Small Amaranth Farm

A Business Plan

Prepared for Catholic Relief Services, Guatemala

2014 Notre Dame Business on the Frontlines Team

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I. INTRODUCTION

1.1 Dedication

Representatives from the University of Notre Dame graduate schools of Business, Law, Biology, and Peace Studies respectfully offer this business plan in support of the mission of Catholic Relief Services, Guatemala, for whose friendship and example of servant-leadership we are most grateful.

1.2 Vision Statement

Catholic Relief Services seeks to eradicate malnutrition and poverty in rural Guatemala, by investing in the development of nutrient-dense, economically viable agricultural value chains.

1.3 Mission Statement

The mission of this business plan is to improve the nutrition of all Guatemalans and create sustainable economic opportunities for rural farming families, by promoting the production, consumption, and surplus sale of safe, healthy, locally-produced amaranth.

1.4 Executive Summary

The nutritional and economic challenges of small-scale farming families in San Marcos and other rural areas of Guatemala are significant, with high levels of malnutrition resulting from both low incomes as well as limited access to healthy foods. Meanwhile, demand for niche health foods is growing among consumers in urban markets, driven by health concerns and lifestyle trends. In Guatemala City, there is a rising, unmet demand for gluten-free and vegan products, particularly grain amaranth.

Our analysis of the Guatemalan amaranth value-chain and global amaranth market included interviews with multiple farmers, growing associations, retailers, consumers, exporters, and experts. Two key findings include:

1. Supporting amaranth cultivation in rural communities is a viable strategy to address malnutrition and improve standards of living, by forming the cornerstone of a nutrient-rich and economically attractive value chain.
2. In the cases we examined, the factors most critical to the success of an amaranth project include seed selection & technical training, dietary behavioral change programs, and strong organization at the intermediary level of the value chain to connect farmers to markets.

To implement these findings, we propose the following business plan for a small-scale producer cultivating 1-2 cuerdas (1 cuerda = 25 m x 25 m) of amaranth. This business plan synthesizes the best practices we observed and studied and offers general guidelines for the considerations required when developing a small-scale amaranth production project.

1.5 Assumptions

We make several assumptions in this business plan, informed by our field research:

1. First, while we use amaranth as the focus crop for this business plan, we assume that farmers have additional land available to cultivate other dietary staples and will diversify their planting.
2. Second, it is understood that a significant portion of the startup inputs, detailed in this report, are already owned or will be covered by grant money from a sponsoring NGO, growers association, or other sponsoring organization.
3. Third, all calculations in this report assume that farmers consume about 30-40% of their amaranth production and sell only the remaining 60-70%. This or a similar benchmark is necessary to ensure that the tandem goals of improving family nutrition and economic health are both achieved.
4. Finally, this proposal assumes that an organization such as a farmer's association, cooperative, or other entity provides technical assistance to farmers in the form of agronomical research and training, and also connects producers to markets by purchasing surplus yield for resale.

II. ABOUT AMARANTH

2.1 Overview

For thousands of years, amaranth was the primary staple food of the indigenous peoples of Central America. After the Spanish Conquistadors arrived in the Americas, their influence eliminated the use of amaranth. In the 1970s, grain amaranth was reintroduced to the world for food use and it has continued to spread throughout the world until today.[i]

Amaranth can be consumed in three main forms: raw seed, flour, and popped. Since milling and popping the seed takes time and resources, amaranth flour and popped amaranth sells at a premium, compared to raw seed.

Amaranth has two main benefits: First, it is high in nutrition, boasting a very high percentage (14%) of well-balanced protein that is high in lysine. Second, amaranth is relatively easy to grow. It is drought tolerant and can be grown in a variety of soil types.[ii] These dual benefits make amaranth a promising crop to help fight malnutrition.

2.2 Nutritional Information

Both the grain and leaves of the amaranth plant provide important nutrients. Relative to corn, the staple crop of Guatemala, amaranth outperforms in most important aspects of nutritional content, having a higher amount of protein, fiber, fat, calcium, iron, calories, folate, and zinc.

Grain Amaranth Nutrition Facts

Protein: Amaranth has 14.5 g of protein per 100 g of grain, which is higher than most major grains such as wheat (10.7 g), corn (9.4 g), and brown rice (6.5 g). Oats are the only major grain with higher protein content than amaranth (16.9 g) (*Figure 1).* Both amaranth and oats have more protein than an egg (12 g per 100 g).

Lysine: Amaranth also has high lysine content, which is an essential amino acid that the body cannot synthesize and so must be supplied in the diet. Amaranth's lysine content is higher than most grains and comparable to legumes and some animal products (*Figure 3).*

Calcium: Amaranth has 153 mg of calcium in 100 g of grain, which greatly exceeds the calcium of all other major grains (Oats – 54 mg, Wheat – 34 g, Corn- 7 mg, Brown Rice – 3 mg).

Iron and Zinc: 100 grams of amaranth grain also contains 7.6 mg of Iron and 3.2 mg of Zinc. This iron content is higher than all other grains (Wheat – 5.4 mg, Oats – 4.7 mg, Brown Rice – 4.23 mg, Corn – 2.7 mg) and the zinc content is higher than both corn (2.2 mg) and brown rice (1.1 mg).

	Amaranth	Brown Rice	Wheat	Corn	Oats
Protein (g)	14.5	6.5	10.7	9.4	16.9
Fiber (g)	9.3	2.8	12.7	7.3	10.6
Fat (g)	6.5	0.5	2.0	4.7	6.9
Carbohydrates (g)	66.2	79.2	75.4	74.3	66.3
Calcium (mg)	153.0	3.0	34.0	7.0	54.0
Iron (mg)	7.6	4.23	5.4	2.7	4.7
Calories (kcal)	374.0	358.0	340.0	365.0	389.0
Folate (mcg)	49	231	41	19	56
Zinc (mg)	3.2	1.1	3.5	2.2	4.0

Figure 1: Nutrition Content of 100 grams of Amaranth Grain.[iii]

Leaf Amaranth Nutrition Facts

In addition to its grain, the amaranth plant's leaves, commonly referred to as *bledo*, in Guatemala, are also highly nutritious and contain more calcium, phosphorous, and vitamin C than both Swiss Chard and Spinach[iv](*Figure 2)*.

	Amaranth, boiled	Swiss Chard, boiled	Spinach, boiled
Calories (kcal)	21.0	20.0	23.0
Carbohydrates (g)	4.1	4.1	3.8
Protein (g)	2.1	1.9	3.0
Calcium (mg)	209.0	58.0	136.0
Phosphorous (mg)	72.0	33.0	56.0
Iron (mg)	2.3	2.3	3.6
Vitamin C (mg)	41.1	18.0	9.8
Fiber (g)	n/a	2.1	2.4
Folate (mcg)	57.0	9.0	146.0
Zinc (mg)	0.9	0.3	0.8

Figure 2: Nutritional Content of 100g of Amaranth Leaves, cooked with Salt.[v]

Amaranth In Nutrition Programming

Research has demonstrated that amaranth has been effective in addressing malnutrition. A study in Mexico showed that one spoonful (13 g) of amaranth protein concentrate per day reduced mild to moderate child malnutrition by 75%. Prior to the addition of amaranth to the diet, the numerous intervention attempts to reduce malnutrition had not had a success rate over 8%. The researchers project that two spoonfuls (23 g) of amaranth protein concentrate per day could reduce severe malnutrition.[vi]

Amaranth For Nutrition Programming in the Western Highlands Food Desert

The Optifood analysis tool assessed the Western Guatemalan Highlands food basket and concluded that residents of that region had insufficient access to nutrients.[vii] The tool demonstrated that a combination of regionally available foods, including tortillas, potatoes, beans, eggs, green leafy vegetables, and a fortified cereal known as Incaparina, along with breast milk, could almost satisfy children's nutrient needs, except for two key nutrients - iron and zinc, which are especially critical for children ages 6-8 months.[viii] Because amaranth is practical, nutrient-dense, and affordable, it may be able to help fill these nutrition gaps and make a nutritious diet more realistic for many with limited access to a variety of healthy foods.

Plant vs. Animal Protein in Nutrition Programming

There is some debate over whether plant-based protein sources are sufficient, as the foundation of malnutrition interventions. Despite the high nutrition content of grains like amaranth, the World Health Organization (WHO) currently recommends that animal protein be prioritized over plant protein, when fighting malnutrition. This recommendation is based, in large part, on the fact that animal proteins tend to be more easily digestible and higher in biological value than plant proteins[ix] and that plant-based diets tend to be low in iron, zinc, and calcium.[x] Fortunately, amaranth comes very close to animal-based foods proteins in providing a nutrient-dense, balanced protein source.

Protein, Digestibility, and Biological Value: Animal protein sources usually contain all essential amino acids in similar proportions to those needed in human diets. Plant proteins can be substituted for animal proteins but the correct balance is needed to ensure that all essential amino acids are contained in the diet.

Food digestibility refers to how easily a food is broken down and its nutrients absorbed. Biological value measures the proportion of protein that will be incorporated into a person's body by assessing how much of the protein will be used to synthesize other important proteins in cells. The biological value of a food is often limited by the amount of lysine it contains, lending credence to the WHO's preference for animal proteins over grains, which are typically low in lysine.

Fortunately, amaranth is a grain that is extremely high in lysine (*Figure 3*). On average, grains have approximately 200 mg/g N lysine.[xi] By contrast, amaranth has approximately 370 mg/g N lysine.[xii] This level of lysine is much closer to dairy products, such as milk (327-487 mg/g N) or eggs (436 mg/g N), compared to most grains or other non-legume vegetables.[xiii] With these high levels of lysine, the body can utilize the high levels of amaranth protein, just as it would an egg.

Food	**Lysine (mg/g N)**
Amaranth[xiv]	372
Maize[xv]	167
Oats[xv]	232
Rice (brown)[xv]	237
Wheat (whole grain)[xv]	179
Legumes (average)[xv]	376
Egg[xv]	436
Chicken[xv]	497
Cow milk[xv]	487
Goat milk[xv]	327

Figure 3: Lysine Content of Common Grain and Animal Protein Sources.

For comparative purposes, an egg has a biological value of 100%. Amaranth has a biological value of 90.4%, when raw, and 85.4%, when popped.[xvi] In comparison, milk has a biological value of 84%, beef 74.3%, wheat 64%, and corn 60%[xvii](*Figure 4*). The biological value of amaranth can actually increase when toasted at temperatures between 170°C - 190°C, but most popped amaranth is made by toasting it at temperatures higher than 190°C, causing its biological value to decrease, as described above.[xviii]

Nutrient Content: Plant-based diets are usually low in iron, zinc and calcium.[xix] But amaranth has higher iron, zinc and calcium content than egg. Per 100 g, amaranth contains 7.6 mg iron, 3.2 mg zinc and 153 mg calcium, while egg contains 1.2 mg iron, 1.1 mg zinc and 50 mg calcium.[xx] Many other grains have comparable zinc and iron levels to amaranth or egg, but amaranth has unusually high calcium content for a grain. This high nutrient content should make a diet that includes amaranth closer to a complete diet than other plant-based diets.

One individual plant will never be able to compare to animal sources of protein, but because of its high biological value, high nutrition content, and high nutrient content, amaranth can be considered a protein source that is almost equal to most animal sources of protein.

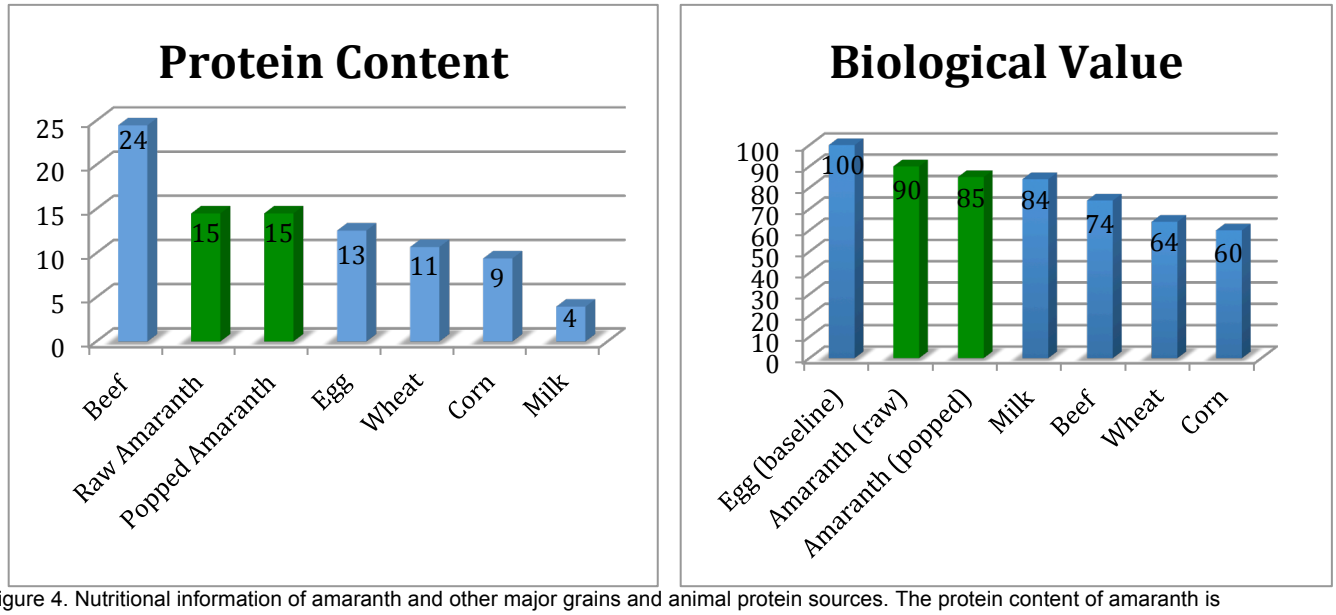

Figure 4. Nutritional information of amaranth and other major grains and animal protein sources. The protein content of amaranth is higher than the content of the comparable weight of an egg. Amaranth has a higher biological value than other major grains and a biological value just below egg, the common food with the highest biological value.

2.3 Cultivation

Amaranth is resilient, easy to grow, and can thrive in many types of environments. As a C_4 plant, amaranth is drought-tolerant and can even be revived after wilting from lack of water. In Guatemala, amaranth can be grown during different months, depending on the region. Amaranth growing seasons vary by region but generally sync with the corn-growing season of each reason. In most areas of Guatemala, the amaranth growing season lasts 3-4 months, from planting to harvest. In other regions, such as the western highlands in and around San Marcos, the season is a more lengthy 8 months. Some farmers plant amaranth together with corn. Others use the same field for amaranth and corn but alternate the two crops, growing one during one season and the other immediately afterward. Optimal timing of planting and harvest can mitigate exposure to seasonal environmental risks, including frost or fungi.

Amaranth Varieties

While there are numerous species of amaranth plants, only three are used for grains – Amaranthus caudatus, Amaranthus cruentus, and Amaranthus hypochondriacus. Another variety of the amaranth plant is Amaranthus retroflexus, a redroot amaranth which is frequently harvested for its leaves and consumed as a vegetable. This leaf is popular because it grows without any cultivation, but this variety does not produce quality seeds for consumption. Unfortunately, seeds from these suboptimal Amaranthus retroflexus plants easily breed with those of higher-quality grain amaranth plants, which can lead to severely reduced yield. The risk of cross-breeding must be considered during any amaranth seed selection or seed saving process.

Note: The term *bledo,* which is commonly used to refer to amaranth leaves, is also used colloquially to refer to Amaranthus retroflexus.

Low-yield Amaranthus retroflexus (left) vs.

Higher quality grain amaranth (right)

The Growing Process

Sowing: Amaranth plants are sown using two different techniques. The first method is to scatter the seed randomly or in pots and then thin or replant once the seedlings have reached a certain height. According to the second technique, seeds are spaced evenly along a raised line.

Field Observations: In some regions, farmers planted amaranth side-by-side with corn. In these cases, some farmers preferred to sow the plants in close proximity, so that the stronger corn stalks would protect the amaranth from wind, while others thought it was better to plant the crops further apart, so plants could grow taller, reaching more sun and helping to prevent fungus.

Watering: Though amaranth is drought-resistant, optimal amaranth cultivation requires more water than corn. For example, amaranth plants will wilt after 4 days without water, while corn can withstand 15-20 days before wilting.

Field Observations: We met with farmers who watered crops by hand, using jugs of well-drawn water as well as two farmers who utilized basic irrigation systems. The irrigation systems we observed included a hose/pump system and the “mariposa” sprinkler system. All of these farms we visited were located relatively near water sources.

Fertilization: Amaranth fertilization practices vary widely in Guatemala. In some regions, we observed that organic fertilizer made from decayed material from the previous harvest was the only fertilizer used. In other areas, store-bought chemical fertilizer was the main fertilizer applied. The amount of fertilizer also varied, depending on the region and the soil.

Field Observations: Members of the Kulb'aalib' Xe'chulub' association used an average of four sacks of fertilizer (400 pounds) per cuerda. Some farmers found using urine and garlic was an effective way to fumigate their amaranth plots. Their yields were usually 30 lbs of amaranth seed per ¼ cuerda, using 1 sack (100lbs) of fertilizer.

Harvesting: The process of harvesting amaranth is slightly more labor-intensive than corn harvesting, requiring an average of five additional harvest days per cuerda. Most farmers harvest amaranth by hand, according to the following process:

1. Grain heads are snapped or cut from the stalk and collected in a pile (using a tarp helps collect any seeds which fall off).
2. Leaves are removed from the stalk (these leaves can then be saved for organic fertilizer/compost or fed to livestock).
3. The grain head is rubbed between hands or against a strainer to separate out the seeds.
4. Debris is captured, using a strainer, and the seeds collect in a basket beneath.
5. Further unwanted debris is separated from seeds using wind or a fan.
6. Seeds are dried in the sun for approximately 8 hours.

Figure 5: Amaranth harvesting process, as demonstrated in Rabinal

Field Observations: Although not a common practice, one farmer we interviewed described a harvesting process in which seeds were removed using a wood chipper-like machine, rather than by hand, before following the steps outlined above. However, it should be noted that this farmer grew grain heads, which were approximately five times larger than the average we saw.

Storage:

- Seed Storage: In general, amaranth seeds can last for quite a long time when properly stored, although seed longevity can depend on the quality of seed. Amaranth grain is usually stored in canvas sacks and can last from 8 months to one year, using this method. The seeds can be stored longer, if storage containers do not allow moisture to enter and are kept in a dark, cool place.

  Pete Noll, Executive Director of the Mexican amaranth promoter, Puente a la Salud Comunitaria, reported that raw amaranth can be stored for 5 to 8 years. At Puente, the farmers store amaranth in 20 kg grain sacks, instead of standard 45 kg sacks, as it allows women and older farmers to move them. These sacks are stored on elevated plastic racks in a dry, relatively cool place, free of rodents or other pests.

  One can assess whether amaranth seeds are in premium condition by whether or not the embryos are still red. Once the red color oxidizes to brown, the germination rate, nutrient content and flavor will diminish.

Seed bank at Asociación Qachuu Aloom, with trap door in the floor

Field Observations: In Nebaj, farmers store the grain in their homes for several months, until they have accumulated enough to sell.

- Processed Amaranth Storage: Toasting amaranth inhibits enzyme activity, which can also extend shelf life. Shelf life for a popped product is quite long, for example, but only lasts about 9 months before the smell from oxidation causes an aromatic head that turns off most consumers, even though it's not necessarily rancid. Processed amaranth flour that is stored in a cool, dry place with mild or low humidity, can be stored for 12-18 months or more.

Seed Selection & Recovery: Careful seed recovery and conservation is vital to the success of any amaranth project. Amaranth seed saving/selection in Guatemala is a sensitive process because of the prevalence of wild Amaranthus retroflexus (bledo) plants, which can crossbreed with higher-quality varietals. Due to the technicality of seed selection, as well as differences in regional agronomic conditions, it is best for qualified agronomists to assess optimal amaranth seed selection in detail before investing in an amaranth production project.

Field Observations: In order to determine which seed variety is best suited for the region, most associations have members experiment for 2-3 years with different amaranth varieties. Farmers who tested different strains of amaranth supplied seeds from higher-yield crops to the association, for preservation in a seed bank. These seeds were then sealed and stored for five years, as a germination test. Conserving a variety of strains acts is an important hedge against potential crop diseases, pests, or changes in weather patterns.

Asociación Qachuu Aloom emphasizes the importance of local and native seeds to achieve their goal of food sovereignty. Five hundred families throughout their community have been trained to care for and conserve seeds. The association maintains several community seed banks and underground storage units, preserving seeds from over 50 plant varieties in natural clay jugs, modeled after those used in Mayan temples. This technique creates a colder, low-humidity climate that extends the preservation period.

For more detailed information on amaranth seed selection, refer to Dr. Riccardo Bressani's articles, listed in the Other Useful Resources section below.

2.4 Consumption

Grain Amaranth

Grain amaranth can be prepared in a variety of ways, many of which resemble popular preparation techniques for corn. It can be eaten raw, toasted or popped, cooked like rice, or ground into flour.

Popped Amaranth: Amaranth can be popped in two ways; with a popping machine or toasted over a fire or stove. Popping in a popping machine, as is common in Mexico, but this method produces a less flavorful amaranth than toasting over a fire or stove, which is the most common method used in Guatemala. Popped amaranth, referred to as "poporopo" in Guatemala, is eaten as a snack or used to make granola bars and treats. One popular treat is *alegría*, a sweet, healthy snack common in Mexico, which combines amaranth, nuts, seeds, and sugar or honey. In

our field tests, we noted that children and toddlers responded very favorably to plain popped amaranth. Alegría received positive reviews from subjects of all ages.

Popping amaranth over an open stove

Amaranth Flour: Amaranth flour is made by grinding popped amaranth, using a machine or manual grindstone. The flour can be mixed into a number of corn-flour based Guatemalan recipes such as atol, pinol, tortillas, breads, and cakes. Due to differences in taste and texture, amaranth flour cannot completely replace corn flour as a recipe ingredient without altering the end product. However, interviewees reported that an 80/20 mixture of corn/amaranth flour can be used to make tortilla, without affecting the taste or consistency. Amaranth flour is also used in *atol fresco*, a chilled drink mixture of amaranth, water, and sugar, which is popular with children.

Since atol is a staple food for rural farming families with little or no disposable income, we found that it is the easiest point of introduction for incorporating amaranth into the diet, followed by popped amaranth. When introducing grain amaranth into the diet of consumers with more discretionary income, we found that the most frictionless point of introduction was through pre-prepared snack or post-workout foods such as alegría, granola bars, granola, or health food drinks.

Corn atol (left) on a rural stove and amaranth atol (right)

Amaranth Leaf

An additional benefit of grain amaranth that is attractive to subsistence farmers, is its dual use. While the amaranth plant is growing, its leaves can be removed for consumption and prepared in a number of bledo recipes, including caldos, the local dish bosh-bol, and with egg as a type of patty. The amaranth leaf is most commonly consumed by the rural poor.

Bledo patty with egg, tomato, and onion

2.5 Other Uses for Amaranth

The vast majority of amaranth is consumed as food, but alternative uses have also been proposed. Amaranth oil is used in dyes and is being investigated for its medicinal and cosmetic qualities. It is sometimes included as an ingredient in shampoos and other beauty products. The technology to extract oil is expensive, but could become more affordable as demand increases.

Amaranth hair conditioner, found in a hotel

III. PRODUCTION

3.1 Small-Scale Farmers in the Western Guatemalan Highlands

Overview & Demographics

This business plan was modeled for rural farmers in the San Marcos Department, or similar communities. San Marcos has a population of approximately 800,000 people, 61% of whom live in extreme poverty. 42.5% of the population is classified as indigenous peoples.[xxi] Most individuals survive through subsistence farming, growing a number of crops including corn, beans, coffee, oats, and bananas, among others. One or more family members may also work as laborers on coffee plantations, which usually requires travel away from home. The typical family income is less than $350 USD per month.

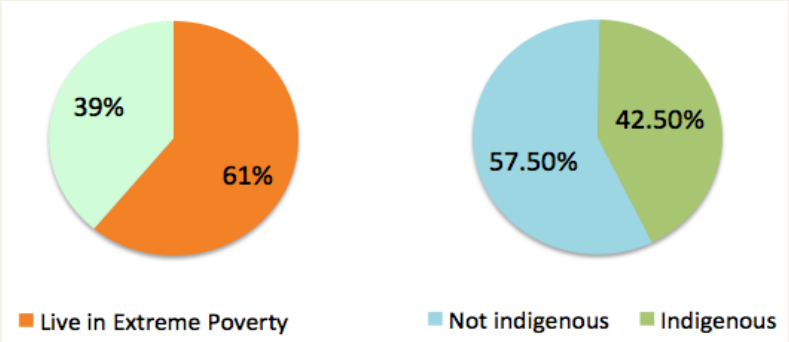

Figure 6. San Marcos population demographics

Economic development faces many challenges, in San Marcos. This regions ranks toward the bottom of the educational index.[xxii] In addition, San Marcos is home to some of the most rugged terrain in Central America, which makes transportation difficult and isolates San Marcos from many trade opportunities, particularly with Guatemala City. For the average farming family, economic activity is limited to what they buy or sell at local markets, with little or no interaction with outside economic entities.

Agronomic conditions in San Marcos are varied. In some areas, the soil is very rich and has superior moisture retention, while in other areas, the soil is hard and of poor quality. In high altitude areas, growing seasons may be prolonged. Families we visited cultivated anywhere from 3 - 40 cuerdas of land, depending on the region.

Nutrition Challenges

The Western Highlands region of Guatemala, including San Marcos and surrounding areas, has large populations of subsistence farmers. Among rural farming families, there are high levels of food insecurity and malnutrition, including an over 70% rate of childhood malnutrition.[xxiii] The Optifood analysis tool assessed the Western Highlands food basket, which includes mainly corn, potatoes, beans, eggs, and green leafy vegetables, and concluded that residents of that region had insufficient access to nutrients.[xxiv] The area fits the definition of a “food desert”, which means that adequate nutrition is unavailable and increased incomes would not necessarily lead to improved nutrition. In fact, individuals we interviewed told us that any disposable income usually goes toward the purchase of soaps, oils, and sugar.

"Even if they had enough money to spend on food *and* they chose all the "right" food, there would still be deficiencies in the diet. Good food is just not accessible."
-Eric Janowsky, USAID/Guatemala Director, Health and Education Office

Ethnographic Characteristics

Motivations: Any agricultural or livelihoods project will have a greater chance of success, to the extent that it aligns with the community's aspirations, needs, and desires. In our ethnographic interviews, we learned that many rural Guatemalan farmers are attracted to agricultural projects that offer a pathway to self-sustainability. Memories of *La Violencia* and a long history of ethnic conflict have engendered a deep mistrust of the national government and a strong desire for independence. The concept of self-sustainability through food security resonates with individuals who wish to be self-sufficient, without reliance on government food rations, in the *bolsa segura.*

Gender and Inclusion: Gender issues and leadership imbalances effect rural farming communities, especially because of the prevalence of temporary migration, in between planting and harvesting seasons. For example, the ECADI system reports having almost 90% female participation in leadership, while other amaranth associations reported that 60-80% of their members are women. Programming for small-scale farming families should be viewed in the context of an integrated community and will be more successful to the extent that it has buy-in and participation from all community members including men, women, and youth.

Field Observations: At Asociación Qachuu Aloom, youth ages 15-20 are trained with adults in seed preservation and amaranth production so that they can help spread knowledge throughout the community. This family-centered model involves everyone in the process to rescue and care for seeds. Qachuu Aloom also emphasizes the important role that women play in leadership positions and provides scholarships for girls. This empowerment of youth and women has a positive social impact at both the family and communal level.

Risk Aversion and Behavioral Change: Families are open to dietary change when they can clearly understand its nutritional benefits and develop convenient ways of integrating the new food into their family's diet. Farmers are willing to assume the risks of cultivating a new crop when they clearly understand the potential rewards, have technical assistance, and see a pathway toward post-program sustainability. Other agricultural projects have been unsuccessful, in the long term, because they failed in one of these two areas. Programming will be most successful when it focuses on habituating new dietary practices, pre-negotiates with buyers to mitigate risk, and trains farmers to be successful, even in the event that the NGO or sponsoring organization ceases to operate.

Field Observations**:** In San Marcos, previous members of Intervida continued to grow amaranth after the association ended its agricultural programming. But when their amaranth crops got a fungus, they were forced to cease production because they did not have the technical knowledge needed to manage the problem. Even worse, one family we met wasted their remaining surplus

amaranth because they had never learned any amaranth preparation techniques, beyond making atol. Rats eventually ate their unutilized amaranth. These women could have been feeding the amaranth to their family or selling it in the market but did not know how without the association's support.

"Our Amaranth got the plague and Intervida was no longer around to help. So we just stopped growing it."
- Former Intervida members

"The amaranth was just sitting there so, finally, a rat ate it"
– Grandmother, San Marcos

3.2 Operations

Production

As stated, we propose a multi-crop family farm that will produce 1-2 cuerda of amaranth per season and distribute surplus products via an intermediary organization or through limited sale at farmer's markets. In addition to amaranth, the farm will grow a number of other crops, to be determined primarily by nutritional diversification considerations and secondarily by market demand.

Labor will be shared among family members but may sometimes be supplemented by hired labor during high-intensity times such as planting or harvest time. Inputs such as seeds, fertilizers, and water will vary by region and an agronomist or regional expert should evaluate the appropriate types and quantities for each area. However, it should be noted that the use of non-chemical fertilizers and other natural processes increases the attractiveness of the product among target customers in Guatemala City.

3.3 Working With Intermediaries

Individual farmers have two paths to market. They can sell products through an intermediary, such as a cooperative or association, or directly to consumers, in a local market. Many small-scale farmers do not have the time or resources to support direct sales so they sell their entire harvest to an intermediary, after retaining a portion for family consumption.

Our research revealed that there is currently a gap in the Guatemalan amaranth value chain, at the intermediary level. While other agricultural products have an established network of actors that organize supply and connect farmers to markets, most areas of Guatemala do not yet have an equivalent infrastructure for amaranth. We considered a variety of models which satisfy the intermediary role,

including cooperatives, private enterprises, and other options. However, our analysis of several Guatemalan and Mexican amaranth growing associations revealed that the growers association model aligns strongly with CRS' current approach to rural agricultural development programs, as outlined in the Pathway to Prosperity framework. In addition, the association model mitigates many of the chronic challenges that cause failure in other models. Based on this, we prefer growing associations as a long-term, sustainable model for improving the wellbeing of small-scale farmers.

About Associations

A growing association is a membership-based, not-for-profit entity that exists to connect farmers with markets and provide other social services. Associations provide farmers with training on growing, harvesting, seed selection and preparation. They also connect farmers to markets, giving them ways to sell their amaranth in areas beyond the local markets. Some more mature associations also engage in financing or organize microcredit or savings groups.

An association is first and foremost a community organization: its roots are in one community and all of its activities are ordered toward improving the well-being of the members of that community, specifically focusing on improving both nutrition and livelihoods for member-families. As independent intermediaries, associations buy surplus crops from members and sell them to bulk buyers. Associations generate income from these sales as well as from member fees and grants and reinvest any profits in member services, such as education.

3.4 Fit With Nutrition Programming

As a nutrition-sensitive agricultural program with a market-led value chain, this amaranth business plan aligns with Catholic Relief Service's approach to nutrition and agricultural livelihoods programs as well as the current trends in donor focus.

Amaranth is a nutrient-dense crop with an attractive, sustainable market. Promoting amaranth cultivation meets the objectives of the Pathway to Prosperity's *Recover* stage, by satisfying market-driven crop selection criteria, addressing diet diversification, and being well-suited for group organization.

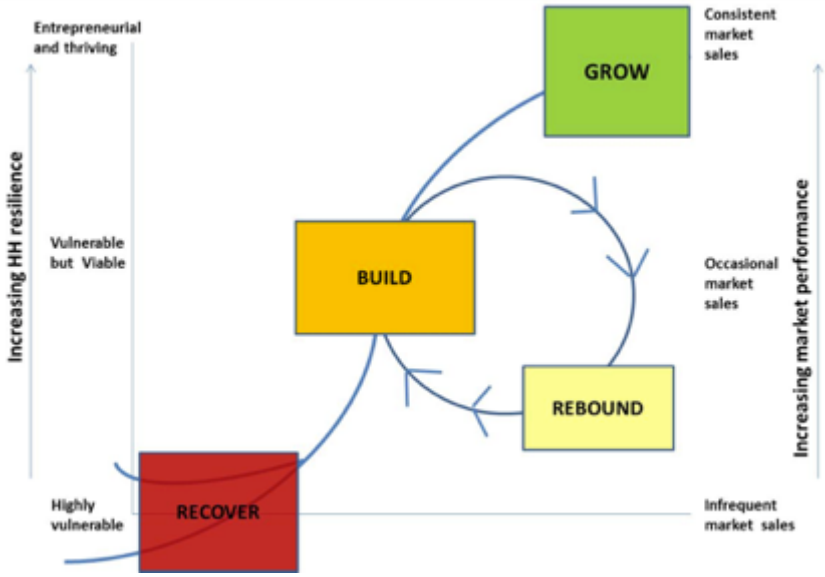

Figure 7: Pathway to Prosperity Agricultural Livelihoods Signature Program Area Implementation Roadmap

In addition, we see overlap between this proposal and CRS/Caritas' current ECADI program. By using the ECADI network, amaranth farmers can connect to other amaranth farmers, access resources and trainings, and strengthen community ties.

IV. MARKET ANALYSIS

4.1 Methodology

As would be expected with a niche product in a small country, deriving an accurate estimate of market potential and growth is difficult, due to the lack of available market research. To arrive at approximate measures, we relied on our primary research as well as reliable market research studies from proxy markets, including the United States and Mexico. Because the target customers for amaranth are of a higher socioeconomic class, trends from the U.S. and Mexico City are likely to influence consumer preferences and behavior. While we acknowledge that several significant demographic and cultural differences make these markets imperfect comparisons, we believe that these are the best estimates available without an in-depth market study.

Fortunately, it is not necessary to have perfect information in order to capitalize on the market opportunity that currently exists for Guatemalan amaranth producers. Therefore, we do not advise commissioning additional research at this time, but instead recommend focusing on meeting current unmet demand, growing the market, and mitigating the risk of over-production by securing forward contracts with buyers.

4.2 Market Overview

We focused our market research on the current suppliers and buyers of Guatemalan amaranth. Through this process, we identified unmet demand for bulk amaranth in Guatemala City, coming from producers of amaranth products and from niche health food stores, which sell raw and pre-packaged amaranth products to consumers. Based on our research, we conclude that market is attractive for Guatemalan amaranth producers.

Two Opportunities

A majority of amaranth sold in Guatemala City is imported from Mexico in popped form. However, even with imports, bulk buyers cannot currently find all desired types and quality of amaranth, particularly raw seed. This indicates a strong market opportunity for Guatemalan amaranth producers to supplement and/or displace Mexican importers.

Compared with more mainstream crops, like corn, amaranth is relatively unknown in Guatemala. Although once a Central American staple, it is now consumed only by the rural farmers who grow it and by urban customers in the niche health food market. However, urban demand for amaranth is increasing even with little or no advertising, due primarily to changing health concerns and lifestyle trends, including rising incidences of gluten intolerance or celiac disease. Because amaranth is still largely unknown and is not sold in large supermarkets, there is also a large, untapped market opportunity among mainstream consumers. As awareness of amaranth's benefits grows, we anticipate consumer demand will increase, suggesting another strong opportunity for Guatemalan amaranth producers.

4.3 Market Trends & Demand Drivers

Gluten-Intolerance & Celiac Disease

One reason for the increasing amaranth demand is the increase in diagnoses of gluten intolerance and celiac disease, which is triggered by gluten, the protein found in wheat. Recent research in the Journal of the American Medical Association reported that the incidence of celiac disease has increased by a factor of four in the past three decades, yet its causes are unknown.[xxv] Symptoms of gluten intolerance range from severe cramping to chronic fatigue and even organ disorders.

Though celiac disease necessitates a gluten-free lifestyle, the majority of gluten-free buying is a choice not a necessity. According to Diane Walters, a spokeswoman for NuWorld Foods, "there is also a growing crossover market of health-conscious shoppers in search of the most nutritious grains."[xxvi]

Vegetarian/Vegan Lifestyle

Vegetarian and vegan diets require nutrient-dense, plant-based protein sources. As described above, amaranth is a very useful substitute for meat, due in large part to its high lysine content. Vegetarians account for 5% of the population in the United States, and this percentage has remained constant over the past decade.[xxvii] Although we were unable to find the exact number of vegetarians in Guatemala, we found evidence to suggest that a strong vegetarian market exists in Guatemala city and is likewise holding steady. According to the owner of the Guatemalan health food shop, Artesano, about 25% of their customer base identifies as either vegetarian or vegan.

The Organic Movement

U.S. Demand for organic food has been increasing around 10% per year, for the past five years, and surpassed a total market size of $30 billion dollars, in 2012.[xxviii] Amaranth, though not always grown organically, tends to benefit from this growth in demand for non-GMO or organic superfoods. We expect these U.S. trends to be a foreshadowing of trends in Guatemala City.

4.4 Market Metrics

Market Size

Given that the urban middle class in Guatemala City constitutes 35.4% of the population and that the core target market is among young adults, we estimate that the number of potential customers in our core target population of Guatemala City is between 175,000 and 225,000 people, with many in the target market still unaware of amaranth.[xxix]

Our estimate of current annual demand for amaranth in Guatemala is approximately 2,000 to 2,500 quintales. Though exact numbers for Guatemala are not known, we have based these numbers on known figures from more developed North American amaranth markets.

Mexico has been producing around 3,500 metric tonnes (~77,000 quintales) of amaranth, annually.[xxx] Mexico has had much more time to develop the market for grain amaranth, which is a key ingredient used in the popular snack, alegría. The crop was re-introduced in Mexico much earlier than it was in Guatemala, and it has received significant government support. After accounting for differences in size and the cultural differences in consumption, we arrived at the estimates above.

Rate of Growth

We observe U.S. trends in the gluten-free market as a proxy for Guatemalan trends. Though the two markets are different, our Guatemalan target market consists of higher-income, technologically connected people who are very aware of and interested in U.S. consumer trends.

Demand for gluten-free products, in the U.S., has seen tremendous growth, over the past decade. For example, NuWorld Amaranth, a U.S. based company and one of the largest buyers of amaranth, reported a 300% increase in sales from 2003 to 2006.[xxxi] Based on these and other recent trends in the U.S. gluten free market, we expect to see demand for amaranth in Guatemala increase about 25% per year for the next 3 years and then stabilize at around 6% growth per year for the next 3 years.[xxxii]

> ***"Gluten-free products will go through a developmental/introductory stage, a rapid growth stage for three to five years, and then level off, and possibly decline, to their long-term level. We are a year or two into the rapid growth stage for gluten-free products. I think that ultimately this category will stabilize to a level consistent with demand associated with about 10 percent of the population."***
> **-Mark Lang, Professor of Food Marketing, Saint Joseph's University 2014[xxxiii]**

4.5 End-Consumer Segmentation

Currently, amaranth is a niche product with two primary end-consumer segments: rural farmers who grow it for home consumption and sell small quantities to their neighbors, and health food store customers in urban areas.

Rural Consumers: These consumers are also the producers of amaranth, who consume their own crops.

Urban: The core demand for amaranth in Guatemala currently comes from the health food consumers in Guatemala City. Health conscious city-dwellers have higher incomes, have active lifestyles, and are generally younger than the population average. According to representatives from Lula's Oven, a producer of amaranth snack foods, these customers want to eat nutritiously but do not want to compromise on taste. Many are interested in avoiding gluten or providing healthy snack foods for their children. Price is not especially important, as long as it is within the range of other gluten-free products. This customer segment is also interested in convenient, ready-to-eat foods.

Health-conscious urban customers are an important customer segment to understand, from a marketing perspective. Many urban consumers have never heard of amaranth but may decide to purchase an amaranth product simply because it is labeled as gluten-free or as a superfood. A number of customers we interviewed mentioned that they stumbled across amaranth when looking for gluten-free foods. Many others were vegetarian or vegans looking for alternative protein sources, who were first introduced to amaranth while searching for sources of protein.

4.6 Competitive Landscape

For the purposes of this report, we consider the primary competition for Guatemalan amaranth to be Mexican amaranth, which appears to be dominating market share in Guatemala City. Health food stores, such as Artesano, currently source their popped amaranth from Mexico, as they are unable to obtain sufficient supply domestically. However, while this Mexican amaranth is less expensive than Guatemalan amaranth, it is of relatively low quality and must be transported from the border. Currently, Mexican amaranth has a reputation for arriving unclean, with dirt, harvesting debris, and insects. This necessitates further processing and repackaging, adding to the total cost. Resellers we spoke with indicated willingness to a pay a premium over current Mexican amaranth prices if they could find a reliable local source that provided clean, high-quality amaranth. This suggests an opportunity for farming associations that wish to supplant the current supply chain.

Domestic competition comes primarily from producers in other domestic amaranth associations. There are several associations utilizing amaranth, such as *Asociación Qachuu Aloom,* in Rabinal, and *Kulb'aalib' Xe'chulub',* in Nebaj but the level of unmet demand suggests that there is room for other players. Furthermore, existing associations demonstrate that there is significant room for improvement, including stronger connections with markets and transport networks.

4.7 Export Considerations

With the potential for amaranth to be the next international superfood, the United States, Canada, and Western Europe represent good markets for amaranth export. These markets have populations with higher disposable incomes and have a significant number of health conscious consumers. But due to large quantities of amaranth being grown in India, China, Nepal, and Mexico, international prices are currently depressed, compared to Guatemalan prices. With time, economies of scale may make it more feasible for Guatemalan producers to enter the export market.

However, the risks and benefits of exports should be carefully considered. The story of global quinoa production highlights risks of amaranth export that could jeopardize the nutritional goals of this business plan.

Quinoa: A Cautionary Tale

Quinoa is a gluten-free grain with all nine essential amino acids required for a balanced diet. Though formerly unknown in the U.S., quinoa experienced explosive sales growth over the past decade, as illustrated below. Unfortunately, supply could not keep up with demand and prices for quinoa have risen so high that lower and middle class Bolivians can no longer consume the grain.

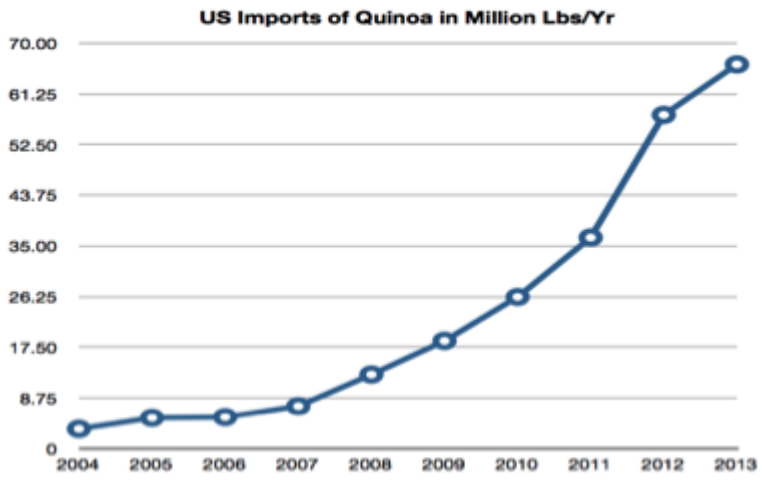

Figure 8: United States Quinoa Imports, 2004-2013.[xxxiv]

Organizations such as Puente a la Salud Comunitaria are concerned that a robust export business will drive up the prices of amaranth, making it economically infeasible for farmers to consume their own harvests. But key technical differences between amaranth and quinoa make it difficult to assess the exact risk of amaranth prices following a similar fate. For example, quinoa only grows in a restricted geographical region so production has been unable to expand to meet the growing demand, leading to sharp increases in price.[xxxv] By comparison, amaranth can be grown in a larger variety of regions, meaning that supply can more easily keep up with increasing demand and prices are more likely to remain stable.

On the other hand, the fact that amaranth has a wider growing region can also pose pricing risks. Unlike quinoa, amaranth can easily be produced in the United States. U.S. agriculture typically has considerable cost benefits resulting from access to industrialized technology, more sophisticated markets, and government subsidies. Fortunately, industrial scale U.S. amaranth production in is unlikely, as demand is insufficient to generate large infrastructure investments, and amaranth production techniques are less amenable to industrial production.[xxxvi] Therefore, downward pricing pressure from the U.S. is unlikely. But, in the end, export markets are complicated, and it is very difficult to predict accurate outcomes.

First Things First

Before even considering exports, we recommend that Guatemalan producers first develop a strong national business, given the significant local growth opportunities and the project's local goals. As amaranth gains recognition in the local markets and production is able to scale to meet increasing demand, the potential to export can be assessed in by comparing the likely return on investment with the impact of such a project on the program's social goals.

If international export is pursued, obtaining "organic" certification from the Organic Crop Improvement Association (OCIA) or a similar organization would be advantageous, particularly in the United States and

European markets. Until this point, there is no advantage in obtaining certification by an international body, apart from advertising purposes, nor is there a Guatemalan equivalent certification.

V. MARKETING & SALES

5.1 Sales Strategy

The majority of individual farmers will sell their surplus products through an intermediary, as discussed above. In this case, farmers need not be concerned with developing a marketing plan, beyond understanding that the association fulfills this role.

Should the farmer choose to sell directly to consumers, the primary point of sale will be at the local market. It would be possible for farmers to sell raw amaranth or to produce some finished products, such as popped amaranth or amaranth flour. Doing so would generate substantially more income than the sale of raw amaranth. Prices should be set using a cost-plus strategy, adjusted for competitive conditions. For example, products could be discounted or sold at a premium depending on a comparison against other local amaranth suppliers, in terms of relative quality and convenience to the consumer.

5.2 Marketing to End-Users (B2C)

Farmers which sell directly to consumers via a local market may engage in a small amount of business to consumer marketing (B2C). Consumer marketing should be targeted at one of the two primary customer groups: higher income, health-conscious consumers or rural consumers.

Marketing efforts directed at the health-conscious group should focus on its benefits as a gluten-free food with niche nutritional properties. This emphasizes how amaranth meets their unique needs and justifies the premium paid in health food stores.

Marketing efforts directed at rural consumers should focus on the exceptional nutritional properties of amaranth as compared with other options and therefore, the ways in which it can help build healthy families. In addition, our research indicated that the cultural connection to amaranth as the “Mayan super-food” is attractive to persons who identify as Mayan.

As is standard practice, any marketing strategy should be targeted and field-tested with consumers before substantial investment is made.

VI. FINANCIAL ANALYSIS

Our financial analysis provides a guide for projecting individual producer economic performance and making financial decisions. The analysis presented here should be viewed as a framework to be applied to a particular situation, rather than a fixed product. Specific information, such as the number of family members participating in production, the local infrastructure, or the availability of grants and technical training will determine the particular economics of any given production site.

6.1 Pricing Data

Aggregated price data from our March 2014 research is included below. This data includes current prices for the three primary finished amaranth products (popped amaranth, amaranth flour, and alegría) and is divided between association sale prices (assn.) and retail sale prices (end). Raw amaranth, not shown here, is sold by farmers for 8 GTQ/lb - 12 GTQ/lb. All price data is in Guatemalan Quetzales (GTQ).

	POPPED (POPOROPO)				
	Source	Lb	GTQ	GTQ/lb	Averages
End	Artesano Store	0.50	38.00	76.00	75.20
End	Super Verduras	0.50	38.00	76.00	
End	Artesano Store	0.25	20.00	80.00	
End	Super Verduras	0.25	20.00	80.00	
End	Kuchub'al (Atitlan)	0.50	32.00	64.00	
Assn.	Qachuu Aloom	0.50	25.00	50.00	48.50
Assn.	Qachuu Aloom	0.25	15.00	60.00	
Assn.	Chikach	0.50	25.00	50.00	
Assn.	Kulb'aalib' Xe'chulub'	0.50	17.00	34.00	

	FLOUR (HARINA)				
	Source	Lb	GTQ	GTQ/lb	Averages
End	Super Verduras	0.7	31.10	43.38	41.69
End	Kuchub'al (Atitlan)	1.0	40.00	40.00	
Assn.	Chicakh	1.0	32.00	32.00	22.50
Assn.	Qachuu Aloom	1.0	20.00	20.00	
Assn.	Qachuu Aloom	0.5	10.00	20.00	
Assn.	Kulb'aalib' Xe'chulub'	1.0	18.00	18.00	

	ALEGRIA				
	Source	Bars	GTQ	GTQ/lb	Averages
End	Artesano	3	15	75.76	70.71
End	Super Verduras	3	13	65.66	
Assn.	Kulb'aalib' Xe'chulub'	1	2.00	30.30	30.30
Assn.	Kulb'aalib' Xe'chulub'	2	4.00	30.30	

Figure 9: Comparative prices of amaranth products

Note: As shown above, amaranth flour currently sells for less than popped amaranth, despite requiring twice as much processing. Despite this, it still boosts sales volume and offers a product diversification benefit.

6.2 Value Chain

Aggregating the above price data provides a view of the value added by each player in the amaranth value chain. It is readily apparent that the association adds and captures significant economic value by

packaging and/or processing the raw amaranth bought from local farmers into flour, popped amaranth, and amaranth bars (alegría) for sale to retailers.

per pound	Farmer	Value added	Aggregator	Value added	Resale
Seeds	GTQ 10.00	120%	GTQ 22.00	–	–
Flour	–	125%	GTQ 22.50	85%	GTQ 41.69
Popped	–	385%	GTQ 48.50	55%	GTQ 75.20
Bars	–	203%	GTQ 30.30	133%	GTQ 70.71

Figure 10: Value chain breakdown for Guatemalan amaranth

6.3 Startup Costs

Start-up costs for small-scale amaranth production are minimal and would ideally be funded by donations of money or supplies or low-interest micro-loans. Our financial model assumes either prior ownership or donation funding for the following start-up inputs:

Item	Description		Price (GTQ)
Tarp	8'x10'		28.00GTQ
Basket	20L		22.00GTQ
Basket	63L		55.00GTQ
Hose	25m garden hose		60.00GTQ
			165.00GTQ

Figure 11: Estimate of amaranth production start-up costs

6.4 Sample Profit and Loss Projections

Based on the pricing data collected, we have provided a profit and loss forecast. Our primary research discovered wide ranges for revenues and costs that small farmers can expect in amaranth production. The “best-case” scenario assumes a high yield with sale prices from the higher end of the range, and costs from the lower end of the range, including no costs associated with irrigation. The “worst-case” scenario assumes a relatively low yield (though not complete crop failure) with sale prices on the lower end of the range and costs on the higher end of the range, including costs for irrigation.

Assumptions

As with any business plan, the output of our financial forecasts depends on the accuracy of our inputs, which vary by region and over time. Readers are cautioned to update these inputs at the time of project development, using the spreadsheet provided with this report. Our model is based on the following assumptions:

Revenue: The income statement assumes that raw surplus amaranth is purchased from farmers by an association or other intermediary. Sale prices are averages of values stated by all farmers interviewed.

Expenses: Expenses are itemized to arrive at the profit generated by the small farmer. We include estimated costs for seed, fertilizer, irrigation, and other costs. Actual costs will vary between regions.

In addition to the example below, an excel template ("Income Statement Templates.xlsx") is provided as a supplement to this document in a framework that can be used to analyze detailed information about a particular farm by changing input values.

Per year	**Worst Case**	**Typical**	**Best Case**
INCOME			
Sale Price (GTQ/qq)	800	1000	1200
Yield (qq/cuerda)	1.25	1.5	2
Amt. Cultivated (cuerdas)	1	1	1
% Consumed	60%	60%	60%
Total Income	400 GTQ	600 GTQ	960 GTQ
EXPENSES			
Seed	100 GTQ	62 GTQ	24 GTQ
Fertilizer	250 GTQ	50 GTQ	1 GTQ
Irrigation	16 GTQ	1 GTQ	1 GTQ
Other	1 GTQ	1 GTQ	1 GTQ
Total Expenses	367 GTQ	114 GTQ	27 GTQ
PROFIT	**33 GTQ**	**486 GTQ**	**933 GTQ**
PROFIT MARGIN	8%	81%	97%

Figure 12: Sample small farmer profit & loss statement

VII. ADDITIONAL CONSIDERATIONS

7.1 Risks

Production Risks

- Environmental Risks: As a C4 crop, amaranth is highly resilient to weather and climate variables, such as drought and temperature changes. However, before beginning an amaranth production project, it is important to conduct a region-specific feasibility analysis, which includes appropriate consideration of environmental risks.

- Pests: In the areas with 3 month growing seasons, a fungus can destroy the crop if the seeds are planted too late in the wet season or are grown too close together. Some farmers try to prevent this problem by planting corn, instead of amaranth, during the wet season. Others plant amaranth approximately one month before the wet

season begins and replant or thin the crop to have greater spacing between plants. Additional pest risks include the potential for stored grains to be eaten by rodents and for birds to eat the grain as it is growing. Furthermore, one farmer mentioned having issues with the small black worm, *guisano nochero*, which eats the trunk of the plant, if not closely monitored.

- Producer Risks: This model assumes that labor is shared among a small set of family and/or community members. As such, production is vulnerable to illnesses, family emergencies, or any other human variable, which could render one or more producers unable to work.

- Political Risks: Any commercial activity is vulnerable to political conditions including war, redistributive land programs, political instability, changes in industry regulations or tax rates, and other circumstances beyond the community's control.

- Natural Disasters: Any commercial activity is vulnerable to natural disasters, including earthquakes, hurricanes, tsunamis, drought, and others.

Market Risks

- Supply Chain Risks: Because this model relies on partnerships with an aggregator or association to connect with larger markets, the business is vulnerable to any disruption in the availability or efficacy of those services.

- Price Risks: As with any commodity, the ability to capture market premiums is eroded as supply is increased. Market prices of amaranth are subject to changes in supply and demand levels, both locally and internationally, and any significant increase in relative supply could adversely affect the profitability of this model.

7.2 Economic Comparison of Amaranth to Corn

Based on sale prices and yield data, we determined that producing amaranth in Guatemala has three times the income potential of corn for a given amount of land cultivated.

	AMARANTH	CORN
INCOME		
Sale Price (GTQ/qq)	1000	150
Yield (qq/cuerda)	1.5	3
Amt. Cultivated (cuerdas)	1	1
% Consumed	60%	60%
Total Income	600 GTQ	180 GTQ

Figure 13: Guatemalan corn/amaranth income comparison, using primary data.

A similar comparison of the profitability of amaranth production in Mexico demonstrates that amaranth is roughly two times more profitable to grow than corn in Mexico.

	Amaranto			Maíz
	Escenario bajo	Escenario medio	Escenario alto	Escenario me-dio
Rendimiento (ton/ha)	1.5	2.0	2.5	4.0
Costo ($/ha)	$4,008	$4,008	$4,008	$3,500
Precio Venta ($/ha)	$4,800	$4,800	$4,800	$1,100
Ingreso Estimado ($/ha)	$7,200	$9,600	$12,000	$4,400
Utilida Bruta ($/ha)	$3,192	$5,592	$7,992	$900
Factor de rentabilidad (Ingresos/costo)	1.80	2.40	2.99	1.26

Figure 14: Mexican corn/amaranth profitability comparison.[xxxvii]

7.3 Metrics

In order to gauge the success of this campaign, we have formulated the following metrics that can be used in its evaluation:

(1) Increase in profits and commensurate increase in family income
(2) Increase in awareness and consumption of amaranth
(3) Reduction in malnutrition levels
(4) Increase in production of amaranth products
(5) Increase in number of workers employed
(6) Increase in number of amaranth farmers supported

By evaluating these metrics and comparing results to benchmarked data and past performance, the success of the overall mission can be evaluated.

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APPENDIX

Table of Useful Contacts

Contact	Organization	Position	Additional Information	Contact Info	Company Website
Amaranth Experts					
Pete Noll	Puente a la Salud Comunitaria	Executive Director	Puente is a successful organization of small farmers growing amaranth	pete@puentemexico.org	http://www.puentemexico.org
Mary Delano de Alcocer	Mexico Tierra de Amaranto A.C	General Manager	Mexico Tierra de Amaranto is a successful organization of small farmers growing amaranth	marymdelano@yahoo.com.mx	http://www.mexicotierradeamaranto.org/
Jonathan Walters	Nu-World Foods	Director of Sales and Marketing	Nu-World Foods sells ancient grains and gluten-free products	jonw@nuworldfoods.com	http://nuworldfoods.com/
Aubrey Sykes	Calvin College, Grand Rapids, Michigan	Engineering Professor	Professor Sykes has experience designing, developing and building amaranth poppers of all scales, that are made for use in the developing world.	jas28@calvin.edu	
John McMillan	Purdue	PhD in Agronomy	He just finished his PhD research in Amaranth	jmcmilla@purdue.edu	
Mark Holt	Matrix Nutrition, LLC	Founder and General Manager	Matrix Nutrition, LLC is a company that works internationally with crops that can be used for food and animal feed	MHolt@matrix-ind.com	
David Brenner	USDA/Iowa State University	Curator of Amaranth and other crops	Manages the Amaranth Institute Listserv	David.Brenner@ars.usda.gov / dbrenner@iastate.edu	
Jorge Luis Pedroma	Centéotl		Amaranth women's group in Oaxaca, Mexico	jlpedroma@gmail.com	
Programing Resources					
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Guatemalan Amaranth Contacts					
Harriet	Chikach		Amaranth retailer & promoter of production		chikach.com
Rosalia Asig	Qachuu Aloom	Coordinator	Qachuu Aloom is a successful organization of small farmers growing amaranth		http://www.gardensedge.org/Guatemala/index.html

Other Useful Resources

General Amaranth Information

- Amaranth Institute - amaranthinstitute.org

Nutrition

- USDA, Nutritional Database, Standard Ref. 20, version 20088. - http://www.ars.usda.gov/Services/docs.htm?docid=8964
- Achigan-Dako, E.G., Sogbohossou, O.E.D., Maundu, P, 2014. Current knowledge of *Amaranthus* spp.: research avenues for improved nutritional value and yield in leafy amaranth in sub-Saharan Africa. *Euphytica* 197(3):303-317.

Amaranth Seed Selection

- Bressani, R., J.M. Gonzales, J. Zuniga, M. Brauner, and L.G. Elias. 1987a. Yield, selected chemical composition and nutritive value of 14 selections of amaranth grain representing four species. J. Sci. Food and Agric. 38:347-356.
- Bressani, R., J.M. Gonzales, L.G. Elias, and M. Melgar. 1987b. Effect of fertilizer application on the yield, protein and fat content, and protein quality of raw and cooked grain of three amaranth species. Qualitas Plantarum 37(I):59-67.

Legal Formation in Guatemala

- Useful for all types
    - http://guatemala.eregulations.org/
- Associations
    - http://contapuntual.wordpress.com/2009/10/05/aspectos-que-deben-cumplir-las-asociaciones-civiles-de-guatemala-en-materia-administrativa-tributaria-laboral-y-fiscal/
    - http://www.slideshare.net/sdellabitta/organizacion-tipos
    - https://ocampoarch.wordpress.com/2006/08/07/asociaciones-y-sociedades-civiles/
- Cooperatives
    - http://www.aciamericas.coop/IMG/pdf/wcms_185442.pdf
    - https://contapuntual.wordpress.com/2011/04/13/caracteristicas-de-las-cooperativas-en-guatemala/
- Businesses
    - http://www.slideshare.net/Faitopedia123/sociedades-mercantiles-en-guatemala