Brenden Marks
Rocky Mountain High School
Meridian, ID
Costa Rica, Factor 6: Sustainable Agriculture

Costa Rica is a country that most people would consider a tropical paradise. The terrain of the country varies from, valleys, rainforests, mountains, volcanoes, wetlands, and plains. The country is bordered by both the North Pacific Ocean and the Caribbean Sea. Costa Rica is blessed with remarkable scenery that doesn't go unnoticed by the some 1.7 million travelers that make trips to the country every year. Costa Rica is known to be the birthplace of ecotourism. It is estimated that up to 80% of all tourists come to the country to take part in ecotourism related activities. Though Costa Rica only accounts for 0.03 percent of earth's surface, it contains nearly 6 percent of the world's biodiversity. It is no doubt that this country is arguably one of the best countries to visit, but what is it like for the locals of Costa Rica? How has the country's history affected it today?

With a large population of about 4.9 million people, 22.4% of the population was considered below the poverty line in 2014 (Worldbank 2014). More and more Costa Ricans are going hungry, but the problem isn't a lack of food; rather it's the families' ability to afford it. A report by the UN Food and Agriculture Organization shows that 8.2 percent of Costa Ricans are "chronically malnourished". This number was less than 5 percent before 2010. With these statistics it is apparent that something is going wrong. With agriculture accounting for 14% of Costa Rica's occupational work force, it is important that local farms have the ability to consistently produce quality foods for the locals. In Costa Rica agriculture and food industry have become commercial in recent years. Food imports have increased by 170% between the years 1992 and 2005. Local food production experienced a significant decrease within that time period. Since the 1990s, agriculture's contribution to Costa Rica's gross domestic product (GDP) dropped from a high of 12% to 5.6% in 2013 (World Bank, 2014)**.** According to Janet Page-Reeves, who has a Ph.D.at the University of New Mexico and is an expert on food security, with the decreased amount of locally grown produce in the country, consumers are forced to buy more expensive products from other regions. With the combination of urbanization and decreased food production, food security becomes a problem for those in low-income and rural households (Page-Reeves, 2014).

The average Costa Rican family size is about 3.8 people. The father of the family typically manages the farm, while the mother is usually a stay at home mom. The children, when not in school, are responsible for helping around the farm and household. Costa Rica was one of the first Latin American countries to offer free and mandatory education for its citizens. The Costa Rican health care system is rated highly on an international level; Costa Rican citizens enjoy the health and life expectancy equivalent to that of developed nations. These great achievements are due to strong universal health insurance and exquisite public and private hospitals. The basic Costa Rican diet consists of vegetables, rice, beans, corn, meats, fresh fruits, milk, fruit juices, and dairy products. About 9.9% of the total land area in the country is used for crop production. Almost half of all farms average less than 25 acres in size. Crops that are cultivated for primarily domestic consumption include: Corn, rice, potatoes, beans, cotton, citrus fruits, pita, yucca, fruits, and vegetables.

At one point in time Costa Rica was completely covered by forests, but during the 1970's and early 1980s large portions of rainforest were cut down and converted into cattle lands and plantations. When the demand for beef went down in the US, Costa Rica was left with a lot of clear-cut land and cattle. In the

1980s Costa Rican forests were down to just 20% to that of its original area. This proved to be extremely detrimental to the countries soil and biodiverse ecosystems. The large number of plant and animal life slowly diminished as habitat was lost.

The effect of deforestation that still affects Costa Rican family farmers today is soil erosion. Soil erosion is the removal of topsoil faster than the soil forming processes can replace it. Soil erosion can be caused by many different human activities including overgrazing, deforestation, mechanized farming, over cultivation, etc. It takes approximately 500 years to replace just one inch of topsoil lost to erosion. Costa Rica loses about 860 million tons of valuable topsoil every year to soil erosion. "During the past 40 years nearly one-third of the world's cropland (1.5 billion hectares) has been abandoned because of soil erosion and degradation." –David Pimentel. The negative effects of soil erosion extend beyond just the loss of topsoil. Crop emergence, growth, and yield are directly affected by soil erosion due to the loss of natural nutrients and applied fertilizers (omafra.gov).

Bananas are Costa Rica's most important agricultural export worth over $900 million in exports annually. While pineapple exports don't fall far behind generating $800 million per year. Pineapple production has increased by almost 300 percent in the last decade. Pineapple plantations now cover about 45,000 hectares of countryside. This growth hasn't come without its consequences however, with improper land management in many agricultural regions; Costa Rica now has severely degraded soil. Surprisingly because of how small the country is, Costa Rica consumes more agrochemicals per hectare of cultivated land than any country in the world. To make the problem of soil degradation and erosion worse, Costa Rica has been declared by experts as "highly vulnerable" to climate change. According Raffaele Vignola of Costa Rica's climate change and watershed program, extreme rain has significantly increased in frequency and intensity. In fact, in July of 2015, banana and pineapple fields were flooded on Costa Rica's Caribbean coast. According to Jorge Sauma, the general manager of the National Banana Corporation, banana production has seen a 10 percent drop since July of 2014 because of higher than normal precipitation rates.

With the factors of climate change, soil degradation, and soil erosion acting as barriers to agricultural sustainability, Costa Rica is expected to face struggles in the future. Some of the current agricultural techniques of Costa Rica will have to change in order to preserve the land for future generations.

The factor that I chose is agricultural sustainability. Costa Rica could highly benefit by implementing sustainable farming techniques. This factor directly impacts the environment, agricultural productivity, food availability, and the safety of village people near farms. Agriculture plays a large role in sustainable development, especially in a country like Costa Rica where 14 percent of the work force is involved with agriculture. Because of unsustainable farming methods the Costa Rican environment and its people are put at risk. Soil erosion alone can affect food availability for family farms due to the degradation of the soil causing the crop to not produce an optimal yield. Climate change can directly affect agricultural productivity by flooding or putting family farms in extreme drought. Such events can completely destroy crops and farmland if not managed correctly. Village safety can be benefited as well with the implementation of sustainable farming methods. In Costa Rica, farms that use agrochemicals have been blamed for contaminating village water supplies. Affected villages have been receiving drinking water from the Costa Rican government because of chemical contamination. In fact, in the village of Milano the most recent water analysis from five springs and Milano's water tank detected up to 3.47 micrograms per

liter of bromacil. This is nearly five times the EPA guidance. If managed incorrectly, runoff from farms that use agrochemicals can also pollute rivers and streams, poisoning fish and wildlife.

Sustainable farming methods to slow soil degradation and erosion are very necessary in order for Costa Rican farmers to continue to produce food for the years ahead of us. The health of soil is extremely important to those whose livelihoods depend on the productivity of their land. Soil erosion can completely destroy land by making it severely degraded. Family farms simply cannot afford to lose soil fertility. The effects of erosion can go beyond the loss of fertile land. Degraded lands tend to not be able to hold onto water, making the risk of flooding increase. Soil erosion has also led to increased pollution and sedimentation in rivers and streams causing harm to fish and wildlife. With sustainable land usage, farmers can reduce the damages of erosion, while preventing further soil degradation and loss of valuable land to desertification.

Costa Rican smallholder farmers are particularly vulnerable to climate changes, due to their limited resources and their little resiliency to cope with setbacks. With the fact being that most of these smallholders depend on agriculture for their livelihoods, sustainable farming techniques are necessary for the farmers of Costa Rica to withstand soil erosion and climate change. With increased awareness in Costa Rica about conservation methods more and more farmers are implementing sustainable farming techniques**.** Farmers are using farming methods that work with the environment instead of against it. A few of these methods include biointensive farming, new tilling methods, and proper water usage. Although food production has seen a drop in the recent years, the trend for sustainability has not. Many Costa Rican farmers have seen tremendous benefits by implementing new methods, some are even making better money by working with the environment.

By improving agricultural sustainability in Costa Rica smallholders and plantation owners can increase food production while adapting to the rough climate change. In the long run, owning a sustainable farm as opposed to using unsustainable agricultural techniques will keep the farm up and running for many generations to come. In addition to improving soil, using sustainable agricultural methods will greatly benefit the unique plant and animal life in Cost Rica. Having the food security that comes along with sustainability can help low income families gain access to food. With a secure local food source families wouldn't have to pay more imported produce from another region. Smallholders will benefit the most by implementing sustainable farming techniques due to the reliance they have on the productivity of their land. By making efforts to mitigate the effects of climate change and erosion, smallholders have the opportunity to make their land more productive for the years to come.

Other major issues in Costa Rica that may affect agricultural sustainability include drought and desertification, overgrazing, and poor water storage/irrigation methods. Desertification can be caused by many different human activities including overgrazing, over-cultivation, deforestation, and poor irrigation practices. Drought and desertification are growing problems not just in Costa Rica, but in the rest or the world. Drought and desertification threaten the livelihoods of more than 1.2 billion people in some 110 countries around the world. According to the United Nations, an estimated six million hectares of productive land are lost every year because of desertification, land degradation, and declining agricultural productivity. Another factor that could cause problems in the future is the overgrazing of land. Overgrazing can cause harm to the environment and the farmers land (http://www.wvu.edu/~). Overgrazing can be caused by a couple different factors. It can be caused by having too many animals on

the farm, by not properly managing the animals grazing activity, or by grazing at inappropriate times relative to plant's productivity cycle. Overgrazing can further increase the soil erosion problem in Costa Rica by reducing soil depth, soil organic matter, and soil fertility. This can greatly affect the lands productivity for the future. Water collection and redistribution methods could also prove to be a barrier to sustainability for this country. Due to climate change, Costa Rica is expected to receive 35% to 75% more rainfall on the Caribbean slope during some months of the year while the north pacific and central regions of the country are expected to see a 15% reduction of precipitation. This will cause cities within the Caribbean slope to experience extensive rainfall and flooding, while the central and pacific regions are exposed to a high risk of extended drought. Without proper water management, climate change has a chance to further degrade the land.

Based on my research the best way to effectively address these problems would be to implement sustainable farming techniques, proper water collection/ redistribution methods, grazing at the appropriate times, and finally to educate the Costa Rican people about the serious problems they could face in the future if no progress is made. The switch to sustainable farming methods can greatly improve the Costa Rican soil, farms, and the environment. Conservation tillage or mulch tillage is a fantastic way to reduce soil erosion while being cost effective. Conservation tillage is any method of soil cultivation that uses the previous season's crop residue (such as wheat stubble or corn stalks) before and after planting the next crop. To receive the benefits of this technique, anywhere from 30% to 95% of the soil surface must be covered with residue or mulch after planting the first crop. The higher the area of land that is covered dictates the methods effectiveness. The more land you cover with residue the better runoff and soil loss rates will be. Conservation tillage works to slow soil erosion by reducing soil detachment caused by falling raindrops. This works because the residue covering the soil absorbs the impact of falling raindrops. This technique can effectively reduce soil erosion by up to 90% compared to unprotected, conventionally tilled fields . The benefits of this practice include more than just reducing soil erosion; conservation tillage can reduce labor, save fuel, and even cut chemical runoff rates in half. In the long run this tilling method is much more sustainable than conventional tillage, especially with the soil erosion problem in Costa Rica.

Contour farming is a simple traditional Pacific island practice that could benefit many family farms in their struggle with soil erosion. Contour farming works by planting crops in lines across a hillside or slope to decrease the speed of water traveling downhill. The decrease in speed keeps valuable topsoil in place and allows water to soak into the soil. Contour farming is also effective in reducing sediment and runoff, while increasing water infiltration. As opposed to up and downhill farming, contouring can decrease soil erosion by up to 50%. Contour farming and conservation tillage could work hand in hand to deal with soil erosion.

With the North Pacific regions of Costa Rica at risk of extended drought periods, proper water management is necessary. Proper soil management is key to reducing water usage. The ability of the soil to hold water for crops is very important in avoiding excessive water usage. Either avoiding or mitigating runoff can save millions of gallons of water in just one growing season. By recycling runoff not only is the water supply benefitted, the environment is too. Recycling runoff can be expensive however, organic farms save money with this process because they do not need to treat the water before re-use.

One program that could successfully be up-scaled is the Agriculture and Livestock Ministry's (MAG) Mountain Microorganism training program. MAG works with companies and agencies around the world to spread knowledge and help farmers learn about new and sustainable farming methods. In 2012, representatives from MAG participated at a workshop created by the Japanese International Cooperation Agency (JICA) focused on developing a plan for organic agricultural methods to support small scale farmers in the Central American and Caribbean regions. The workshop was held in Costa Rica and Japan for three months. While participating in the workshop, Rolando Tencio, an engineer for MAG, developed a program for MAG to teach small to medium farmers the use of Mountain Microorganisms. Mountain Microorganisms are naturally occurring soil bacteria that are cultured from decomposing organic matter sourced from local soil and cultured on a farm. MM is made up of over eighty different species of bacteria and fungi that are responsible for decay. Since 2012, MAG of Costa Rica's Eastern Central region has trained farmers to cultivate organic produce using the natural soil bacteria. In the MM program farmers are taught sustainable farming techniques as well as how to create home-grown organic fertilizers, pesticides, and other products that fortify and replenish their soil. The overall goal of the MM program is to educate farmers about the benefits of organic MM techniques and how avoiding agrochemicals, farmers can reduce environmental contamination, improve food quality, and reduce production costs. **This program has dramatically improved soil and food quality on family farms.**

The Costa Rican government has helped tremendously with its conservation efforts. Costa Rica has been effectively reforesting its land. The country has gone from just having 20 percent of its lands forested to now having over half forested. In addition to its positive impact on reforestation the government has implemented programs such as the payment for environmental services and carbon credit programs. The Carbon Credit program was an agreement made between the Forest Carbon Partnership Faculty and the Costa Rican government. This agreement makes Costa Rica the first country in the world to access large-scale performance based payments for the conservation of its forests, regeneration of degraded soils, and scaling up agro-forestry systems for sustainable landscapes and livelihoods . The government has also been rewarding farmers who aid the environment with their farming practices through the Payment for Environmental Services Program. The Costa Rican government and organizations can tremendously help out family farms with these kinds of programs; the government and organizations are effectively addressing Costa Rica's problem with sustainability and needs to continue to do so.

Communities within Costa Rica can help spread the importance of conservation throughout their country. By promoting sustainable agriculture people may become inspired to either change their ways or do something to make a difference. The typical Costa Rican family can help out by supporting sustainable farms in their area. With the implementation of sustainable agricultural techniques and the support of organizations, the government, and the people of the country it is likely family farms will continue to operate for generations to come. Costa Rica truly sets an example for conservation around the world.

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