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How Agriculture Could Uplift a Nation and its People: Providing Analytical Data to Farmers in Belize

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Agriculture is the bedrock of the Belize economy both nationally and locally with an abundance of varieties of fruits, vegetables, and root crops to choose from. However, in the Stan Creek district, there is a lack of available information and dialogue between the local markets and local farmers. This has led to wildly inefficient production cycles where farmers grow crops based on their gut feelings instead of actual market demands. This has caused large amounts of waste. Farmers overproduce or underproduce causing radical price changes for products that must be imported during a shortage or thrown out during a surplus.

This is the basis for our thesis project here in Dangriga as we hope to better align the supply and demand of the markets to streamline production, decrease food costs, decrease wasted products, and reduce food insecurity. Further, we hope to create connections between local farmers, market vendors, and the final consumers to help stabilize the market and reduce market anarchy.

Global Background

The agriculture sector of a nation serves as the driving force towards achieving high-income status. Economic transformation is predominantly caused by agricultural development which also provides essential steppingstones toward becoming a developed nation. For example, a robust agriculture sector ensures food security and good nutrition for its people. “Therefore, to end hunger and undernutrition while accelerating economic

growth, agricultural transformation must become a reality" (Lin, 2018). History has shown how difficult achieving high-income status is. However, countries that have succeeded did so by prioritizing agriculture to accelerate growth while also tackling hunger and malnutrition. "For example, China's rapid growth in GDP per capita in current US dollars from $155 to $8,123 between 1978 and 2016 was due to this kind of transformation" (Lin, 2018). This source shows that to uplift a nation and its people agriculture must be the first step. Agricultural not only creates economic prosperity but also challenges many of the issues facing Belize right now such as malnutrition and food insecurity. Agricultural is the way forward not only for economic gains but for social as well.

The agricultural sector of the workforce arguably provides the most vital production of commodities for survival in developing countries. "For example, the World Bank (2007) has reported that 75% of poor people in developing countries live in rural areas and depend on the agricultural sector" (Nugroho A.D., 2021). This data reveals that those living in poverty require the work of rural farmers to survive and feed their families. However, most rural farmers battle the disadvantages of limited education, poor health, and poverty (Nicholas-Ere, 2017). These disadvantages prevent rural farmers from reaching their full potential and consequently, limit the quality of life for the people in the community who depend on these crops. Farmers often receive information from various sources within their communities and use this information to plan their production (Owusu et al., 2017). Unfortunately, this pooled information varies in accuracy causing economic uncertainty "when farmers utilize it, especially in the case of asymmetric information resulting in price fluctuations or price volatility." (Owusu et al., 2017). Price volatility reduces farmers' income and consumers' purchasing power. Additionally, it "disrupts agricultural markets

and investments, and increases the share of food expenditure over total consumption or food insecurity" (Owusu et al., 2017). Price volatility also has an impact on the use of labor. When agricultural product prices are low, children and adolescents are employed to replace adults on the farm (Beck et al., 2018). This puts additional stress on local families who are already struggling to make ends meet and provide their children with proper education. Additionally, the lack of accurate information to plan crops negatively affects the health of the people within the community. When prices increase, this leads to increased infant and child mortality, undernourishment, and food importation (Lee et al., 2013). That is why it is so important for farmers to have access to accurate information regarding the supply and demand of their crops. Lives are at stake. To summarize, a vast majority of those in poverty in rural areas depend on farmers to survive; unfortunately, farmers are not equipped with accurate data to properly support the community's needs and this poses a great threat to the survival and health of the people and the economy.

The significance of information as a tool is often overlooked; however, it is important to note that information is a necessity for survival and can be utilized in many ways, such as in farming (Odini, 2014). For example, "information can be used as a powerful tool for empowerment, as it takes away ignorance and enables an individual to be enlightened and bold" (Nicholas-Era, 2017). That is why the limitation of access to information such as schooling, community data, and public policies causes an enormous negative impact on the community. Information is the driving force of modern society and will permanently serve as a vital tool in any community, society, or organization (Idiegbeyan–Ose & Akpoghome, 2009). Information is the most versatile tool known to man, yet not everyone has access to the information they need for their careers, goals, or

desires such as the rural farmers in Belize. Information is the number one way of increasing productivity in any field, especially agriculture. “Knowledge and information play a central role for farmers to respond to opportunities that could improve their agricultural productivity” (Nzonzo & Mogambi, 2016). Essentially, agricultural information is vital to growing small-scale agricultural production and linking that production to new, lucrative markets, “thus leading to improved rural livelihoods, food security, and national economics” (Masuki et al, 2010). For example, precision agriculture is designed to maximize agricultural production by utilizing a foundation of confirmed information rather than guesses or estimates “and is often described as the next great evolution in agriculture” (Mittal & Tripathi, 2009). These sources further the idea that information is the key to agriculture success and is the single best way to uplift not only local communities but uplift entire nations as well.

Belize Background

Belize, while boasting a robust climate for agriculture, has higher on average undernourishment (15%), growth stunting (12.9%), overweight children (7.3%), obesity in adults (22.4%), and diabetes in adults (17%) than its fellow Central American countries. This is what has been called the ‘double burden of malnourishment’ and ‘Obesity Paradox’ which states that food insecurity leads to higher rates of obesity and diabetes due to low-quality processed foods that are often cheaper than high-quality foods. In 2016 the Food and Agriculture Organization found that 28% of Belizeans eat less than they should due to a lack of money or other resources—and 9% are in extreme food poverty meaning they do not eat for an entire day or more.

Next, while being considered an upper-middle-income country in the world, the United Nations International Children's Emergency Fund (UNICEF) has found that 42% of the population lives in poverty and that 58% of Belize youth under 18 are classified as multi-dimensionally poor. UNICEF along with United Nations Economic Commission for Latin America and the Caribbean have estimated that six out of ten children in Belize lack access to at least one of the following basic needs: adequate nutrition, clean drinking water, proper sanitation, adequate housing, and or access to education and information.

With agriculture being the backbone of the Belize economy, many officials in Belize believe in its power to uplift the country and its people. Supporting this belief, the World Bank stated that agriculture is the most important economic sector in Belize in terms of income generation, employment, food security, and poverty alleviation. Agriculture also plays a large role in tourism as some of the largest buyers for farms and markets are hotels, resorts, and restaurants that feed tourists from around the world. This is a great connection we were able to make with the tourism team that helped us in our research. In addition to this agriculture makes up more than 18% of formal occupations in Belize and over 70% of informal occupations in rural areas.

In 2015 the Belize Government, along with various private and national organizations, identified five pillars to better the agricultural sector. The five pillars or objectives of the National Agriculture and Food Policy of Belize are:

1. Sustainable Production, Productivity, and Competitiveness
2. Market Development, Access, and Penetration
3. National Food and Nutrition Security and Rural Livelihoods

4. Sustainable Agriculture and Risk Management
5. Governance Accountability, Transparency, and Coordination

My team partnered with the Ministry of Agriculture of the Stan Creek district in Belize to focus on Pillar three: National Food and Nutrition Security and Rural Livelihoods. The goal of this pillar is to ensure food security for the country by increasing local production and decreasing food imports by substituting local products. This is especially important for Dangriga where the vast majority of food is imported. These imports lead to increased costs, making it harder for more people to access fresh, high-quality food.

Demand Survey and Analysis

To combat these issues and help the local community my team began by issuing two buyer demand surveys to all local market vendors. There was one survey for vegetables and one for root crops each consisting of a mix of qualitative and quantitative questions adding up to 28 questions each that you can see in Figures 1 & 2 below. The best way to administer these surveys was going through the questions orally with each market's owners/workers and writing down their responses ourselves. This allowed us to treat each survey as a conversation. The benefit of this was creating a friendlier atmosphere that made the person we were interviewing much more comfortable and willing to collaborate. While the national language of Belize is English, as Belize was once a British colony, my team was surprised to find that Spanish-speaking immigrants ran four out of the seven markets surveyed in Dangriga. My partner Sergio is a native Spanish speaker and was able to conduct the surveys in Spanish when necessary, saving our team lots of trouble. Next, our team traveled to Hopkins, another small town in the Stan Creek district, to continue the

survey process. Here we surveyed three markets that provide for both the local people and the resorts in the Hopkins area. This was step one of research and fielded us all our starting information that we would later analyze to produce estimated demand.

Next, our team consolidated all the quantitative data into excel and created a table and graph to visualize a starting point for estimated demand (Figure 3). From here we refocused on the massive amounts of qualitative data we received from the surveys. During the interview process, we received lots of information regarding the routine issues that plague the farmer-vendor relationship. Every market vendor in the Stann Creek district had the common grievances of stability/reliability in delivery, consistency in quality, and variety. To address all these issues a brief write-up was made and presented to local farmers. This write-up presented all the issues mentioned above directly to the farmers and showcased what we believe are the most important steps farmers should take.

Most importantly is building a relationship between the local farmers and vendors by opening a line of communication. Creating a relationship will allow for vendors to request directly from the source providing the vendors with a guaranteed supply and the farmer with a guaranteed buyer. These relationships will also help to address two of the three main grievances internally. By connecting the two parties, stability/reliability in delivery and variety of products can be settled through communication. The closer together vendors and farmers can work the more streamlined their businesses will run. These direct relationships also help to provide much-needed quantitative data to farmers on how much product they can expect to sell and therefore plan their harvest accordingly.

As relationships grow vendors can have direct connections to all their products through local farmers, which lowers costs for everyone involved including the final

consumer. These steps will help not only the farmers and vendors in business, but also accomplishes the third pillar's goal to ensure food security for the country by increasing local production and decreasing food imports by substituting local products. Finally, remains the problem of consistency in quality. As I do not know agriculture or the specific reasons behind the lower quality harvests, I must recommend the ministry of agriculture work to further educate all farmers on the best practices. As mentioned in my literature above, information and education are the driving forces of improvement. Therefore, the best plan of action is to further educate and provide information to the farmers. This includes aiding in upgrading current facilities where possible to meet quality demands. According to the responses from vendors, most of the vegetables and root crops sold in Stann Creek come from the Cayo district, Belmopan, and even Mexico and Guatemala. This leaves the Stann Creek district with a huge opportunity. High transportation costs and recent global inflation means locally produced vegetables not only create profit for farmers and vendors but provide high-quality fresh products at the lowest cost to the consumer.

The second portion of the write-up focused on the quantitative numbers we received from our interviews. Since these vendors do not keep formal records throughout the year our numbers in this section are not exact but estimated with the knowledge available to the vendors themselves. The information in Figure 3 was presented to the farmers to help create a starting point for their production. As mentioned above most farmers grow crops based on a 'gut feeling' as opposed to actual data, so we tried to create a starting point for them. Our idea here was to provide a tentative demand for the month we surveyed for the farmers to start their production based on. Because there was no backlog of data our team was unable to create any sort of demand based on past instances

and had to use only our source data. This was the most apparent shortcoming of our project and therefore, I state clearly that this is a starting point for the farmers.

Finally, I would like to address the government's involvement in the agriculture markets and some of the responses we received from the vendors themselves in our surveys. We asked each vendor to give us their own opinion on current issues as well as ways to address them. This helped us learn a lot about the day-to-day issues that affect these vendors. We discovered that import bans were one of the most routine annoyances for vendors and consumers alike. During certain times the government will ban the import of some products to help protect local farmers. While I and the vendors understand the good intentions, many issues were brought to my attention. As mentioned before locally produced products are often not of the variety nor quality expected by the vendors. This means that during times of import bans vendors are being forced to buy lower-quality products. Many times, at higher prices as well because of the reduced supply due to the ban on imports and the lack of accurate information in local agriculture. I believe that by trying to protect local farmers the government of Belize has unintentionally allowed Belize farmers to be less competitive while making the vendors and consumers suffer the consequences of lower quality at higher prices. The best way to support Belize farmers is to push them to be the most competitive they can be. This is done by providing up-to-date information as well as technology to Farmers, not by providing them an artificial monopoly on the market. Every vendor shared this sentiment. Vendors believe the government should remove the import bans that are hurting their own and customers' pockets, and instead should invest in local farms. Many vendors also stated their hope that the Ministry

of Agriculture would continue to do surveys. These surveys assess local demand as well as talk to vendors about real issues that can be relayed to farmers continually.

During my time conducting this project, I learned so much about the state of agriculture in Belize. Many of the routine issues facing agriculture are things we take for granted in the states. Lack of education and available information makes farming that much more difficult in Belize. Whereas in the states farmers and vendors alike can rely on high-quality government and private databases of information. It is not that the people of Belize do not know how to farm, they do not have the knowledge or information available to know how much to plant, or when to harvest. They are not educated in the newest and most efficient way of farming or do not have access to reliable measures of protection against nature such as flood or pest control. These are key examples of why providing information to everyone involved in agriculture is the single most important way to improve the agriculture sector of Belize and Stann Creek specifically.

This is where the project leaves our hands to be continued in the future. More demand surveys need to be done each month to continually supply these farmers with information until they have a healthy production cycle. We believe steps must be taken to create a database of local demand to create that backlog for the future. Doing the very same sort of surveying that Sergio and I did each month rather than just 1 month out of the year could create a forecast for the future. Next, we believe that an online database of these years' information should be made available for farmers to use. Without accurate information, the wildly out-of-sync production cycles that we see in the Stann Creek district will continue to repeat themselves. This is a long-term project, and our project is just a

small piece of it. Belize, its farmers, and the Ministry of Agriculture must continue to work towards the goal of developed local agriculture systems.

Reflections

Reflecting on my time in Belize I learned so much not only about how to work, but mostly how to live and define myself. Firstly, in the United States, we treat our job as an extension of ourselves and define ourselves by our profession. This has led to jobs being a status symbol in the United States where we feel that we can judge a person based on their job. For example, we see people with high-paying, competitive jobs as inherently better people than those who work in what you might call less viable professions. Further, this has created an environment in the United States that I will call material fulfillment. Where this obsession with work and increased wealth is believed to be the key to fulfillment and that only the affluent are winners. This could not be further from the truth from what I have witnessed in Belize. The happiest, most loving, fulfilled people I have ever met in my life are here in Belize and have seemingly nothing compared to what we even consider poor in the states. Now I do not believe this is an individual mindset of each person, rather it is an extension of the culture of Belize that manifests itself in the unconscious of its citizens. In the United States, we begin almost every interaction with a new person with "What do you do/study?" and from a young age we ask every child "What do you want to be when you grow up?" only furthering this idea that your profession is what defines you. During my time in Belize however not once was, I asked this. I was constantly bombarded with questions about how I am enjoying Belize, its food, and its people. I was of course asked my reason for being in the country and would respond with a typical answer about studying abroad and working, but quickly I understood that in Belize work was just that,

work. The people were interested and excited about our projects, but they did not treat us or their fellow human beings differently because of the work being done.

I learned that I want to use my Economics and Finance Majors along with my business knowledge to uplift and help people around the world. To go along with what I said above I began my journey in business to gain that material fulfillment. I wanted to earn my degree and begin working for large companies to earn material things. However, after this trip, my eyes have been opened and my goals in life completely redefined. I have learned that connecting with people and living my life for myself and others as opposed to working each day for the purpose of a check is my key to fulfillment. Further, before this trip, I had no idea the extent to which business to take me. I knew that business could do good, but my entire image of work was sitting in an office pushing out work until the day was over so I could go home and relax until I had to do it all again. Once again, this trip opened my eyes to the possibility of my degree. This trip helped me realize that I do have control over my life and career. That I do not have to simply follow the path laid out in front of me by my forefathers, but that I can change my reality to fit my life.

Next, I learned so much about hands-on work, especially in a developing country that I hope to carry with me foreword in my career and life. I came into this project with a work-only mindset, but that is not how you make progress. Especially when working hands-on in a community you must first immerse yourself in their culture and then work to make connections with the people. Simply going into these people's lives and treating them like a statistic for your work will not get you or your project anywhere. I learned this early on as the best way to get information for my project was to just talk to the people before surveying them. Firstly, this will give you a much better perspective on your work and how

it will help people's material conditions. Next, when working hands-on in a community you come in as an outsider and must prove yourself to be a force for good. The best way to do this is to make human connections. This is exactly what my group did as we talked to each market vendor without the intention of surveying them for days, maybe a whole week, before we came back with questions.

Finally, I want to thank the University of Arkansas, PeaceWorks, and Dr. Amy Farmer for facilitating this incredible experience for myself and the others. Additionally, I would like to thank the Belize Ministry of Agriculture and everyone we worked with in the district for allowing us to research and complete our project. Without the cooperation of everyone involved, I and the others would not have been able to have such a fulfilling experience where we learned not only valuable work skills but invaluable life skills.

Figure 1

Buyer Demand Survey (Root Crops)

Dangriga and Hopkins Root Crops

Buyer Survey

General Information

Business name	
Address	
Business employee surveyed	
Name of person completing survey	

	Product Type	
1	What vegetable products do you currently stock?	
2	Which of the root crops products are source outside the village?	
3	What root crops products do you source in the village?/ area	
4	How many suppliers are you currently sourcing from?	
5	Are you interested in increasing your number of suppliers? If so, why?	
6	How much product, and which rootcrop products, would you like to increase local sourcing of?	
7	Are you interested in stocking Cerebuitu cereal?	
	VOLUME & REQUIREMENTS	
8	How much of each vetable product would you be interested in sourcing per week/month?	
9	Cerebuitu Cereal (lbs/week)	
10	Cassava (lbs/week)	
11	cocoyam (lbs/week)	
12	Sweet potatoes (lbs/week)	
13	Yam/ Yampi (lbs/week)	
14	Are there any months in particular that you would like to source, or have more rootcrops products available to your customers?	

15	What are your main type of customers for rootcrop products? (i.e. households, companies, hotels)	
16	Do you have a preferred size or variety of rootcrop products?	
17	What frequency of delivery do you require for each product	
18	Does the supplier need to package?	
19	Does the supplier need to deliver?	
20	When should it be delivered (day/time)?	
21	What is a suggested price range you would be willing to pay for desired rootcrop products?	
22	What are your payment terms?	
23	What are the most important requirements a local supplier must meet to continue to work with you?	
24	Do you have any requirements as to the inspection and acceptance of products?	
25	Does the rootcrops need to come from the same farm? (i.e. do you accept farmers to aggregate product to meet your volume requirements?)	
26	What do you require in terms of traceability of products from farms?	
27	What are your biggest challenges at the moment in sourcing local root crops products?	
28	In your opinion, how could this be improved?	

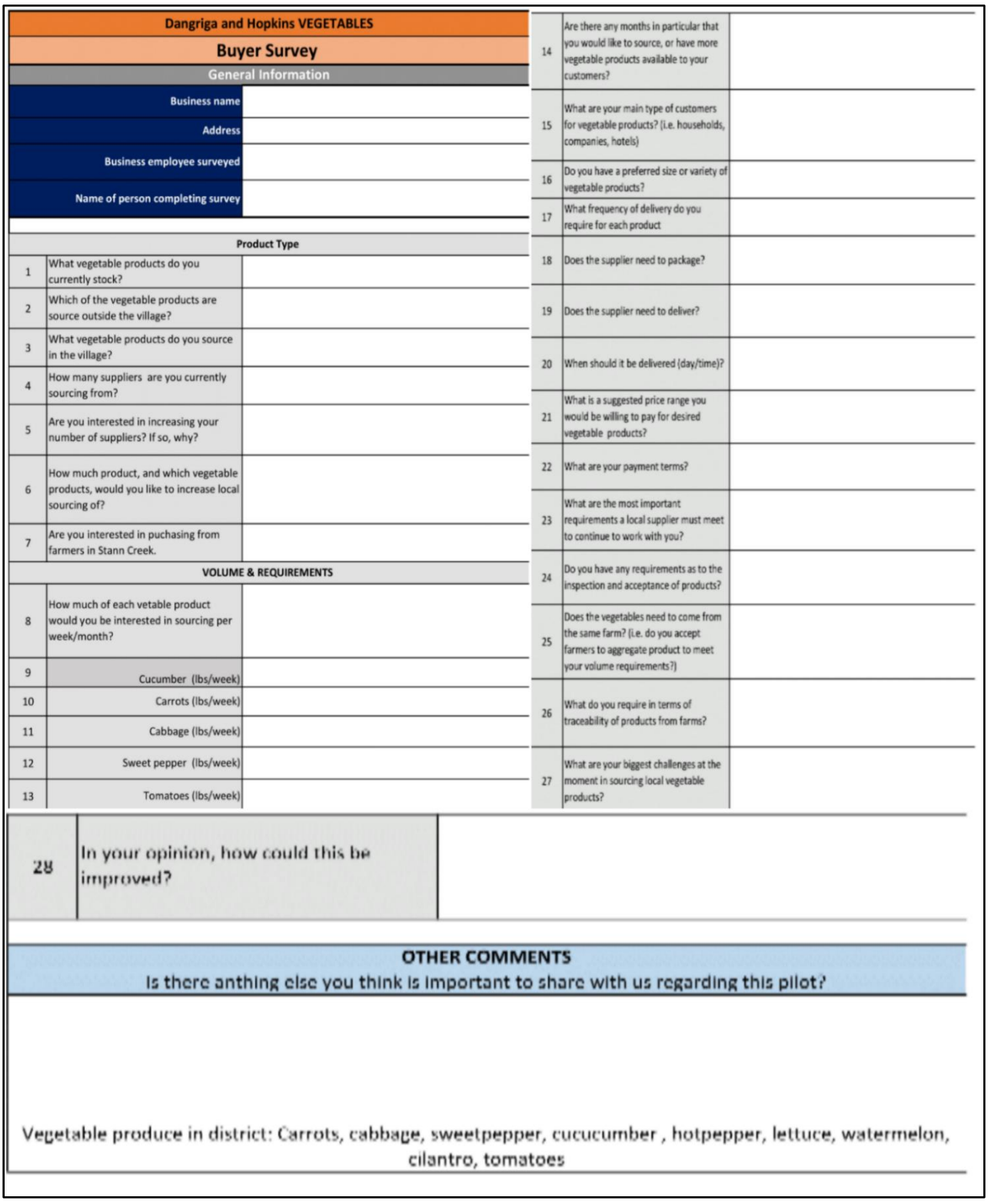
OTHER COMMENTS

Is there anthing else you think is important to share with us regarding this pilot?

Root crops : Cassava, Cocoyam, Dasheen, Sweet potato, Yam ,Yampi ,

Figure 2

Buyer Demand Survey (Vegetables)



Dangriga and Hopkins VEGETABLES

Buyer Survey

General Information

Business name	
Address	
Business employee surveyed	
Name of person completing survey	

Product Type

1	What vegetable products do you currently stock?	
2	Which of the vegetable products are source outside the village?	
3	What vegetable products do you source in the village?	
4	How many suppliers are you currently sourcing from?	
5	Are you interested in increasing your number of suppliers? If so, why?	
6	How much product, and which vegetable products, would you like to increase local sourcing of?	
7	Are you interested in puchasing from farmers in Stann Creek.	

VOLUME & REQUIREMENTS

8	How much of each vetable product would you be interested in sourcing per week/month?	
9	Cucumber (lbs/week)	
10	Carrots (lbs/week)	
11	Cabbage (lbs/week)	
12	Sweet pepper (lbs/week)	
13	Tomatoes (lbs/week)	

14	Are there any months in particular that you would like to source, or have more vegetable products available to your customers?	
15	What are your main type of customers for vegetable products? (i.e. households, companies, hotels)	
16	Do you have a preferred size or variety of vegetable products?	
17	What frequency of delivery do you require for each product	
18	Does the supplier need to package?	
19	Does the supplier need to deliver?	
20	When should it be delivered (day/time)?	
21	What is a suggested price range you would be willing to pay for desired vegetable products?	
22	What are your payment terms?	
23	What are the most important requirements a local supplier must meet to continue to work with you?	
24	Do you have any requirements as to the inspection and acceptance of products?	
25	Does the vegetables need to come from the same farm? (i.e. do you accept farmers to aggregate product to meet your volume requirements?)	
26	What do you require in terms of traceability of products from farms?	
27	What are your biggest challenges at the moment in sourcing local vegetable products?	

28	In your opinion, how could this be improved?	

OTHER COMMENTS

Is there anthing else you think is important to share with us regarding this pilot?

Vegetable produce in district: Carrots, cabbage, sweetpepper, cucucumber , hotpepper, lettuce, watermelon, cilantro, tomatoes

Figure 3

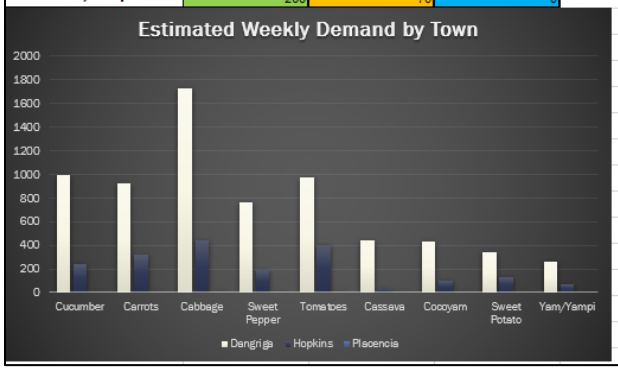
Estimated Demand Charts

Stan Creek District, Belize

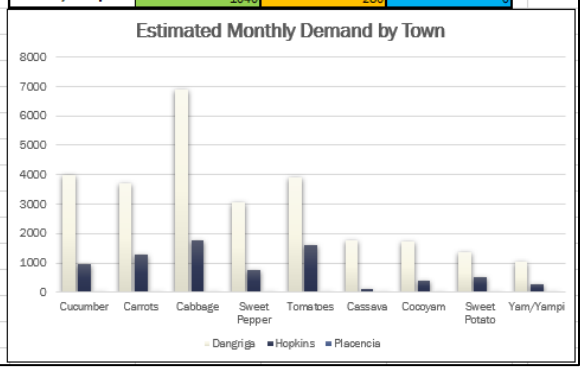
Vegetable/Root Crop Demand

Demand Forecast

Town Name	Dangriga	Hopkins	Placencia
Type of Crop	Demand on a weekly Basis in lbs		
Cucumber	995	245	0
Carrots	925	325	0
Cabbage	1725	440	0
Sweet Pepper	760	190	0
Tomatoes	975	400	0
Cassava	440	25	0
Cocoyam	435	100	0
Sweet Potato	340	130	0
Yam/Yampi	260	70	0



Town Name	Dangriga	Hopkins	Placencia
Type of Crop	Demand on a Monthly Basis in lbs		
Cucumber	3980	980	0
Carrots	3700	1300	0
Cabbage	6900	1760	0
Sweet Pepper	3040	760	0
Tomatoes	3900	1600	0
Cassava	1760	100	0
Cocoyam	1740	400	0
Sweet Potato	1360	520	0
Yam/Yampi	1040	280	0



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