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Guatemala, Factor 6: Sustainability

Guatemala: Adoption of Sustainable Agriculture Practices to Increase Crop Yield

Located in the Yucatan Peninsula, throughout Guatemala, Belize, and into parts of El Salvador and Honduras, the Maya were some of the most prosperous ancient peoples in the New World for well over 2,000 years. They mastered agriculture, perfected the art of pottery making, and excelled at mathematics and other areas of scientific knowledge. Grandiose and seemingly unreal archeological sights are scattered throughout the vast ancient lands of the Mayan Empire as remnants of the past. The empire may have been lost in the 9th century, but enough exist today, especially in Guatemala the heart of the Mayans, to carry on some traditions.

Today people of Mayan descent make up roughly fifty percent of the Guatemalan population and the vast majority of them are impoverished and food insecure. Many traditional Mayans live in isolated, mountainous, dry rural areas that are not well suited to agriculture. Those living in the "dry corridor" of the highlands are the most vulnerable to food insecurity. Researchers at the University of Florida propose that a severe drought exacerbated conditions that led to the Mayan Empire's demise, and when combined with the unbalanced Mayan society where the wealthy few required an abundance of food and the extreme warfare, the great civilization collapsed (Broschwimmer, 2002).

Other recent research studying ice core and tree ring patterns suggest that a series of volcanic eruptions in that era led to the distribution of aerosols into Earth's atmosphere causing major drops in temperature and sunlight, resulting in crop failures (Zielinski, 2015). Others believe that warfare between city-states caused relations to deteriorate, leading to the eventual collapse of many of the participating city-states in the empire. By the time the Spaniard conquistadors reached the New World, most Maya had made the transition from urban city-states to rural agriculture villages. This enabled the conquerors to exploit some of the Mayan who became their source of forced labor on newly created plantations. Other Mayans escaped to the lowland or the highland mountains, where their culture and traditional practices were protected from missionaries and conquerors. Once a great civilization that ruled throughout Central America and the Yucatan Peninsula, the Maya now were shoved to the bottom of the social pyramid where they remain over 400 years later.

According to the UN World Food Program in Guatemala "the chronic undernutrition rate for children under five is 49.8%, the highest in the region and the fourth highest in the world." There are many factors that are associated with these extremely high numbers, which include economic inequality especially among the indigenous population, political unrest, lack of investment in public education and access to infrastructure, and a clean water supply. On FEWS NET (Famine Early Warning Signs Network) the July 2015 Food Security Outlook for Guatemala includes current crisis and stress category conditions for a large portion of the country. In the western temperate highland farmers affected by coffee rust and low rainfall and do not receive food aid will face a crisis situation of food insecurity until November.

Jalil is a Mayan who lives in the municipality of San Marcos in the southwest region of Guatemala with his parents, two brothers, three sisters, and his grandparents. It's October, the end of the wet, harvest season in Guatemala. The early morning sun's rays peek over the mountain that dominates the eastern landscape, his family's four-hectare farm nested within its steep slope. His grandfather was lucky to receive this plot of land from the government in 1952 when the government mandated Decree 900, an agrarian land reform program. The program was designed to develop Guatemala's economy and reduce their reliance on aid from foreign nations (Harbour, 2008). However, eight years after acquiring the land,

a civil war began that last 36 years. The civil war focused on the issues of land use and human rights of the Mayan people. Approximately 80% of the estimated 200,000 people killed during the war were Mayan (The Center for Justice & Accountability, 2009). As a result of the war, many Mayan people immigrated to other countries or fled to the mountainous forests and established rural farms throughout the country.

Jalil stands atop a hill, like a hawk scouting the land below for prey, looking around at what's left of the year's corn crop and then at the chickens that have not yet been wakened by the rooster that stands alone on a fence post. Jalil knows there will not be enough corn for both his family and their chickens. Two figures off in the distant stand out like two drops of blood on a white canvas. As he squints his eye, he can see his father and grandfather having an intense discussion. They are arguing over the necessity to burn the one-hectare of land that has only been fallow for three years because there is almost no rain this year. Although his grandfather discourages this, he realizes the necessity to put food on the table for the family; the dry season is only a month away. The sound of an infant crying breaks the silence. His little brother begs for food, but there is not enough; 67 percent of young children in Guatemala suffer from malnutrition (Feed the Future). He pivots on his planted foot and faces his family's house, a mere scaffold composed of sticks plastered with clay and topped with a thatched-roof made of dried palm leaves, and wonders how he is going to remain a farmer when he grows older (Lugo, 2009). Hopefully the few beans, squash, vegetables, papaya and cacao that surround them will help fill their stomachs. Luckily, in the past he and his family have received nutrition education and food assistance from the Secretariat for Food Security and Nutrition (SESAN), which involves relevant government institutions, donors and civil society and is supported by USAID Feed the Future, a U.S. government sponsored program that invests money in rural agriculture development to countries throughout the world. This program has helped his family afford more food from local markets, but they still cannot produce enough food to become independent from foreign relief aid (The U.S. Government's Global Hunger and Food Security Initiative). Hopefully, this safety net will be there if his family needs it to get them through until the next cropping cycle.

With roughly 14 million people and a population growth of 2.5 percent, Guatemala has the largest and fastest growing population in Central America. If analyzed using the demographic transition model, Guatemala's recent population trends place the country in the second phase. This means that overall the country has a high but slightly decreasing birth rate while at the same time the death rate is decreasing significantly. However, due to economic inequalities among the population, there is a high birth rate among the poorer and indigenous communities in the country. The wealthiest 20 percent of the population average 1.8 children per woman, as opposed to an average 5.7 children per woman in the poorest 20 percent, who are mostly of Mayan descent (The Population Reference Bureau, 2011). As time progresses and if these statistics remain constant, the demand for food will increase.

With its situation as one of the poorest countries in Latin America, there is not much investment in the public sector. There is no free education system in Guatemala and as a result, the overall illiteracy rate stands at 25 percent. Looking only at the indigenous population, the rate increases to roughly 60 percent (The Global Education Fund). "According to USAID, average schooling in Guatemala is a short four years and only three in ten children graduate from sixth grade" (The Global Education Fund). Another consequence of the economic inequality and poverty within the country's population is Guatemala's struggle to provide equal access to healthcare for all of its population. Efforts have been made to increase public health spending, but the healthcare system still relies heavily on private expenditures (The World Health Organization, 2014). Guatemala's classification as a lower-middle-income economy means the average individual annual income is between \$1,046 to \$4,125 (World Bank, 2015). Despite a rather high infant mortality rate of 23.5 and comparably good life expectancy of 71 years, it remains difficult to receive the appropriate amount of aid from not-for-profit organizations (The World Health Organization, 2014). It is a country of extremes.

Guatemala's socio-economic issues contribute to food insecurity. Many of the impoverished rural Mayans have little money to buy inputs such as improved seeds and fertilizer. Their farming systems are based on the traditional farming method, called slash-and-burn, used by their ancestors as well as many other poor farmers in the developing world. The current methods may not allow time for fallow growth and the soil may be depleted as well, therefore, there is an opportunity to improve crop yields. The slash-and-burn method involves a farmer burning plots of scrub or forest to clear land and plant crops. The organic ash left from the dead plant material provides nutrients to the topsoil and stimulates healthy crop growth for about three to four years until the soil has been depleted of most of its nutrients (Cornell, 2007). Farmers then move on to another section of the forest and conduct the same process, allowing the previous plot to lay fallow for 15 to 20 years, enough time for the forest to regenerate (Cornell, 2007). If done properly, slash-and-burn agriculture is a highly productive method of agriculture; however, many Mayan farmers are not conducting slash-and-burn agricultural techniques in a sustainable manner. With limited land available, and increasing population, farmers do not allocate a sufficient fallow time for previously burned plots of land to regenerate. This leads to less nutrient availability as the fallow period is shortened for the subsequent crops thereby reducing overall production. This type of farming strategy to increase production is referred to as extensification. According to Erenstein (2005), in these systems farmers increase production by "increasing the area they farm while maintaining or reducing aggregate input levels per unit area" per unit land area. Also, with a large increase of plantation land holdings for palm oil and other export industries, many Mayan simply do not have enough land.

Unsustainable slash-and-burn agriculture methods can have other negative impacts as well. Trees in tropical mountainous areas play an essential role in the ecosystem. During the rainy season the leaves that fall and decompose on the forest floor act as a buffer to prevent the raindrops from removing soil particles as the droplets hit the ground (Rutherford, 2009). Their deep root systems stabilize the topsoil and prevent erosion by absorbing large amounts of water from the soil (Rutherford, 2009). When farmers deforest a mountainside area using mismanaged slash-and-burn agriculture, the topsoil that contains most of the soil nutrients erodes down slope under the force of wind and water (Bradford, 2015). Guatemala is susceptible to hurricanes that pass through the Gulf of Mexico. In 1998 when Hurricane Mitch devastated the country, the country was placed in a fragile state. Landslides and flash flooding caused damages to infrastructure totaled 60 million U.S. dollars; roads were destroyed, houses obliterated, and banana, coffee, and cardamom plantations were flooded (The Inter-American Development Bank). Some of these impacts can be attributed to soil erosion due to the lack of extensive root systems that can stabilize mountainsides.

Trees play a vital role in preventing water pollution because they reduce erosion. In addition to ingesting contaminants through drinking water, people can also contract diseases such as Norovirus, Hepatitis A, and Salmonella associated with human and animal waste (The Center for Disease Control and Prevention, 2008). Young children and elderly adults are the most susceptible to these diseases because their immune systems may not be strong enough to combat them. Lake Atitlán, located 120 kilometers west of Guatemala City, is one water body that is contaminated. In the past, the lake has been a major tourist destination and a source of food for local fishing communities that surrounding it. However, due to recent contamination from untreated sewage, agricultural runoff, and increased inflows due to deforestation around the lake basin, there has been an increased growth of cyanobacteria in the lake (The Earth Observatory, 2009). Martha Dix, a biology professor at De Valle University, states that, "pollution of the lake has led to a reduction in tourism, jobs, fish and food, and an increase in poverty and illnesses for the surrounding communities, for whom the lake represents a primary source of water" (Bevan, 2014).

Of the roughly 30 percent of dry land on earth, only seven percent is tropical forests. These tropical forests foster nearly 50 percent of all species in the world (Lindsey, 2007). When practiced in unsustainable ways slash-and-burn agricultural methods may destroy tropical forests. Many species, some

endemic to Guatemala, can become extinct if unsustainable slash-and-burn agriculture is practiced on a large scale especially in biodiversity hot spots found in Guatemala. “Some researchers and scientists believe that in the genes of some of these unique plant and animal species lie the possible cures for cancer and other diseases, or the answer to improving crop yields” (Lindsey, 2007).

When a farmer practices slash-and-burn agriculture, the burning of the trees and associated living material releases large amounts of carbon dioxide into the atmosphere (Bradford, 2015). The loss of trees and their function in releasing water through transpiration has been shown by scientists to reduce rainfall patterns in certain regions. So the burning of trees and removing their functional role in the ecosystem can negatively impact the climate, crop productivity and food security. Deforestation plays a crucial role in climate change. Gas molecules within the atmosphere that absorb thermal infrared radiation are referred to as greenhouse gases. Carbon dioxide is the most prevalent greenhouse gas in the earth’s atmosphere due to mankind’s reliance on fossil fuels for energy.

The present day practice of slash-and-burn agriculture in Guatemala has been identified by governmental and non-governmental organizations as a possible threat to the environment and food security. Many organizations are working with rural farmers to identify appropriate practices and technologies that would provide sustainable alternatives to this practice. For example, the Rainforest Alliance “works to conserve biodiversity and ensure sustainable livelihoods by transforming land-use practices, business practices and consumer behavior” (The Rainforest Alliance). This organization provides training for rural farmers and works with them to adopt sustainable agriculture methods such as the use of cover crops and riparian buffers that stabilize soil and reduce erosion. Farmers who adopt practices based on a set of standards can gain Rainforest Alliance certification, which uses a market base approach to attract environmentally conscious consumers interested in the products the farmers have to sell.

Contour farming is a method of designing and planting a crop field, and it can help reduce the risk of soil erosion. Contour farming involves planting crops generally perpendicular to the slope on hills or mountainsides, as opposed to vertically (USDA-NRCS). According to the USDA, contour farming preserves valuable topsoil, slows down water and allows it to be absorbed into the soil, improving both rain-fed and irrigated cropping systems. This helps farmers maintain their soil quality when they are farming in regions with steep slopes and minimal vegetation coverage.

The Alliance for International Reforestation (AIR) is a non-governmental organization that works in Guatemala to train farmers in sustainable agriculture practices (The Alliance for International Reforestation). The organization helps farmers establish tree nurseries and teach the technical skills and knowledge associated with tree production with the goal of helping farmers to establish “income-generating microbusinesses” (The Alliance for International Reforestation). In total, the training program lasts for five years, but after it is completed, local volunteers continue to make monthly visits to each farmer nursery to make sure sustainable practices are still being used (The Alliance for International Reforestation). Through this program, the Alliance for International Reforestation both provides a model to help with reforestation and educates communities about sustainable agricultural practices.

In order to combat against malnutrition in the country, the Guatemalan government is working alongside nongovernmental organizations (NGO) to distribute food to impoverished populations in the country (Loewenberg, 2009). One of these NGOs is the World Food Programme (WFP). The WFP is the world’s largest humanitarian organization fighting against hunger in impoverished nations throughout the world. On a monthly basis, the WFP distributes supplementary food in rural communities at distribution centers. People travel many kilometers to these centers to receive food and aid from doctors (Loewenberg, 2009). In most cases, this is the only time for children to see a doctor (Loewenberg, 2009). By working alongside humanitarian organizations to promote food security and health aid, the rural impoverished communities of Guatemala are able to combat malnutrition and other health issues.

The sound of a rooster pierces the sleep bubble that floats above Jalil's head. It's a warm, pleasant March morning. As Jalil shakes off the last bit of drowsiness and sits down at the dining table, his eyes perk wide open. Jalil is happy and as he looks around the dinner table that night, his family members are happy as well. It is hard for Jalil to imagine that only three years ago, his family was dependent on food relief aid. Now his family has plenty to eat and even excess to sell at the local market. Ever since his father received his Rainforest Alliance certification, life has never been better for the family. It took his father nearly three years to become certified but it was well worth the wait. After finishing his meal, Jalil walks out the door with a belly full of food. At first he does not recognize the farm he was born and raised on because so much has changed since then. In order to become certified, his father had to adopt more sustainable agricultural methods. Now, there is produce to sell at the local market enabling his mother to send his younger siblings to school and buy nutritional food at the market.

Hopefully, like Jalil, Mayan farmers in Guatemala can realize this vision of the future. With the help of government and non-governmental organizations that provide innovative solutions, Mayan ingenuity, hard work, social equity and political stability, perhaps the next generation of Mayan farmers and their families will not go hungry. Their future may be partly in the hands of agronomists, agricultural scientists, and others who may lead the way in finding innovative ways to combat coffee rust, cyclical drought, contaminated water, deforestation, and depleted soils. Food security can, at least in part, be solved through sustainable agriculture.

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