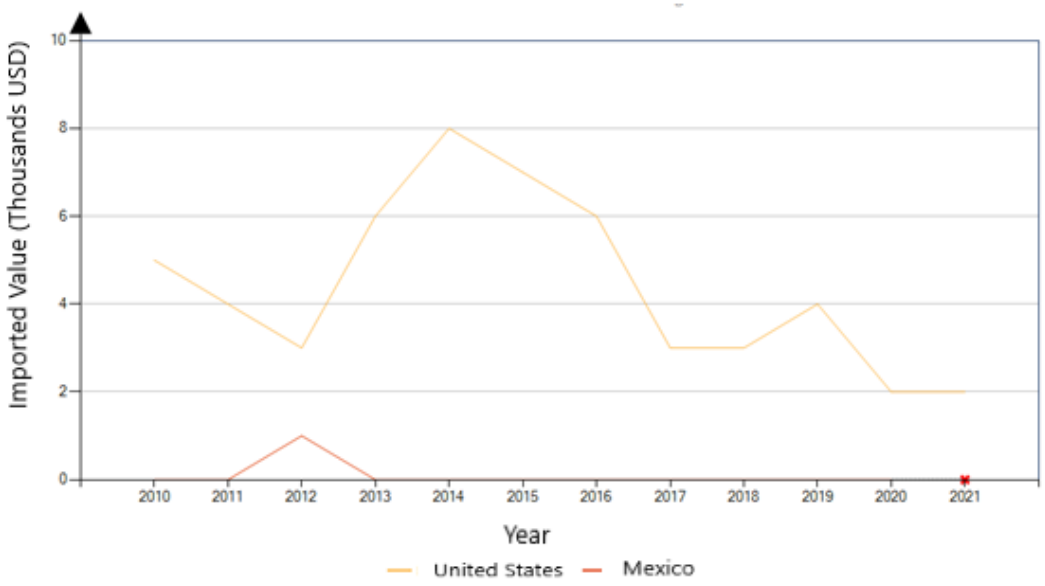

Figure 6. Import trend of tomato – Belize (2010-2021)

Table 3. Importation of Tomato (ton) into Belize years 2010 to 2021

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)	QI (ton)
United States	1	3	3	5	5	2	2	1	1	1	0	0
México		1	1									
World Total	1	4	4	5	5	2	2	1	1	1	0	0

Intermediaries (Collectors)

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

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

Tomato distribution is different from other agricultural products, due to its life cycle and fragility, which requires reaching the final market quickly and carefully. Therefore, this stage is extremely important to guarantee the provision of the product in good conditions to the consumer.

Processor

There are no processors that use local tomato in the transformation of products such as tomato sauce or ketchup. Verena Foods has said, in the past, that it could transform the domestic tomato into tomato paste which is what they were importing to supply about 10% of Belize's market. However, this company stops operations during Covid pandemic. Belize imports most of its processed tomato-based products from the United States, Mexico and Guatemala.

There is a high potential for tomato processing in sauces, preserves or other value-added products. This lack of processing limits reaching new consumer markets and is a barrier to developing greater economic benefits and generating new jobs.

Retailers

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

Consumers

The most significant users of tomatoes are household users. Other main users include the tourist resorts, restaurants, hotel restaurants and fast-food establishments. Consumers are familiar with imported tomato-base products like tomato sauces and ketchup.

In the case of tomato, consumers make the purchase decision based on the following characteristics that identify the quality of the product (Figure 7).

Figure 7. Characteristics that identify tomato quality

4.3 Profit Margins and Share Benefits along the value chain

Cost of production and prices across the value chain were obtained by interviews with key persons in the cooperatives from 7 Miles Village in the Cayo District and Nago Bank Village in the Belize District. Table 4 shows an analysis of the profit margins and share benefits along the value chain.

Table 4. Profit Margins and Share Benefits along the value chain

Description	Actors			
	Farmers	Collectors	Retailers	Horizontal Sum
Purchase Price (Bz$)	0.00	2.10	2.60	4.70
Total Input Cost (Bz$)	0.60	0.16	0.07	0.83
Sale Price (Bz$)	2.10	2.60	3.00	7.70
Market Margin (Bz$)	2.10	0.50	0.40	3.00
% share of margin	70.0	16.7	13.3	100.0
Profit Margin (Bz$)	1.50	2.44	2.93	6.87
% of share of profit	21.8	35.5	42.7	100.0

The data shows that for the farmer the cost of inputs is the highest. In Belize, agrochemicals and seeds are costly and are very important inputs for farming. The second is the collector and is very likely due to transportation of the product given that fuel prices are high here in Belize compared to other countries in the region. Together, the collectors and retailers take 78.2% out of the total profit margin. The retailer's profit margin constitutes the highest share (42.7%) followed by the collector (35.5%). The farmer share profit in this analysis is 21.8% (Figure 8).

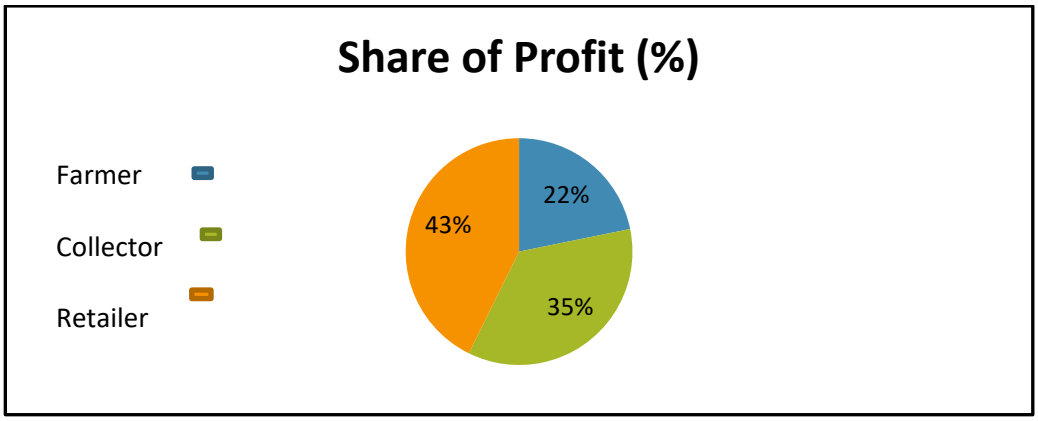

Figure 8. Share of profit of actors for Tomato value chain in Belize

5. Role of women in Belizean agriculture

It is worth noting the relevance of the role of rural women in the development of agricultural activities, depending on the type of crop and the production phase. In the case of vegetables, such as tomatoes, not only planting is a predominantly a female activity, but they are also involved in all phases of crop production. This activity is normally added to the daily activities at home that women must carry out.

The Convention on the Elimination of all forms of discrimination against women (CEDAW), highlights the important role those rural women play in the economy and family food security. For their part, the Development Goals (SDGs) promote a multidimensional perspective of development and the implementation of Article 14 of CEDAW, to change the approach to addressing gender inequality. This new approach replaces work based on women's vulnerabilities with work based on their contributions to social, economic, and environmental development, considering them as a fundamental piece in the resilience of communities in the face of current crises.

Under the concept that employment is “persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The agriculture sector consists of activities in agriculture, hunting, forestry, and fishing (Index Mundi) (FAO 2017). The Figure 9 shows the variations in relation to female employment in agriculture in Belize since 2010 (OIT 2020).

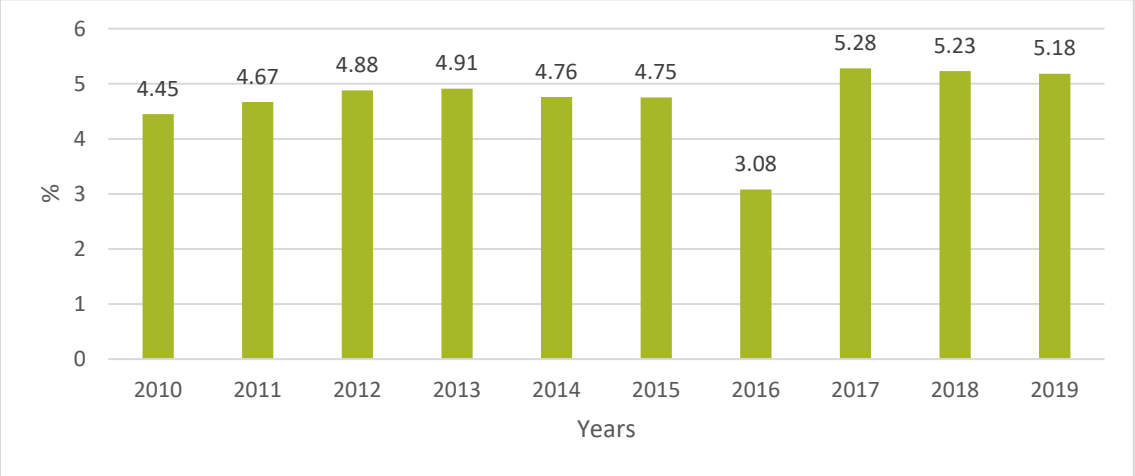

Figure 9. Indicators of female work in agriculture in Belize

Women in rural areas, play an important role in guaranteeing food security of their households and communities. While the men are in charge of the production of crops for sale, the women are usually responsible for different tasks in the home such as: supporting the productive activity, cultivating for self-consumption, taking care of the children's education, and carrying out different household chores, such as cleaning, preparing food at home, etc.

The Government of Belize, recognizing that rural women are the most affected by poverty and lack of access to services and resources for personal development and for their contribution to the development of their communities and territories, participates in the framework of the Agricultural Council Central American (Council of Ministers of Agriculture of the Central American Integration System Region and the Dominican Republic) in the development of an Agenda for the Economic Empowerment of Rural Women and has a focal point in the Ministry of Agriculture and in the Women and Family Support Department (Ministry of Human Development) to implement this agenda at the national level and give a better response to these women. Human, material, and financial resources are currently insufficient, and it will be necessary to strengthen the institutional ones to generate the expected results. (IFAD 2019).

6. Market Analysis

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

The main tomato varieties grown include Nirvana F1, P52 F1, Tyrall F1, Bianco F1 and Faraon F1, Tacana F1, Pony Express F1, Morelos F1. The most popular varieties planted is Pony Express F1 as it has proven to be sturdy for transportation and shelf life.

6.1 Market Size

The estimated local consumption of tomatoes is 73,800 pounds per week. Table 5 details the yearly consumption for the last five years. Noteworthy is that the amount of tomato imported by private importers is fifteen percent more than the amount authorized by BAHA in the import permit (MOA, 2021). However, the excess amounts are not classified as illegal importation. The decrease in consumption is directly related to the decrease in production for 2019 and 2020.

Table 5. Yearly consumption of Tomato in Belize (2016 to 2020)

Yearly consumption of Tomato in Belize				
2016	2017	2018	2019	2020
6,304,212	5,404,809	4,675,830	2,507,123	2,910,663

6.2 Market Channel

A significant amount of the Tomato produced by the Cooperative is sold to the collectors, then to retailers and finally to consumers. In Nago Bank, when prices are high, individual farmers sell their produce to the Cooperative (RRB, 2019) A few individual importers sell directly to consumers or to retailers; these retailers then sell to consumers. The main marketing channels identified from the point of production to consumers through intermediaries for Tomatoes in the Belize are as follows (Figure 10).

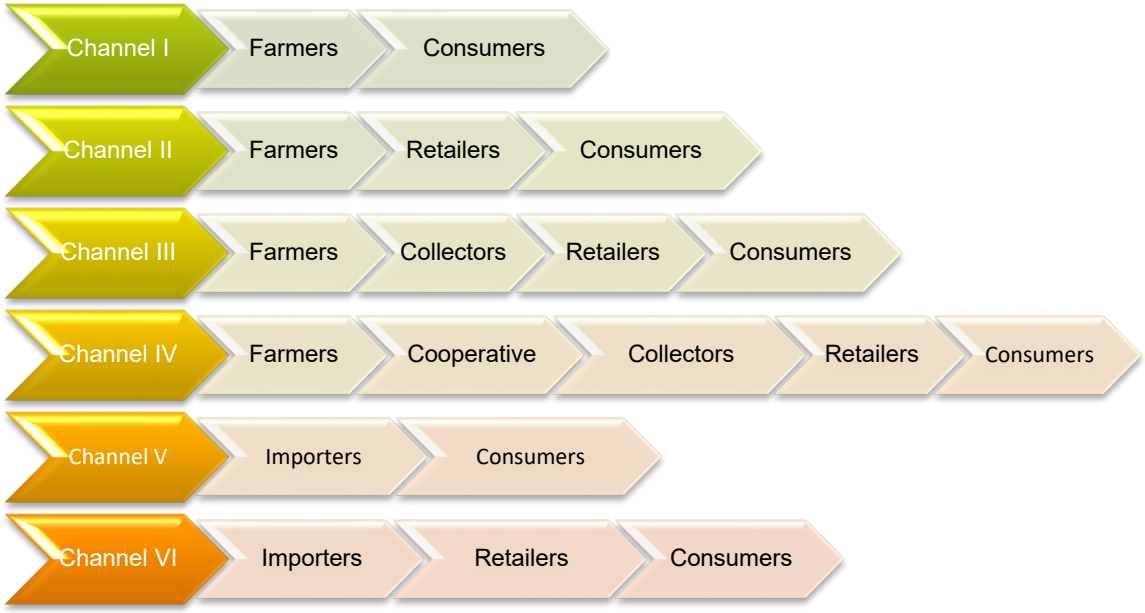

Figure 10. Main Marketing Tomato Channels

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

6.3 Price trend of Tomato in Belize

The price for Tomato in Belize was very stable. Figure 11 shows the price trend of tomato in Belize for 2016 to 2020 at producer's average price of BZ$0.55/lb. This price information was sourced from SIB. Surprising is to see the price stability at the production level, especially given that at the consumer level the history has been very different.

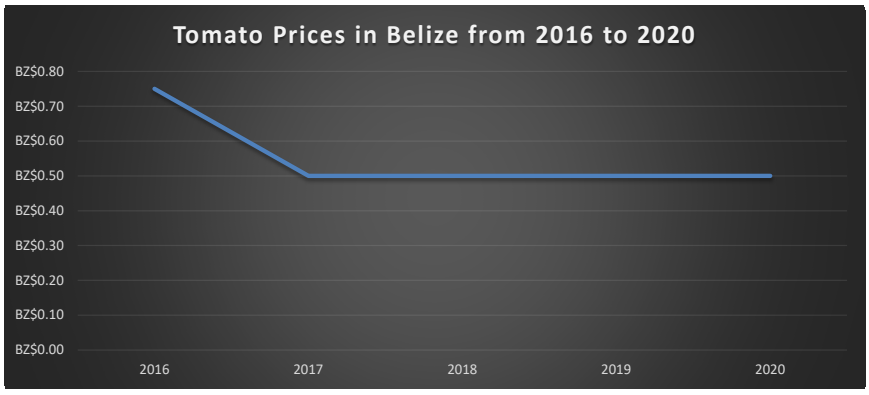

Figure 11. Price trend for Tomato production in Belize (2016 to 2020) at Producer's Price (SIB)

Consumer prices were sourced from SIB. Figure 12 shows monthly average prices per pound of tomatoes in the country. Bz$2.55 per pound for the year 2021. There is seasonal price variability in the tomato value chain in Belize. Price is based on weight; there is no tier in prices based on size or quality. Three periods in the year mark the behaviour of consumer prices: a dip period from February to May, a stable increase between November, and a marked increase in price is seen in December, this is mainly due to the Christmas season.

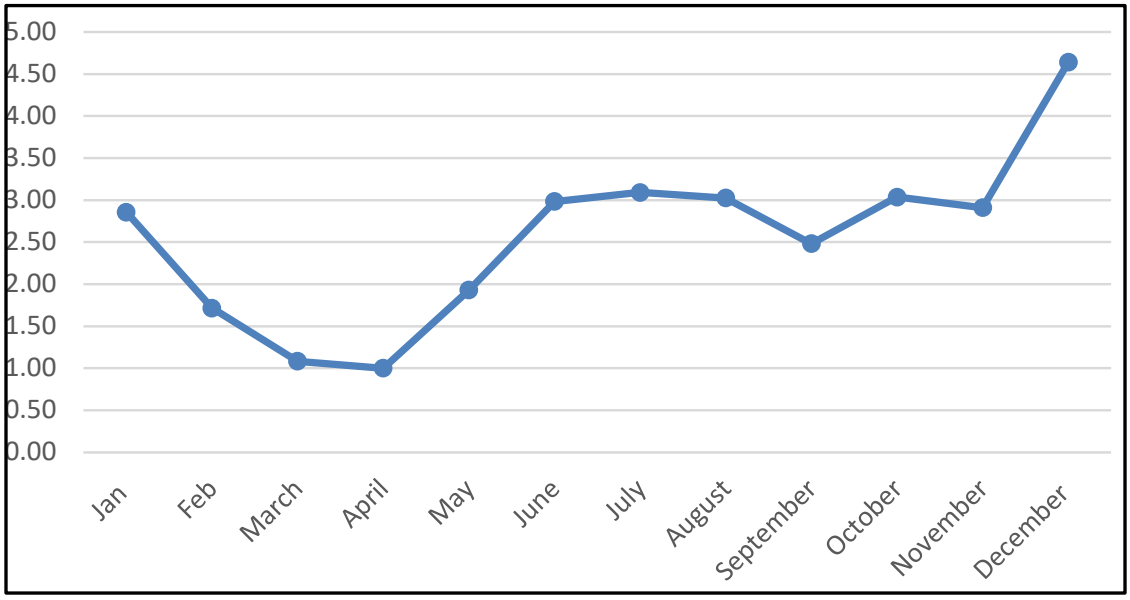

Figure 12. Consumer Price Trend for Tomato (2021)

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

The farmers are holding back production so as not to flood the market. Perhaps a venture such as processing tomatoes can be an alternative market for this produce.

7. Supply Chain

The supply chain considers the production, importation, profitability, and cost of production across the value chain. The total production of Tomato in 2020 in the country was and estimated 2,910,663 pounds valued at BZ $5,745,297.28 (SIB, 2020). The main suppliers of Tomato in Belize are farmers and through legal importation from the United States and Trinidad and Tobago. The imported Tomatoes account for 0.55 % of the total consumption.

Table 6 shows the yearly supply of tomatoes for total consumption for the last five years. The contribution of imported tomato for consumption is negligible. However, farmers in the Belize District are adamant that illegal importation is significant. The main supply of tomato in Belize is the farmer. Table 7 register a marked decrease in acres planted and harvested for Tomatoes in all districts except for the Corozal District which registered an increase in 2020. The decrease in consumption is directly linked to a decrease in production.

Table 6. Annual Supply of Tomato (pounds) (2016 to 2020)

Year	Consumption	Production	Imports	Illegal entry
2016	6,304,212	6,301,746	2,466	0
2017	5,404,809	5,404,705	104	0
2018	4,675,830	4,675,680	150	0
2019	2,507,123	2,454,292	52,831	0
2020	2,910,663	2,910,458	205	0

Table 7. Total area harvested for tomato

District	Total Area Harvested (Ac.)				
	2016	2017	2018	2019	2020
Cayo	91.00	68.00	47.00	30.00	34.00
Belize	129.00	116.00	94.00	83.00	80.00
Stann Creek	3.00	4.00	3.00	3.00	3.00
Toledo	6.00	5.00	2.60	0.00	1.80
Orange Walk	8.00	7.00	5.00	4.00	5.00
Corozal	55.00	41.00	53.00	31.00	57.00

District	Total Area Harvested (Ac.)				
	2016	2017	2018	2019	2020
Total	292.00	241.00	204.60	151.00	180.80

7.1 Domestic Production

Table 8 shows the production of tomato by districts. Belize District is the largest producer, followed by the Cayo District. Figure 13 shows the total yield of Tomato production in each district. In both districts, most of the tomato producers are members of a co-operative that plant tomatoes and other vegetables. In the rest of the districts, the farmers operate individually.

Table 8. Total Annual Tomato Production (pounds) in the districts (2016 to 2020)

District	Total Annual Production (Pounds)				
	2016	2017	2018	2019	2020
Cayo	1397,821	1502,800	1687,350	537,750	425,000
Belize	3562,000	2942,000	2033,600	1349,900	1502,000
Stann Creek	21,000	28,000	21,000	12,800	14,008
Toledo	43,425	2,405	3,425	4,900	17,050
Orange Walk	200,000	77,000	100,000	100,000	98,000
Corozal	1077,500	852,500	830,305	448,942	854,400
Total	6301,746	5404,705	4675,680	2454,292	2910,458

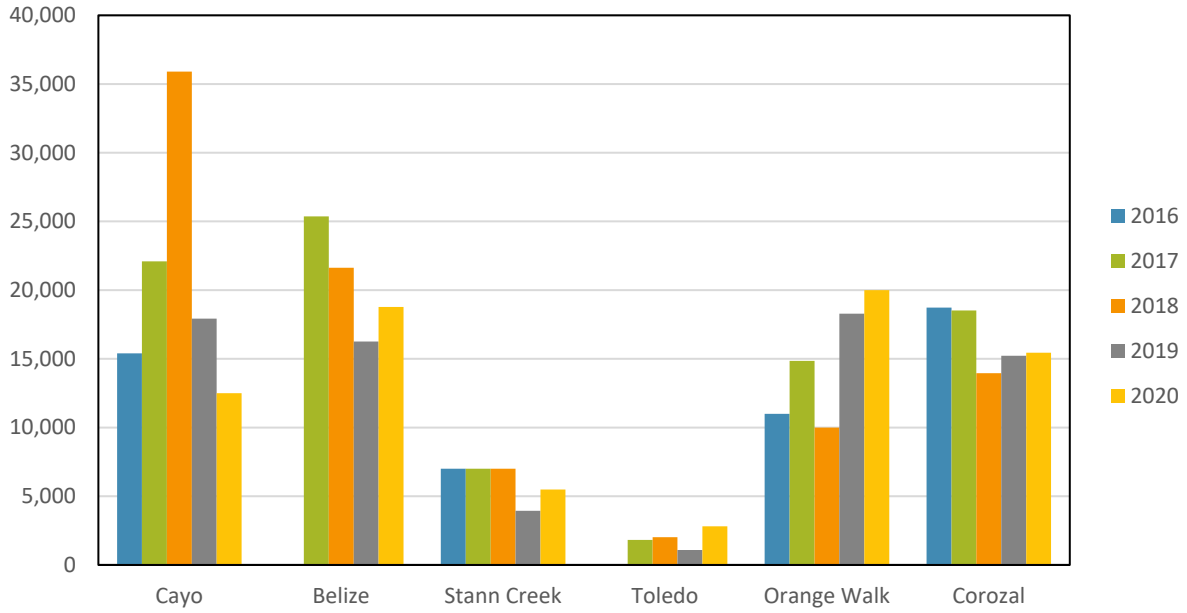

Figure 13. Average Yield (pounds/acre) of Tomato in Belize (2016 to 2020)

7.2 Cost of Production

The Belize District MAFSE estimates BZ$ 0.26 to produce a pound of tomato. Four studies about the cost structure of producing one acre of tomato were found in our research. Table 9 shows the recap of all four studies. The table has been built so a comparison among those studies is possible: for example, additions for interest and contingency were calculated for those missing that information. Similar, a labour row has been added and calculated for those sources that do not include it. The original details of each of the four cost structures presented in Table 8 can be found in Annex 3: *Cost of Production Analyses for Production of One Acre of Tomato.*

The cost of production could be around BZ$20,000 when farmers follow the fertigation model (intensive system) that produces 70000 pounds of tomato per acre. When the farmer produces with less intensive systems, around 30000 pounds of yield, the cost of production is about 8 to 10 thousand dollars. However, with average yield of 20000 pounds a year as our data from 2016 to 2020 shows, we expect the “in field” cost of production to be lower that 10 thousand dollars. The unit cost per pound of tomato is consistent among three of the sources analysed and it is about 0.24BZ$. The fourth study recapped in Table 9 shows a cost of production of BZ$0.43 per pound. This is almost double the data from the other studies, but we note that it uses a relatively low yield of 25000 pounds per acre. Adjusting the reported yield will approximate that fourth estimate unit cost of production to the other studies.

Table 9. Recap of studies on Cost of Production for one Acre of Tomato

Cost structure	TOMATO with Fertigation (Belize District 2021)*		Tomato (in 4000 plants system)**		Tomato (4000 plants system)***		Tomato (year 2015)****	
Capital Investment-irrigation	BZ$5,289	29%	BZ$4,153	54%	BZ$3,476	50%	BZ$3,745	35%
Land preparation	BZ$880	5%	BZ$414	5%	BZ$75	1%	BZ$140	1%
Inputs -seeds	BZ$1,104	6%	BZ$240	3%	BZ$260	4%	BZ$920	9%
Fertilizers	BZ$765	4%	BZ$1,151	15%	BZ$498	7%	BZ$2,503	23%
Insecticide	BZ$2,758	15%			BZ$472	7%		
Fungicide	BZ$1,455	8%			BZ$309	4%		
Herbicide	BZ$134	1%			BZ$126	2%		
Labour	BZ$2,686	15%	BZ$325	4%	BZ$525	7%	BZ$1,500	14%
Total operational cost	BZ$15,069	82%	BZ$6,284	82%	BZ$5,741	82%	BZ$8,808	82%
Miss	BZ$1,507	8%	BZ$628	8%	BZ$574	8%	BZ$881	8%
Interest	BZ$1,808	10%	BZ$754	10%	BZ$689	10%	BZ$1,057	10%
Cost of Production	BZ$18,385	100%	BZ$7,666	100%	BZ$7,004	100%	BZ$10,746	100%
Yield in Pounds	70000		32000		32000		25000	
Cost per Pounds	0.26		0.24		0.22		0.43	

* Belize District Agriculture Department. 2021
** Alfonso Bautista, Statistical Officer, Statistical Institute of Belize
***Gary Ramirez, Ministry of Agriculture (MAFSE)
****Cost of production of one acre of tomato, March 2015, Ministry of Natural Resources & Agriculture

The cost structure is not completely consistent among studies. Therefore, in our analysis, we work with ranges. Table 9 shows the percentage that each item represents of the estimated total cost of production. We can see that the investment item (irrigation) represents between 30 to 50% of the costs. Seeds and other inputs (fertilizers, insecticides, fungicides, and herbicides) account for 3 to 9% and 15%-28%, respectively. Labour, on the other hand, ranges from 4 to 15%. It is precisely this last item that presents many doubts. Reviewing the detail of each cost structure it is evident that not all labour has been incorporated into the analyses, especially for maintenance

work. Our opinion is that even 15% of the cost of production is low, even more so 4% as reported in one of the studies.

When reviewing inputs costs, we found the expenditure on seed can be BZ$250 or BZ$1100, this is 3 or 6% of the total cost of production. In the workshops, producers also expressed their concern about the cost of inputs, seed, and agrochemicals. Both items represent between 18 and 30% of total costs. It is important to note that the relative weight of expenditure on seeds and agrochemicals goes hand in hand with the production system: more intensive systems greater weight of these items.

For Belize, there are no production data by district, except for the district of Belize which is presented in the first column of Table 9 (see also annex 3). We believe that cost study for the districts of Cayo and Corozal could be strategic at this time. For Corozal district we project significant losses in its suitability/adequacy for tomato production under scenarios of climate change (see section 9 of this document). This means, if farmers want to continue producing in Corozal, they will have to face increasing production cost. In general, it is argued here that in places where the suitability for cultivation is eroded, irrigation implementation and its efficient use are essential for the future of those farmers like in Corozal.

8. Climate Change Vulnerability of the Tomato 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 Tomato 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 Tomato business.

For this report, we bring in context of the tomato value-chain 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. First, we report changes on climate adequacy for the Tomato production for the whole country of Belize. Using maps and a color-coded to understand those changes, a general futuristic perspective to produce Tomato can be described. Second, findings specifically for the 10 intervention areas of the RRB program are presented. Aiming to describe the uniqueness of each area and how this could bring similar or very different picture of the future for Tomato production, we identify losses and gains in suitability or adequacy in percentages of the adequacy reported for the baseline data.

8.1 Tomato 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 Tomato 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) and two emission scenarios RCP2,6 and RCP8,5. Both scenarios (RCP2,6 and RCP8,5) show increases in the average temperature towards 2050. RCP2.6 shows average temperature values that exceed the baseline between 0.7°C in Belize and Corozal up to 1.5°C in Toledo. On the other hand, the RCP8.5 scenario shows larger increases in 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), see Figure 14. 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.

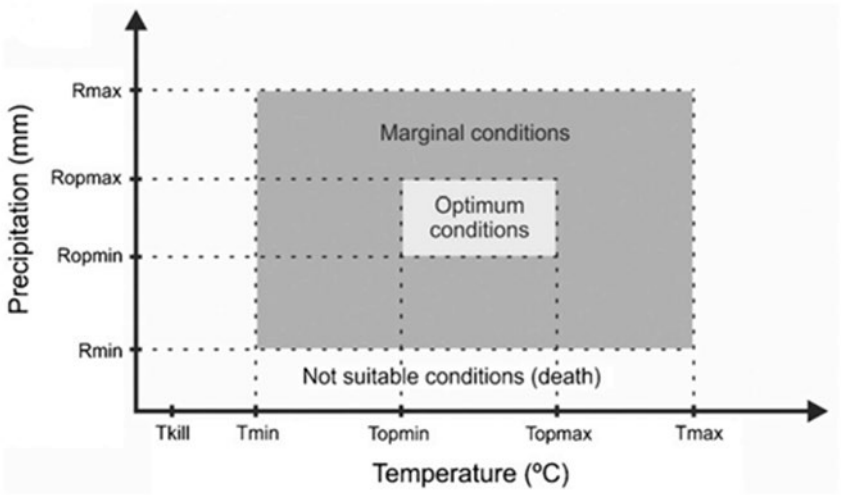

Figure 14. Interaction between precipitation and temperature parameters for absolute and optimal ranges

Figure 14 shows the interaction between precipitation and temperature parameters for absolute and optimal ranges. Table 10 shows the values of the different variables used to define those

absolute and optimal ranges for the case of tomato. Thus, lower, and upper limits of temperature for the optimal range are 20 and 27°C, while lower and upper limits of precipitation are 600 and 1300 mm respectively.

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 for the climate adequacy analysis for the Tomato value chain

Description of parameter used in the model	Value used
Gmin: Minimum duration of the growing season	70
Gmax: Maximum duration of the growing season	150
Gused: Used duration of the growing season	110
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)	20
Topmax: Upper limit of the optimum temperature range (°C)	27
Tmax: Upper limit of the absolute temperature range (°C)	35
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	1300
Rmax: Upper precipitation limit (mm) of the absolute range	1800

Source: Own elaboration with support from VCA team

Below are the climate adequacy maps for Tomato (Lycopersicon esculentum) cultivation in Belize selected species at national level. Figure 15 shows the climate adequacy for growing Tomato in Belize for the baseline (current conditions, year 2000) and both future scenarios (centered in year 2050). The suitability for cultivating tomato is very high in the whole country with some cases of medium suitability in Corozal District -see map of suitability for the baseline in Figure 15.

Mapping suitability for cultivation of tomatoes under scenario RCP2,6 and RCP8,5 shows that both scenarios will bring serious consequences to basically half of the country (norther half). Under scenario RCP8,5, the one more severe on climate conditions, Orange Walk and Corozal districts are expected to see more of their territory with very low suitability for cultivation. Even the area connecting Toledo and Stann Creek district is expected to have areas with low suitability.

Figure 16 describes the general losses and gains on adequacy comparing each scenario with the baseline climate adequacy for production of Tomato in the whole country. Here, brown identify areas losing suitability and dark green areas gaining suitability for tomato cultivation. Losing suitability could mean for a specific are to become unsuitable for production or that the area is now less suitable for production. Bottom line, brown colour implies production of tomato more difficult and expensive, dark green the opposite.

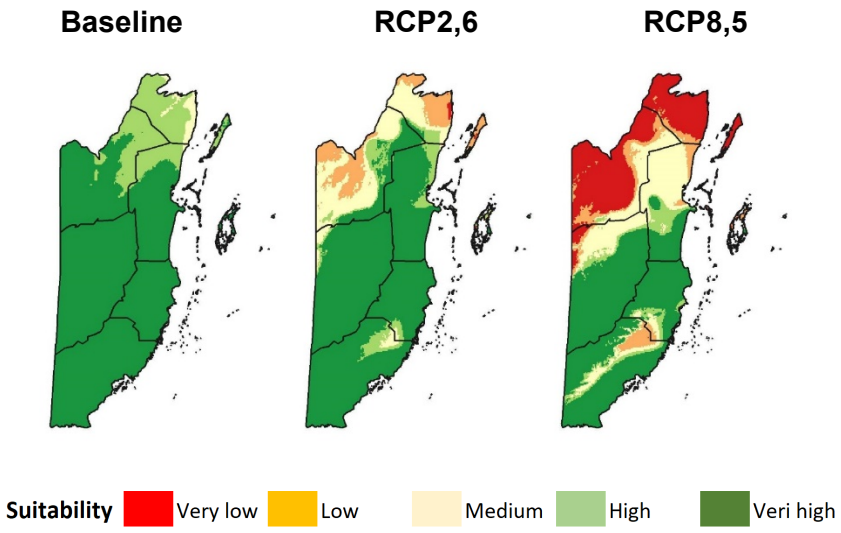

Figure 15. Climate adequacy for tomato cultivation

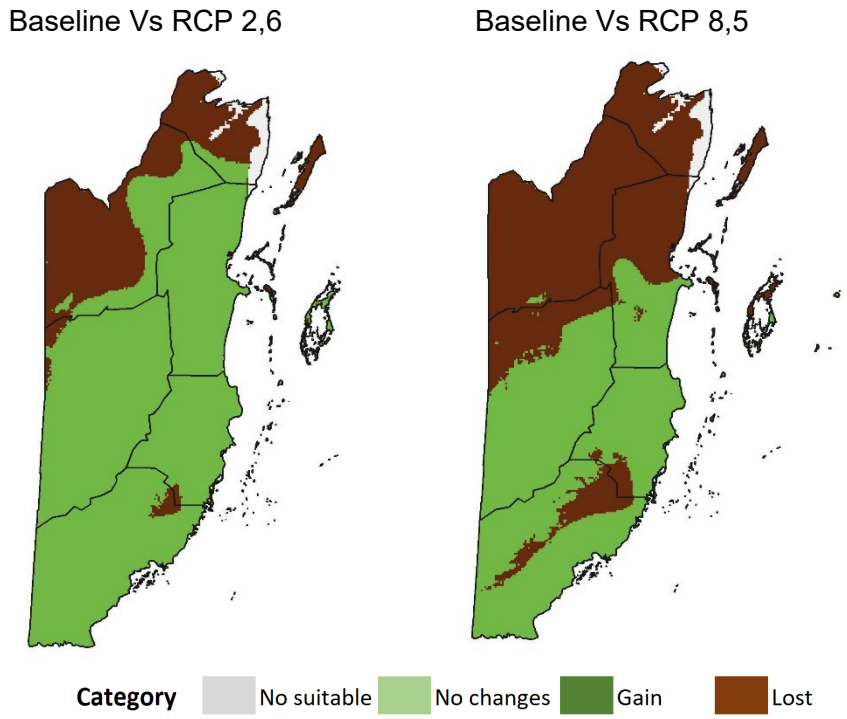

Figure 16. Mapping scenarios of loses and gains on suitability for cultivation of tomato

Under both scenarios, climate adequacy to produce Tomato sees major losses, and not a single area gaining suitability. Light green means no change in the suitability and grey colour means unsuitable for cultivation. Figure 16 shows lot of areas losing suitability, but no area is projected to became unsuitable for cultivation of tomato. Corozal and the north part of Belize districts where tomato has been an important crop and source of income for families, are projected to lose competitiveness in rain-dependent-production of tomato. Paramount is therefore to continue with the transition to less rain-dependent production systems like the currently promote based on irrigation. Knowing that the original investment for these systems is significant this could be one of the issues to support with RRB partners.

8.2 Tomato value chain and changes in climate adequacy for RRB's intervention areas

As much as the data for the whole country could tell us the story on sensibility and vulnerability for our target crop, the RRB defined 10 intervention areas (Assessment Units of the rural resilience program in Belize RRB) and is on those areas where knowing how conditions will affect the value chains. We note, for our value chain, the future may play significantly different at RRB's intervention areas than those at the national level. Assessment Units of the Rural Resilience Programme in Belize (RRB) are shown in Figure 17.

Figure 17. Mapping Intervention Areas-Assessment Units of the Resilience Rural Belize Program

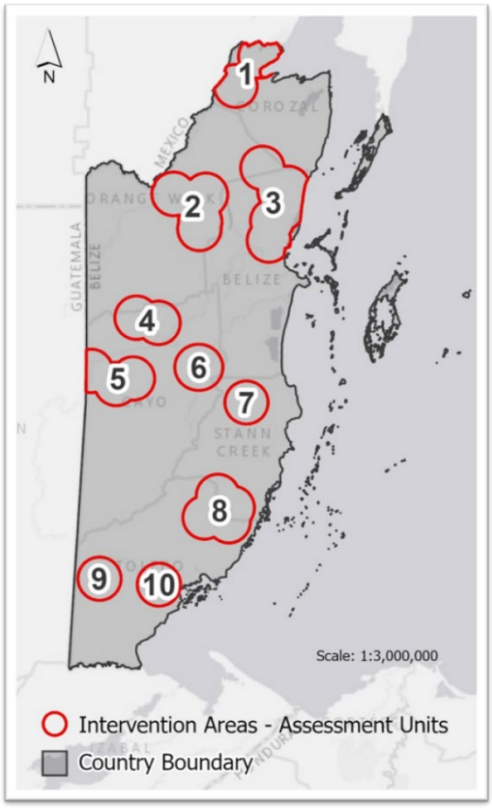

Table 11 shows changes in climate adequacy between baseline and future scenarios for Tomato (Lycopersicon esculentum) cultivation in Belize as a percentage of each RRB programme intervention area. When intervention area is the focus of the comparison between scenarios, and not for the whole country of Belize, we are able to identify area of intervention 1, 2 and 8 as loosing suitability in scenario RCP2,6. If scenario RCP8,5 is considered more intervention areas and in a bigger percentage will lose suitability. Note as well that area of intervention 1 will even find 4.1% of its territory unsuitable for cultivating tomato. Corozal district and area of intervention 1 exemplify why the value chain of tomato need to plan to adapt to new condition under climate change.

Table 11. Changes in climate adequacy as a percentage of area of each RRB intervention area

Change direction Percentage (%)	Intervention Areas- Assessment Units									
	1	2	3	4	5	6	7	8	9	10
	RCP 2,6									
Gain			0.4							
Not Suitable	4.1									
Lost	95.9	36.2	0.1	0.2	7.5			18.8		
No changes		63.8	99.5	99.8	92.5	100.0	100.0	81.2	100.0	100.0
	RCP 8,5									
Gain										
Not Suitable	4.1		0.4							
Lost	95.9	100.0	99.6	90.1	40.9			71.2	10.4	0.5
No changes				9.9	59.1	100.0	100.0	28.8	89.6	99.5

Source: Own elaboration with VCA team support

9. Constraints and Opportunities

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

Table 12. Challenges and Opportunities for Tomato Value Chain in Belize

	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 tomato production, potential reduction on fertilizers and insecticides could help significantly in reducing the cost of production. • Substitute organic fertilizers could be explored as a cheaper alternative to chemical fertilizers. This could be analysed together with an evaluation on 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 delivery products between the actors. • The prices of inputs (i.e., fertilizer and pesticides) may not change rapidly enough but efficiency in application could be tremendous. A training on the ABC of efficient use could reduce the total bill paid by farmers.
	Seed Quality and Availability: • Seed variety suitable to Belize's climatic	• Opportunity for collaboration and strengthening of relationships between farmers, agronomists, and local extension service for training on Good Agriculture Practices. • Facilitate importation of seeds and establish local seeds banks to supply farmers.

	Constraints	Opportunities
	conditions not readily available and when available, prices are very high • Seed quality not guaranteed by the supplier.	• It is recommended to support seeds providers 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 it. • Guarantee of seed should be part of the input providers commercial strategy, if this is not currently something that those providers are doing, the practice of guarantee could be encourage by a) share of information on those providers with good reputation and willing to guarantee their seeds, b) coordinating with seed providers workshops about care and maintenance of seed for both farmers and input providers.
	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. • Integrated Pest Management could reduce the need for chemicals as it reduces the cost of production. By forming a IPM task force focus in crops like tomato, it will be possible to identify gaps on knowledge.
Production	High Cost of Planting Infrastructure • Production in the Maskall area is exclusively in the open field with	• Possible opportunity from international funding to access grants for construction of greenhouses as a tool to mitigate climate change impacts in Maskall area and for farmers in the Cayo District • Explore among plastic film protected agriculture systems the one that better matches the conditions of these farmers.

	Constraints	Opportunities
	increased pest pressure as acquiring screenhouse is very costly.	• Farmer to Farmer program could be implemented as a mean for discovering cost-saving techniques and practical infrastructure for production. Maskall Village could be targeted in this kind of program.
	Climate Vulnerability • Poor access to water suitable for irrigation and Tomato production during draught conditions. In the Maskall area which is closer to the coast the water becomes saline during the dry season • Scenarios of climate change show adequacy to produce Tomato sees major losses in northern part of the	• Share information on climate change and technical assistance on irrigation systems for tomato 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. • Continue with the transition to less rain-dependent production systems like those currently promote based on irrigation. Knowing that the original investment for these systems is significant this could be one of the issues to support with RRB partners. • Elaborate a proposal for agriculture transition to water efficient systema and request financial support to the international cooperation that are working to mitigate impacts of climate change. • Consult with international research organization, like CATIE, about innovative and cost-effective ecosystem-based adaptation (AbE) measures that could implemented in rural area of Belize. It is about developing a toolbox that can be share with different actors in the value chains. • Training on appropriate technologies to collect and store rainwater, specially for those farmers with limited capacity to invest in a water well or irrigation systems, this a part of a more general training and/or workshop in water efficient use.

	Constraints	Opportunities
	country affecting Corozal and northern region of Belize Districts	
Harvest and Post-Harvest / Processing	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. • 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 but land ownership, or lack of it to be more exact, could seriously restrict the impact of the suggested infrastructure-business plans. Farmers could benefit from written statements, radio programs, and meeting presenting the procedure for formalisation of land ownership and the benefit that this could carry to them.
	Post/harvest loss due to lack of options of Processing • Interviews with key farmers they estimate that about 20% of their crop is lost mainly because the size or shape does not qualify for	• Farmer to Farmer program could be implemented as a mean for discovering cost-saving techniques and practical procedures to reduce losses in post harvesting. • Identify funding opportunities by international cooperation sources for value added alternatives like producing salsa pico de gallo (chimichurri), homemade tomato sauce and pizza toppings at farmer level. • Identify a processor that want to explore the alliance with tomato producers to process the sizes rejected in the fresh market. RRB could be an advisor to a commercial agreement between the processor and associated/organized producers to develop a product with potential in the market: ketchup sauce, for example.

	Constraints	Opportunities
	the market preference.	• There are small processing units that can serve a cooperative to process these tomatoes into salads or paste
Quality Standards	Quality standards are not followed or understood • Organized groups or cooperative need to understand and request for the development of these standards and possible price control	• It should be explored why there is not a quality premium paid for those farmers following the quality standards. If farmer does not perceive the benefit, it will be difficult for him to adhere to standards. Either there is not quality premium possible to offer, or the standards are not clear to farmers. • As production systems become more intensive, quality standards will need to continue to be adjusted for new good practices to reduce chemical residues and leakages. A monitoring program with the participation of farmers could be an opportunity to prevent future environmental issue: consumers are getting more demanding on food safety and avoiding pollution. • Current cooperatives may be able to work much easier with the Belize Bureau of Standards, but they need coaching and technical support to sit in a technical table to discuss the standards. • Conduct a study that demonstrates how much rejection could be reduced with best practices and adherence to the quality standard.
Marketing and Distribution	Poor Business Practices • Poor record keeping resulting in poor understanding of cost of production	• Farmer needs to think and act like a businessman/businesswoman. Also essential, farmers need the knowledge to farm as a business. In most cases, training on record keeping, cost of production estimation, and knowledge about contract and negotiation should be basic content of the training on entrepreneurship for farmers.

	Constraints	Opportunities
	• Lack of formal contracts with intermediary resulting in late payment to farmer for produce sold • No official medium to learn about price information on the market	• Continue to be promote participation of business services providers of the value chain, in particular input providers. They could increase customer satisfaction by offering guarantee for seed of tomato and irrigation systems. For this to happens, business must recognize how important is the quality of their service to the member of the value chain. • 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 cost of inputs, should be obtainable with strengthening the cooperatives. • Manuals and simple brochures easy to complete/read are necessary as well as make them available to tomato 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 title, however, many of the farmers are squatters and do not have land title to use as collateral to access finance.	• Given the projections of climate impact in Belize, and in particular for Corozal and Belize districts, where the ability to produce tomatoes over the next 30 years is reduced, a proposal can be drawn up to seek funding from the international cooperation. This proposal lies in the importance of seeking measures to adapt to reduction of rainfall and higher temperatures. The proposal would seek to promote the shift from a rain-dependent system to systems with less dependence on rainfall. • Poor access to finance is normally a result of limited collateral value to offer to banks, however, access can be improved if farmer is able to demonstrate administrative skills:

	Constraints	Opportunities
		bookkeeping, inventories, etc. NGO´s 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 capacity to provide advance payments or credit to members which is 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 emphasis in investment and financial management for cooperatives, should reduce the need to find often high-cost credit for the organization. Even if the cooperative has low capitalization, it should not mean that it needs to work with expensive capital: learning where to borrow as 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 the why farmers do not formalize the landownership.

10. Adaptation practices to climate change events

The main climatic threats for tomato cultivation have been identified and some practices that are easy to develop to reduce climatological impacts are presented. Table 13 details the main climatic events that occur in Belize, as well as the viable practices most used to adapt and mitigate the negative effects on production.

Table 13. Challenges and Opportunities for tomato Value Chain in Belize

Constraints	Crop damage	Measures Adaptation	Measure description
High temperatures	It decreases the availability of water for the plant and the loss of soil moisture, which generates physiological delays in the development of the plant and loss of vigor by reducing the transport of nutrients and photo-assimilates necessary for vegetative growth.	Irrigation Change in sowing time Plastic meshes Proper fertilization	Supply water to a crop by artificial means when the demand for water resources is high.
Heavy rains	Heavy rains can cause erosion and loss of effective areas due to the dragging of soil particles, which causes low sprouting and loss of plants. In addition, they favor the increase of weeds that compete for water, light, and nutrients.	Drains Sowing in loins Manual control or weeding Contour planting Reseeding	Topological layout for a better use of the land with respect to contour lines.
Prolonged rains	Prolonged rains cause an excess of water in the soil, causing saturation, water stress and anoxia, which hinders root development and vegetative growth necessary for plant development. It causes delays in practices and loss of fertilizer by leaching. When subjected to stress, the plant is weakened and becomes susceptible to disease and pest attack.	Drains Application of preventive and curative fungicides Sowing in loins Manual control or weeding	Construction of canals on the soil surface to eliminate excess water in the plantation, lowering the water table, improving aeration, and increasing soil nutritional access.
Drought impact	Drought decreases the availability of water resources in the plant, generating stress due to water deficit, it can cause an increase in the population of pests, physiological delays of the plant caused by stomatal closure, the decrease in the photosynthetic process and low transport of necessary photo assimilates. for plant development.	Irrigation Foliar application Reseeding Change in sowing time Proper fertilization Water harvest	Increase the volumes of water for irrigation, to reduce the stress of the plant Improved recycling of nutrients on the farm. Modify planting dates. Reseeding
Tropical storms, hurricanes,	These climatic events can cause loss of total areas within the tomato crop since the combination of strong winds and rains	Use of climate data	Use climate data and predictions to plan cultivation and mitigate

Constraints	**Crop damage**	**Measures Adaptation**	**Measure description**
and tornadoes	cause the overturning of plants and irreparable physical damage.		the negative impact of disasters.

11. Conclusion

Tomato Value Chain is rudimentary. Tomato is grown in all the districts in the country. The Belize District is the leading producer of tomato followed closely by the Cayo District. Main producers of tomato are part of a cooperative. The Belize and Cayo District produces tomato in the open field, productivity is low so there is a dire need for technical assistance to help farmers improve their farming operations. Tomato quality and availability are inconsistent. We argue, the Tomato value chain is not an integrated value chain since there are not examples of value-added commercial agreements or any other initiative of collaboration among stakeholders. Farmer´s organizations are the lonely example of strategic alliance between actors; however, they are accused of not representing well their member's needs.

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 Tomato Value Chain requires strengthening of the cooperatives who are one of the main produces of tomato. All farmers require technical assistance and training in Good Agricultural Practices, training in basic farm business management. There is a need to development a national seed policy and development of vegetables quality standards. Orange Walk and Corozal districts are projected to be the most affected by our projections of climate change. Area of intervention one in Corozal will be the most impacted by our climate suitability analysis.

Limited production volumes and quality control. Among the vast majority of agriculture-based farmers organizations 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. Almost no existent, economic incentives for quality production and/or sanctions for noncompliance. Yields on irrigation-based production systems could be at least 32000 Pounds/acre compared to the national yield of 20 000 Pounds/acre.

Processing opportunities but no capacity. Moving from post-harvest treatments or simple first-stage processing is proving a challenge. Among other things, this reflects lack of technical

capacities and skills, low access to capital for investment in processing equipment and machinery, restricted access to services for processing, or reduced opportunities in local markets for higher-value processed products: tomato sauce, ketchup or just the tomato paste use for derived products. Farmers estimate that about 20% of their tomato crops remain in the fields, a loss mainly due to fruit size and deformity, rendering the fruit unsuitable for the fresh market. This situation gives rise to an opportunity for processing of tomatoes into fresh shredded vegetables, pastes or a product like the popular "Salsa Casera" as it is known here in Belize. Searching for the right equipment for small and medium size processing companies could be facilitated by the RRB team as well as offering technical assistance to cooperative and/or farmers in management of value-added agroindustry.

Impact of covid-19 on 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. Not surprisingly, many of the products analysed show unexpected consequences under the pandemic since 2020. Sanitary restrictions for mobility of people and vehicles produced a contraband reduction for several crops mainly from Mexico. 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, 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 the 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, 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 from 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 the reason for gathering in the cooperative. This is currently reported and being corrected with help from the institutions in charge of promoting cooperatives and should be explicitly included in the capacity building and training to farmers. It has been argued that members do not recognize clear, explicit benefits 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. Low levels of financial capital stock – Undercapitalization was presented in many forms and instances during the consultation process. It is argued that undercapitalization limits capacity to provide advance payments or credit to members critical for planting and harvesting/collection, and/or force the organization to search for often high-cost credit. Similar, delays in payment by buyers, combined with lack of own financial capital, mean competition with buyers for members raw material increases. These and other barriers must be eliminated with appropriate business training with emphasis in investment and financial management.

Priorities for the whole value chain. When thinking of a value chain as a system, all stakeholders are interlinked, and all are mutually dependent. RRB must recognize that some interventions are prioritized differently for different actors/stakeholders. Interventions for the whole value chain requires extra effort to create consensus on priorities. Through workshops carried out for the VCMAs studies, a couple of constraints/needs were prioritized and presented here in Table 12. Prioritizing value chains should also be understood as a necessary step toward efficient use of resources. To maximize the impact of the program, the tomato value chain should be prioritized given the potential to improve yields and intensify the production systems. The projected lose in

suitability for cultivation (under climate change scenarios), and the value-added opportunities that cooperatives could help to create should be priorities for this value chain. Lack of infrastructure limit the development of value-chains – year-round road access, 24/7 electricity and secure telephone and internet connection. 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 limit 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 but land ownership, or lack of it to be more exact, could seriously restrict the impact of the suggested infrastructure-business plans.

12. Final comments on limitations of the study

The following list includes major challenges for achieving the best tomato 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. 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.

3. **Short sightedness as the new norm.** Covid-19 had everyone focusing on the short-sightedness of event, losing the potential of the studies to reflect long-sight strategies. For example, having no tourism make people ignore the opportunities that linking farmers to tourism supply chain represent 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 limitation 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 as well return. Here, challenges on quality and acceptance of standards that have been already identified in the VCMAs studies will be paramount.

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.

13. References

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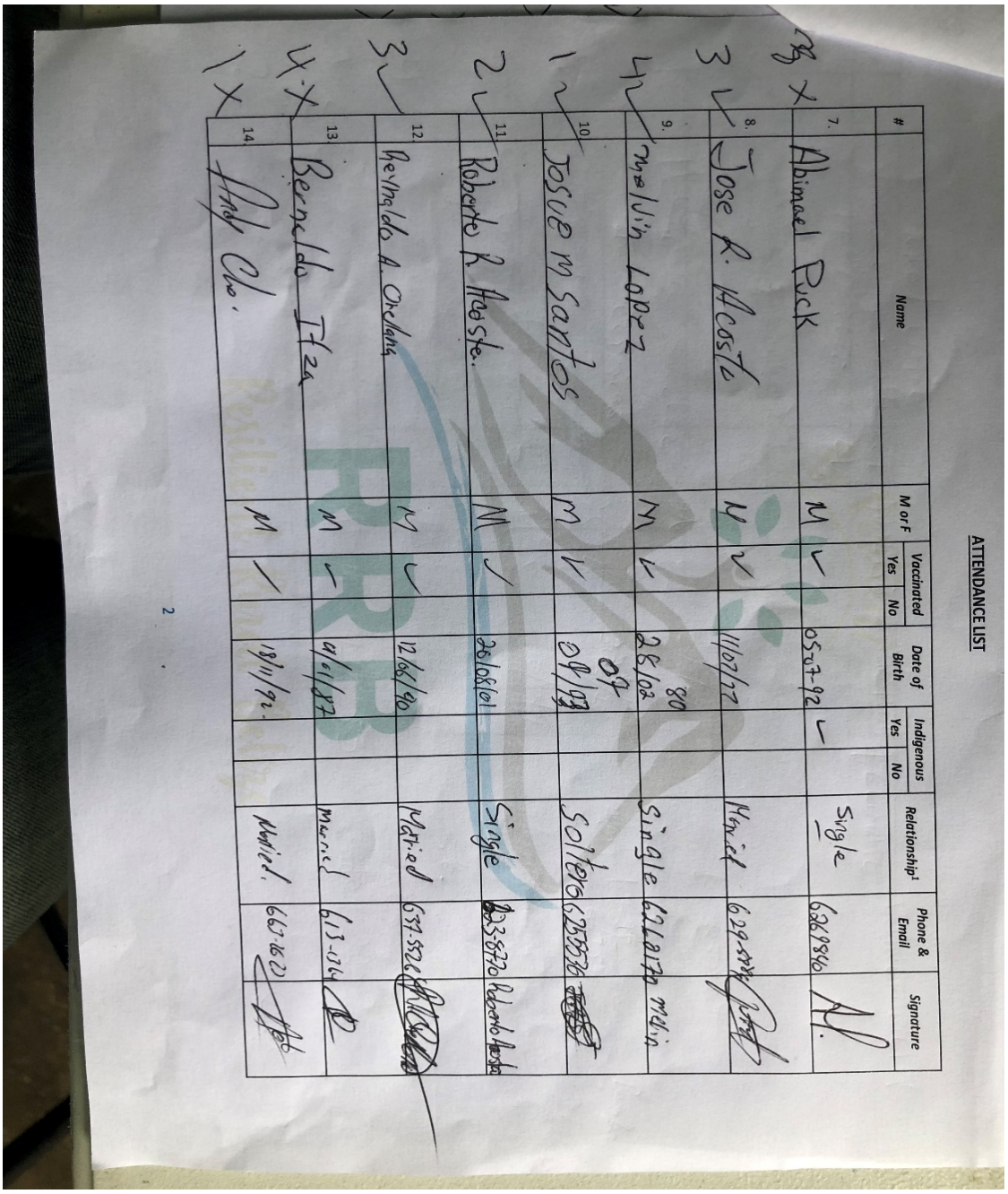
10. Vargas-Ortega, E. 2021. Detailed Value Chain and End Market Assessment Methodology Report (VCMA). Tropical Agricultural and Higher Research Education Center (CATIE) and Resilient Rural Belize (RRB) Programme (Belize).

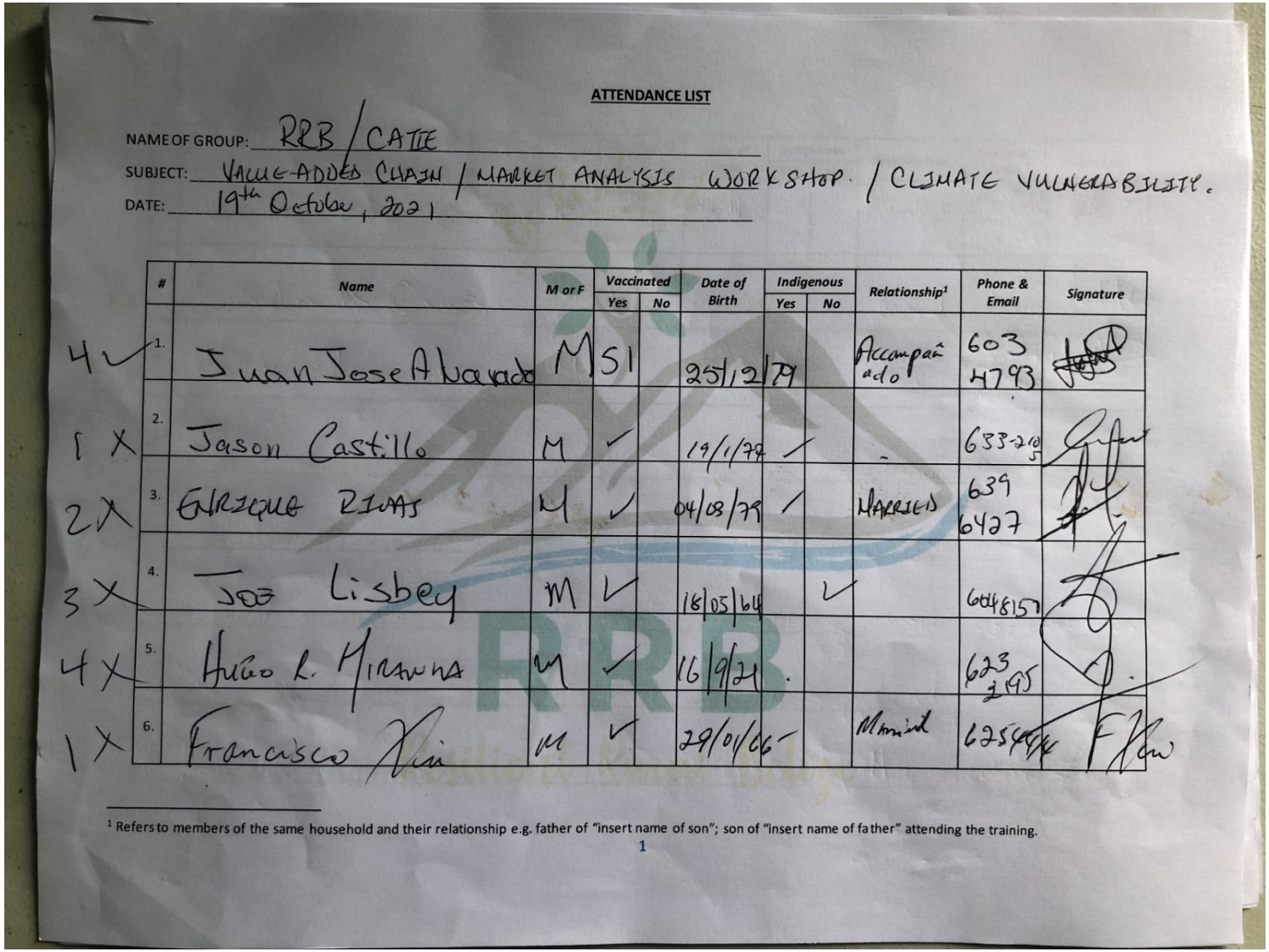
14. Annexes

14.1 Annex 1: Participant's List for Value Chain and Market Analysis Workshop for Tomato.



ATTENDANCE LIST

#	Name	M or F	Vaccinated Yes	Vaccinated No	Date of Birth	Indigenous Yes	Indigenous No	Relationship[1]	Phone & Email	Signature
7.	Abimael Puck	M	✓		05-07-92	✓		Single	6268946	
8.	Jose R. Alcoser	M	✓		11/07/77			Married	629-[illegible]	
9.	Marlin Lopez	M	✓		28/02 80			Single	622[illegible]	
10.	Josue M Santos	M	✓		09/09/93			Soltero	62[illegible]	
11.	Roberto R Hoste.	M	✓		26/08/01			Single	03[illegible]	
12.	Reynaldo A Orellana	M	✓		12/06/90			Married	637-[illegible]	
13.	Bernaldo Ifza	M	—		4/6/87			Married	633-[illegible]	
14.	Andy Cho.	M	/		18/11/92.			Married	663-[illegible]	



ATTENDANCE LIST

NAME OF GROUP: RRB / CATIE

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

DATE: 19th October, 2021

	#	Name	M or F	Vaccinated Yes	Vaccinated No	Date of Birth	Indigenous Yes	Indigenous No	Relationship[1]	Phone & Email	Signature
4 ✓	1.	Juan Jose Alvarado	M	S1		25/12/79			Accompañado	603 4793	
1 X	2.	Jason Castillo	M	✓		19/1/72	✓		-	633-2105	
2 X	3.	ENRIQUE RIAS	M	✓		04/08/79	✓		MARRIED	639 6427	
3 X	4.	Joe Lisbey	M	✓		16/05/64		✓		6048157	
4 X	5.	Hugo R. Miranda	M	✓		16/9/21				623 2195	
1 X	6.	Francisco Xi	M	✓		29/01/66			Married	625[illegible]	

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

1

ATTENDANCE LIST

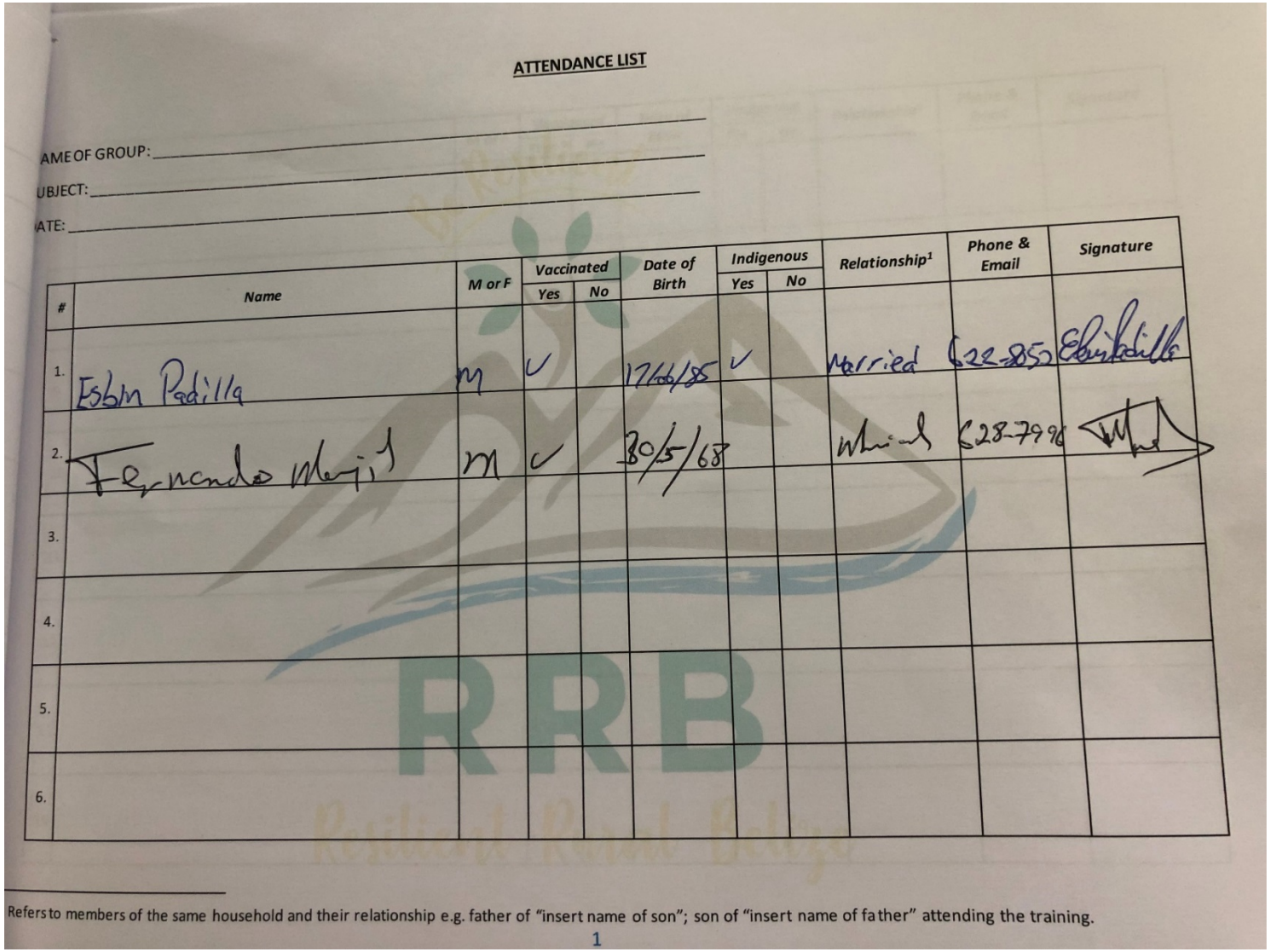
NAME OF GROUP: DEPARTMENT OF COOPERATIVES

SUBJECT: _____

DATE: 19 OCT 2021

#	Name	M or F	Vaccinated		Date of Birth	Indigenous		Relationship[1]	Phone & Email	Signature
			Yes	No		Yes	No			
1.	MICHEL LEWIS	M	✓		30.9.72				670-7101	
2.	VICTOR PADILLA	M	✓		301067		NO	MARRIED	6301639	
3.										
4.										
5.										
6.										

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



ATTENDANCE LIST

NAME OF GROUP: _____

SUBJECT: _____

DATE: _____

#	Name	M or F	Vaccinated Yes	Vaccinated No	Date of Birth	Indigenous Yes	Indigenous No	Relationship[1]	Phone & Email	Signature
1.	Eblin Padilla	M	✓		17/06/85	✓		Married	622-855	Eblin Padilla
2.	Fernando Marin	M	✓		30/5/68			Married	628-7996	
3.										
4.										
5.										
6.										

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

1

14.2 Annex 2: Pictures of Participants at the Value Chain and Market Analysis Workshop for Tomato.


RRB


RRB

14.3 Annex 3: Cost of Production Analyses for Production of One Acre of Tomato

This annex contains thestructure of production costs per acre of tomato according to source. There are four in total and their references are as follows.

- Belize District Agriculture Department. 2021
- Alfonso Bautista, Statistical Officer, Statistical Institute of Belize
- Gary Ramirez, MINISTRY OF AGRICULTURE (MAFSE)
- Cost of production of one acre of tomato, March 2015, Ministry of Natural Resources & Agriculture

	Cost Of Production 1 ACRE TOMATO with Fertigation			
		Belize District 2021		
Capital Investment	***Unit***	***Quanity***	***Cost***	***Total Cost***
Water pump HONDA gas	Unit	Water Pump 5.0 hp	BZ$1,300.00	BZ$1,300.00
1 roll Main Line 2 hose	roll	1 roll	BZ$625.00	BZ$625.00
Connectors	Unit	50	BZ$2.95	BZ$147.50
2'' Air relife Valve	Unit	1 pc	BZ$35.00	BZ$35.00
Well	Ft (Depth 25 Ft)	25ft	45.00 a hr 2.5 hr	BZ$112.50
Ventrui Fertigation Unit	Unit	1	BZ$570.22	BZ$570.22
1 roll Drip Tape	roll	1 roll	BZ$650.00	BZ$650.00
2'' Suction Hose	Ft	30 ft	per ft 2'' Hose 5.95	BZ$178.50
2'' Check Valve	Unit	1 pc	BZ$35.00	BZ$35.00
2'' Gate Valve	Unit	1 pc	BZ$35.00	BZ$35.00
Crates	Unit	50 pcs	BZ$15.00	BZ$750.00
2'' Filter	Unit	1 2'' Filter	BZ$350.00	BZ$350.00
Miscellaneous	$500.00	$500.00	BZ$500.00	BZ$500.00
				Amortized Cost
		Sub Total for Capital Investment		***BZ$5,288.72***
Land Preparation				
Bush Hogging	hr	2	BZ$80.00	BZ$160.00
Rototilling	hr	8	BZ$25.00	BZ$200.00
Under Brush\Falling	hr	8	BZ$30.00	BZ$240.00
Ploughing	hr	3	BZ$80.00	BZ$240.00
Harrowing	hr	1	BZ$40.00	BZ$40.00
Sub Total				***BZ$880.00***
INPUTS				
Seed Pony Express	1,000 seeds per pack	8 pack	BZ$138.00	***BZ$1,104.00***
Fertilizers Required				
Fertilizer	14-36-12 110 lb	6 bag	59.05 110 Lbs	BZ$354.30
Polyfeed	18-18-18 2 kg	5 pack	13.00 2kg	BZ$65.00
Polyfeed	12-43-12 k ME	8 pack	14.50 kg	BZ$116.00
Crop Finisher	20-5-30 2 Kg	6 pack	12.50 2kg	BZ$75.00
Polyfeed	19-19-19 kg	5 pack	13.00 kg	BZ$65.00
Eco hume	Lt	5	18.00 Lt	BZ$90.00
Sub Total				***BZ$765.30***
Insecticide				
Tryclan	2k	2	58.00 /200 g	BZ$116.00
Rotaprid Gold 37 5 SE/ ACE	250ml	6	30.00/ 250ML	BZ$60.00
Malathion	Lt	2	19.25 Lt	BZ$38.50
Colofluna	Lt	4	28.00 Lt	BZ$112.00
Engeo	Lt	2	198.50 Lt	BZ$397.00
New Mectin	Lt	6	339.00 Lt	BZ$2,034.00
Sub Total				***BZ$2,757.50***
Fungicidie				
Phyton	Lt	1	125.65 Lt	BZ$125.65
Vondozem	kg	15	13.95 1kg	BZ$209.25
Bravo	Lts	10	47.50 1Lt	BZ$475.00
Antracol	km	15	35.00 1 km	BZ$525.00
Rodomil	kg	3	39.95 1 kg	BZ$119.85
Sub Total				***BZ$1,454.75***
Herbicide				
Paraquat	Gallons	2	35.00 1 gal	BZ$70.00
Fusilade	Lt	1	63.50 lt	BZ$63.50
Sub Total				***BZ$133.50***
Labour				
Tranplanting	Days	7	BZ$30.00	BZ$210.00
Fertilizing	Days	4	BZ$30.00	BZ$120.00
Harvesting	Days	40	BZ$30.00	BZ$1,200.00
Spraying P&D	Days	4	BZ$30.00	BZ$120.00
Spraying weeds	Days	2	BZ$30.00	BZ$30.00
Staking	Days	3	BZ$30.00	BZ$90.00
Pruning	Days	5	BZ$30.00	BZ$150.00
Runing string	Days	10	BZ$30.00	BZ$300.00
Fuel	Gallons	40	BZ$11.64	BZ$465.60
Sub Total				***BZ$2,685.60***
Total Operational Cost				**BZ$15,069.37**
Estimated Yield per Acre:70,000 lbs				
	Misc 10%			***$1,506.94***
	Interest 12%			***$1,808.32***
	Cost of producing 1lbs of Tomato		**$ 0.26**	
	Total Cost Of Production			***BZ$18,384.63***

Cost of production- tomato/(Acre)					
Activity	**Amount**	**Price**	**Unit**	**Cost**	**Total**
Plough	2	$50.00	hr	$100.00	
Harrow	1	$50.00	hr	$50.00	
Bedding	1	$50.00	hr	$50.00	
Transplanting	2	$25.00	days	$50.00	
Fertilizer appl.	2	$25.00	days	$50.00	
Irrigation setup	3	$25.00	days	$75.00	
gas	16	$10.40		$166.40	
oil	1	$48.00	gal/gas	$48.00	
SUB TOTAL					**$589.40**
Irrigation					
ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT COST**	**RUNNING COST**	**Total**
PVC ELBOW	2", 900, SCH 40	5 UNITS	3.62	18.1	
PVC PIPE	2" SCH 40	5 FT	2.18	10.9	
PVC CHECK VALVE	2", SCH 40	1 UNIT	19.69	19.69	
PVC TEE	2"	5 UNITS	4.73	23.65	
PVC REDUCER	2"X 3/4"	2 UNIT	2.7	5.4	
PVC PIPE	3/4", SCH 40	5 FT	0.7	3.5	
PVC ADOPTAR	FEMALE, 3/4"	2 UNIT	0.75	1.5	
PVC BALL VALVE	3/4", SCH 40	2 UNITS	4	8	
PVC ELBOW	3/4"	2 UNITS	1.15	2.3	
PVC ADOPTAR	2", FEMALE	8 UNITS	1.05	8.4	
VENTURI INJECTOR	3/4" MALE	1 UNIT	100	100	
PVC CHECK VALVE	3/4"	1 UNIT	3.71	3.71	
PVC BALL VALVE	2"	3 UNIT	16.65	49.95	
PVC ADOTAR	FEMALE 2"	4 UNITS	2.53	10.12	
FILTER	2", SCREEN, 65 GAL/MIN	1 UNIT	350	350	
PVC REDUCER	2"X 1"	1 UNIT	3	3	
PVC ADOPTAR	1" FEMALE	1 UNIT	1.1	1.1	
TAFLON TAPE	1/2" X 520"	1 UNIT	2.05	2.05	
PVC GLUE	8 OZ	1 UNIT	10.97	10.97	
ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT COST**	**RUNNING COST**	**Total**
POLYBARB	2" MALE	8 UNITS	4.5	36	
HOSE CLAMPS	2"	23 UNITS	1.5	34.5	
AIR RELEAF VALVE	1" MALE	1UNIT	35	35	
WATER PUMP	HONDA, 35 M3/HR, 85 FT PRESSURE	1 UNIT	950	950	
POLY BARB	TEE, 2"	1 UNIT	10.5	10.5	
BLUE STRIPE HOSE	P.E. TUBING 2"	1 ROLL	570	570	
IRRIGATION TAPE	0.75 GAL/MIN/100 FT, 1 FTEMMITTER SPACING, 16 MI	17,000 FT(3rolls o	475	1425	
TAKE OFF	16 MM	80 UNITS	2.75	220	
SUCTION HOSE	2"	30 FT	8	240	
					4153.34
INPUTS					
Activity	**Amount**	**Price**	**Unit**	**Cost**	**Total**
Seed(SUMO)	4	$60.00	pk(1,500seeds)	$240.00	
Gaucho	1	$45.85	gram	$45.85	
Confidor	1	$55.50	cc	$55.50	
New Mectin	1	$39.95	cc	$39.95	
Engeo	2	$21.25	cc	$42.50	
phyton	1	$75.00	lts	$75.00	
Manzate/helizab	2	$27.75	kg	$55.50	
Fertilizer				$0.00	
Bayfolan/nitrofoska	3	$7.10	liters	$21.30	
18-18-18	1	$62.25	bags	$62.25	
0-0-60	2	$60.25	bags	$120.50	
multi-k	1	$90.75	bags	$90.75	
MAP	1	$80.75	bags	$80.75	
Helosate	1	$26.50	gallon	$26.50	
string	1	$35.00	roll	$35.00	
sticks	4000	$0.10	unit	$400.00	
Harvesting	6	$25.00	days	$150.00	
SUB-Total					**$1,541.35**
TOTAL COST					**$6,284.09**
Economic analysis					
yield per acre-	Tatal # of tomatoe plants - 4000(8lbs per tree)	32,000			
Total Expense per acre		$6,284.09			

COST OF PRODUCTION 1 ACRE TOMATO

INPUTS	QTY	UNIT COST	TOTAL
Land Preparation			
Plow	1 hr	$40.00	$40.00
Harrow	1hr	$35.00	$35.00
SUB TOTAL			**$75.00**
Seeds	4 pks	$65.00	**$260.00**
Fertilizer Requirements:			
14 -36 -12	2 bags	$36.00	$72.00
Amonium Nitrate	2 bags	$28.00	$56.00
Potassium Nitrate	3 bags	$79.00	$237.00
MOP	1 bag	$63.00	$63.00
Poly Feed(19-19-19)	1 bag	$70.00	$70.00
SUB TOTAL			**$498.00**
Fungicide:			
Phyton	1 litres	$98.00	$98.00
Ridomil	2 kg	$67.00	$134.00
Bravo	2 litres	$38.50	$77.00
SUB TOTAL			**$309.00**
Insecticides:			
Malathion	1 liters	$12.75	$12.75
Pegasus	500 ml	$37.50/250ml	$75.00
Confidor	250 gms	$210./250gms	$210.00
Karate	1 litre	$45.00	$45.00
New Mectin	250 cc	$85.00	$85.00
Indicate	2 liters	$22.00	$44.00
SUB TOTAL			**$471.75**
Herbicide:			
Gramoxone	1 gl	$66.00	$66.00
Fusilade	1 litres	$60.00	$60.00
SUB TOTAL			**$126.00**
Labour			
Fertilizing	1 day	$25.00	$25.00
Harvesting	5 days	$25.00	$125.00
Transplanting	3 days	$25.00	$75.00
Spraying(pest/disease)	4 days	$25.00	$100.00
Spraying(weed ctrl)	2 days	$25.00	$50.00
Staking	4 days	$25.00	$100.00
Pruning	2 days	$25.00	$50.00
SUB TOTAL			**$525.00**
Irrigation Equipment:			
Water Pump 5.5 hp	1	$1,300.00	$1,300.00
Drip Tape	1 roll	$635.00	$630.00
2" Hose	1 roll	$570.00	$570.00
Connectors	50	$2.75	$137.50
Fuel	40 gls	$8.46	$338.40
Accessories			$200.00
Disc Filter	1	$300.00	$300.00
SUB TOTAL			**$3,475.90**
TOTAL			**$5,740.65**

COST OF PRODUCTION OF ONE ACRE OF TOMATOES

16-Mar-15

Ministry of Natural Resources & Agriculture

Activity /Inputs	Quantity	Unit	Unit Cost	Total Cost
Land Preparation:				
Plough	1	acre	$ 60.00	$ 60.00
Harrow	1	acre	$ 40.00	$ 40.00
Bedding	1	acre	$ 40.00	$ 40.00
Inputs				
Seeds	8	pk	$ 115.00	$ 920.00
Confidor (52 g)	5	pk	$ 62.50	$ 312.50
Baythroid	3	liter	$ 111.00	$ 333.00
Antifol	3	liter	$ 28.50	$ 85.50
Antracol	4	pk	$ 18.50	$ 74.00
Ridomil	3	pk	$ 48.75	$ 146.25
Fusilade	3	Liter	$ 62.50	$ 187.50
Spreader Sticker	6	Liter	$ 18.75	$ 112.50
New Mectin	1	liter	$ 300.00	$ 300.00
Fertilizer				
14-36-12	4	bags	$ 67.00	$ 268.00
18-18-18	4	bags	$ 65.00	$ 260.00
Polyfeed (20-5-30)	4	bags	$ 106.00	$ 424.00
Labor				
Seedling care	4	days	$ 30.00	$ 120.00
Transplanting	2	days	$ 30.00	$ 60.00
Fertilizing	4	days	$ 30.00	$ 120.00
Pruning	3	days	$ 30.00	$ 90.00
Staking & Tying	5	days	$ 30.00	$ 150.00
Weed Control	7	days	$ 30.00	$ 210.00
Pest Control	9	days	$ 30.00	$ 270.00
Irrigating	9	days	$ 30.00	$ 270.00
Harvesting	7	days	$ 30.00	$ 210.00
Transportation			$ 300.00	$ 300.00
Fuel	50	gal	$ 8.00	$ 400.00
Oil	1	gal	$ 35.00	$ 35.00
Total				**$ 5,798.25**

Yield/acre (lbs)	BZ$ 25,000.00
Price /lb	BZ$ 1.00
Total Cost	BZ$ 25,000.00
Cost of Production	$ 5,798.25

Investment in Materials & Equipment				
Equipment	Unit	Quantity	Unit Cost	Total Cost
Mistblower (Makita)		1		2845
Crates		30	20	600
knapsack sprayer (20 liter)		2	150	300
TOTAL				3745