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Nicaragua, Factor 6: Sustainable Agriculture

Nicaragua: Sustainability through Permaculture

Located in Central America, Nicaragua is the largest country in its region. While large amounts of land provide numerous agricultural opportunities in the country, Nicaragua is the poorest country in its region, with the average income at five-thousand dollars per capita (“World Fact Book: Nicaragua”). Much of its poverty can be attributed to the lack of crop diversity in the country, as most farmers focus on growing an individual commercial crop that will earn a high price in the international market. While commercial products such as coffee do fetch a high price, the crop’s lack of sustainability causes immense problems within the country.

Nicaraguan families are typically small, with the average family only having about two children (“Nicaragua”). Foods in the Nicaraguan diet often include yucca root, corn, beans, and plantains (“Nicaragua”). Most Nicaraguans only receive six years of schooling. Agriculture plays a key role in the Nicaraguan economy, as it makes up over eighteen percent of the GDP, and provides jobs for just over thirty percent of the country’s work force (“World Fact Book: Nicaragua”). Most of the agricultural jobs are located on commercial farms where day laborers work for low incomes. Low incomes add to the struggle to access healthcare, because medical expenses are often larger than the pay of the laborers. Accessing medical care in the Central American country is difficult, because there are only 0.9 physicians for every thousand Nicaraguans (“World Fact Book: Nicaragua”).

Farm sizes range greatly in Nicaragua depending on if the farm is subsistence or commercial. The small subsistence farms usually are no more than ten acres, while commercial farms are much larger (“NICARAGUA”). Crops grown in Nicaragua include coffee, bananas, sugarcane, rice, corn, and cotton (“World Fact Book: Nicaragua”). Most farms use large amounts of pesticides and other agrochemicals in order to keep growing rates at a maximum (“PTS-containing Products Used in Agriculture”). Nicaragua’s largest exporter is the United States (“Nicaragua Economics”).

Commercial farms, such as coffee farms are not sustainable because they often grow only one crop. Humans cannot live on one crop alone, and growing mass amounts of a crop such as coffee cannot feed a family. If coffee prices were to drastically drop, as they have in the past, it would leave thousands of farm owners and laborers with only coffee to drink. Laborers who often make little money through working on a commercial plantation could not support their families if their jobs were lost. A lack of biodiversity in Nicaragua can also cause a lack of food supply for the inhabitants. Many Nicaraguans cannot afford to import food, so when too much land is devoted to commercial crops, the people of Nicaragua suffer (“World Fact Book: Nicaragua”). A population cannot live entirely on coffee beans.

In the past, Nicaragua has seen the damage caused by a lack of sustainability. This damage could be seen when coffee prices plummeted in the late nineties and early two-thousands, and hundreds of laborers on coffee plantations became unemployed (“History of Coffee in Nicaragua”). Prices went from over \$2.50 per lb in the late nineties to under \$0.50 per lb in the early two-thousands (“Coffee Prices 1972-2016.”). The nation that depended on a single crop for a large portion of its economy was devastated by a price drop of a single crop. Most impacted by the crisis were the 45,334 small scale coffee farmers who lost their main source of income during the event (“History of Coffee in Nicaragua”). Without a source of income, many farmers could not afford to purchase food for their families and so they suffered from hunger. At the climax of the economic disaster, hundreds of unemployed workers and their families gathered in parks and roadsides, surviving off of donated food (“History of Coffee in Nicaragua”). Coffee

prices have risen since, as of July 2016, coffee prices are just under \$1.50 per lb ("Coffee Prices 1972-2016"). Much of the Nicaraguan economy still depends on coffee, as the product makes up 8.1% of exports and 26.94% of the national GDP ("Nicaragua Economics"). If coffee prices were to drop as they did in the past, countless farm laborers and their farmers would again suffer from hunger and little to no income. This lack of biodiversity continues to pose a threat to Nicaragua's people and economy.

Monocultures are still seeing great problems in Nicaragua today. Now threatening Nicaragua's coffee industry is a fungus known as coffee rust. Leaves infected with coffee rust develop "yellowish, oily spots on the upper leaf surface that expand into larger round spots that turn bright orange to red and finally brown with a yellow border. The rust pustules are powdery and orange-yellow on the underleaf surface. Later the pustules turn black," according to an article by Britannica. The article continues, saying, "Rusted leaves drop so that affected trees are virtually denuded; such trees have significantly lower coffee yields and usually die within a few years" ("Coffee Rust"). Due to this fungal disease and elevated temperatures in the 2015-2016 season, Central America has harvested below average coffee yields, as Mexico saw a 29% decrease in coffee output (Verdin). Coffee rust is spread through spores, so coffee monocultures are especially at risk because if one tree is infected, spores do not have to travel far to find another host ("Coffee Rust"). While fungicides containing chemicals such as copper sulfate can be used to control the fungus, the chemicals can cause more harm than help. Copper sulfate is toxic to humans at 11mg/kg, can cause liver disease, and can pollute groundwater ("Copper Sulfate"). Coffee rust would not be as much of a concern for Nicaragua if it wasn't one of their main sources of income. If Nicaragua had other main crops to fall back on, crop failures and lowered harvests would have a decreased impact.

Also contributing to the lack of sustainability of Nicaraguan agriculture, is the usage of agrochemicals to boost production. Agrochemicals used on commercial farms in Nicaragua cause large amounts of environmental degradation. Not only did pesticides cause 2,407 cases of acute pesticide poisoning from 2009-2013, but the harsh chemicals used also greatly damaged the Nicaraguan environment ("Implementation"). In 2007, coffee produced in Nicaragua was found to have traces of endosulfan, an agrochemical, proving that Nicaraguan farms use chemicals to grow their food ("PTS-containing Products Used in Agriculture"). Endosulfan is considered extremely dangerous to the environment because it is poisonous to humans, birds, fish, and other wildlife; the harsh chemical also sticks to soil molecules, and can be moved through runoff streams, posing a threat to wherever the water goes ("Endosulfan"). Polluting the environment surrounding coffee plantations and other Nicaraguan farms opposes sustainability because if the environment is destroyed, crops cannot continue to grow. Environmental damage poses a threat to Nicaraguans who work on the farms because if the plants cannot grow, workers do not have a job. Usage of agrochemicals is not determined by the laborer, rather by the farm owner, so farm workers have little control of the situation ("History of Coffee in Nicaragua"). Also, pesticides have the capability of killing beneficial insects that prey on the damaging ones. Nicaraguan farmers usage of pesticides to kill one insect can lead to a massive problem of no predator insects to control numbers of crop eating insects, ultimately upsetting an environment and causing greater damage on farms than the original pest would have ("Environmental Sustainability Issues in Nicaragua"). Usage of the agrochemicals to increase farm production in Nicaragua is still practiced and still poses a threat to the environment and the people of Nicaragua.

The solution to Nicaragua's current unsustainable and monoculture system of agriculture is permaculture. Permaculture is built on the foundations of biodiversity and sustainability in order to create an ecosystem beneficial to both nature and humans. Through including permaculture in Nicaragua, humans and nature would benefit directly due to the biodiversity of the plant life. Diversifying the plants grown on Nicaraguan farms translates into diversifying the economy. A diverse economy is a successful and sustainable economy more resistant to events such as the coffee price drop during the turn of the century mentioned earlier. Also, biodiversity means more types of food grown and able to be eaten. So part of the solution to the lack of sustainability in Nicaragua is not to find different chemicals to use, but to find

different plants to grow. As seen by Nicaragua's current pesticide usage, a monoculture situation will almost always depend on the usage of unsafe pesticides and herbicides, so growing one crop will only continue the problem ("Implementation"). However, implementing systems of permaculture, where numerous varieties of plants are grown in coexistence, would greatly aid the Nicaraguan people. Permaculture lies upon the principles of intercropping many types of plants and working with the ecosystem to produce food year round. No agrochemicals are used in permaculture; instead, it relies on nature to pick the best growing plants to produce the most food. When multiple plant varieties are grown, societies are less susceptible to economic ruin and hunger because there is always a backup plant to produce food if one is destroyed through disease or drought. Great amounts of biodiversity create an ecosystem for animals and organisms to thrive in. Additionally, the large biodiversity in a permaculture system allows for the soil to be replenished and repaired through plants putting nutrients back into the soil.

Furthermore, large permaculture farms could be created across Nicaragua to increase sustainability. The farms could feed Nicaraguans in need, employ lower class Nicaraguans, and sell excess food produced in local markets. Employees at the farms would receive fresh produce for their families and live on or near the properties. Without the need to buy food or pay rent, families living on the property could use their wages for medical and other needs. Hunger would decrease dramatically because a large variety of food bearing plants grown on farms would provide necessary nutrition. Economic ruin would no longer be a constant threat because if one crop price plummets, there would be numerous other plants to sell.

These new permaculture farms would be employee owned, with 25% of all harvests going directly to the workers. The other 75% would be sold in local and international markets. Since the farms would be employee owned, the workers could recommend and change pieces and parts of the farm as needed.

Numerous different plantings would be present on a single farm due to geography and plant characteristics. On one piece of land, there could be an area that receives little sun, another that is always sunny, and yet another that is more of a swamp than farmland. Due to the differing zones geography, there must be different plants at every location to maximize the efficiency of the farm. In one successful pilot permaculture farm in the Nicaraguan island of Ometepe, there are over 30 different plantings within 26 acres ("Interactive Base Map"). However, a simple design for a new permaculture farm would consist of a variety of ground cover, understory, and canopy plants in each area (Paradise Lot). In a sunny and dry area, for example, plantings may consist of a moringa tree that provides shade. Intercropping systems such as these are sustainable because they have the capability of continuing for generations and providing for the people on the farm. With a large spectrum of plants ripening at different times of the year, food would continuously be available to eat or sell. While plants use and replace nutrients, soil quality is maintained and improved, allowing for high yields year after year.

One of the first hurdles in installing permaculture farms is acquiring land for them to be located on. Grants from organizations such as United Nations would undoubtedly cover the pecuniary needs to purchase land and plants. Neighboring and developed countries could provide persuasion for Nicaragua to sell land for the new farms. Microloans could also aid in acquiring land for permaculture farms.

In addition to creating new farms where permaculture is practiced, existing Nicaraguan farms can be transitioned into a permaculture situation. Transitioning from a commercial monoculture farm to a sustainable permaculture farm can be done, as can be seen by Miracle Farms in Canada. The orchard in Quebec relied on intercropping to aid in supplementing soil nutrients and building an ecosystem where their fruit was grown (Possiblefilm).

Similarly, many coffee farms in Nicaragua can be mended into a more sustainable operation through a few varied additions. Through incorporating a system of intercropping within coffee plantations,

commercial or non-commercial, a more sustainable farm could be created that required little to no added chemicals while producing more crops. An already existing coffee farm may be intercropped by replacing one in every four coffee trees with a tamarind or calliandra tree. Tamarind trees provide a large amount of shade under the plant and can produce up to 386 lbs of edible seed pods that may be sold or eaten ("Tamarind"). If only ten tamarind trees were planted in a coffee farm, there would be the potential of harvesting 3,860 lb of tamarind fruit to sell or distribute. Seed pods from tamarind trees can be sold at five dollars a lb at Indian grocery stores. Even if only 2,000 lb of fruit were harvested and sold at only three dollars per lb, a coffee farm could receive \$6,000 as a result of planting ten trees. The tall trees can be pruned and used as trellises for vine plants such as passion fruit and cantaloupe, both of which grow well in Nicaragua ("Fruits and Vegetables of Nicaragua"). Also, tamarind trees are legumes, meaning that the plants aid in replacing nitrogen in the soil ("Tamarind"). The harvest from tamarind trees could be distributed to the farm workers and local Nicaraguans. Calliandra trees also provide a shade under its branches and replace nitrogen in the soil. Additionally, the attractive flowers of the calliandra tree attract many birds, including hummingbirds and finches ("Fairy Duster Plant: How To Grow A Calliandra Fairy Duster Shrub"). In attracting birds to the plant, the calliandra plant would play a key role in turning a coffee plantation into a beneficial ecosystem, which is one of the main goals of permaculture. Many coffee varieties, such as the popular *Coffea Arabica* requires shade for the plant to grow and produce well (Sage). Most of the coffee grown in Nicaragua requires shade, as one article reads, "Ninety five percent of Nicaragua's coffee cultivation is considered 'shade grown,'" meaning that the planting of the tamarind and calliandra trees would be beneficial due to their large canopies ("History of Coffee in Nicaragua"). Additionally, breaks of trees and bushes in between coffee fields could be installed to prevent the spread of fungus such as coffee rust, and provide space for wildlife. So by implementing a system of intercropping in a coffee plantation, the owner would be benefitted by needing fewer fertilizers, harvesting larger crops, and by growing more successful coffee plants in shade. Through using minimal or no fertilizers and agro chemicals, there would be a lesser chance of workers being poisoned by harsh chemicals, and less chemicals damaging Nicaraguan ecosystems. This relatively simple solution could be used in many coffee farms with great success.

Education is a key to making permaculture in Nicaragua more successful, and ultimately making the country's agriculture more sustainable. Without the knowledge of permaculture methods such as using native crops and intercropping, it would be a greater challenge to integrate permaculture into Nicaragua's agricultural setting. However, a permaculture farm, named 'Project Bona Fide', on the Nicaraguan island of Ometepe offers permaculture design courses. Central American students receive a reduced tuition price of \$750 for a 14 day course that incorporates lessons in designs and methods used in permaculture. This course would especially be helpful to Nicaraguans because the plants used, environment, and methods can be all directed at the Nicaraguan environment ("Permaculture Design Course"). Through visiting the farm, the Nicaraguans could view a successful permaculture design in action, and know that the idea is viable. The educational course would also teach students how to read the landscape and plant accordingly ("Permaculture Design Course"). For the new permaculture farms, three people could be sent from each prospective farm to take the course, and they could then act as permaculture teachers to the other employees on the farm. Nicaraguan coffee farms looking to be transitioned into a permaculture setting could send the farm owner and one of the workers to take the course. Scholarships and tuition aid could be provided by the Bona Fide School. Also, microloans from organizations such as the Foundation for Sustainable Development could be taken out by students to pay for the design course, and repaid once the permaculture operation began. Students could also be sponsored by the Nicaraguan government as an investment of the Nicaraguan people. Education about permaculture creates the opportunity for the system to succeed.

The environment would be greatly improved in a permaculture because one of the foundations of permaculture is sustainability. Different crops improve the soil without chemicals, and continue to grow

successfully because of the great soil. Erosion would be greatly reduced in the permaculture farms since permaculture employs many perennial plants that develop large root systems that remain in place for years (Paradise Lot). Usage of pesticides is not needed in a permaculture setting. This lack of need for pesticides is due to the fact that intercropping would be used in Nicaraguan permaculture farms. Intercropping is a method used in the greater theme of permaculture. Intercropping has been defined by one organization as, “a method of planting two or more crops of differing characteristics in close proximity to reduce weeds; to encourage plant diversity in order to avoid insect and pest infestation; and to provide shade, nitrogen fixation, or other benefits to the plants being grown”, which outlines some of the major benefits of using an intercropping system ("Sustainable Crop Production"). For an example of why intercropping requires less agrochemicals, take the real life example of coffee rust on Nicaraguan plantations. To prevent the spread of the coffee fungus spores, lines of nitrogen producing trees and fields of native trees could be planted in between coffee fields. Coffee crops have a lesser chance of being destroyed because of the distance and threat of predators and fungi created by intercropping. Without using any agrochemicals, damage is limited simply through the principles of intercropping and permaculture (Possiblefilm). Since permaculture farms do not need to use agrochemicals, the result would be no acute pesticide poisoning and no pesticides being transferred through water runoff. Safe for both humans and the land, the methods of permaculture have the capability of continuing for years.

Permaculture is a permanent solution to one of Nicaragua’s lack of sustainability. Through implementing different techniques a system resistant to crop failures and price drops in crops would be created. Nicaraguans would become less susceptible to hunger crises and economic disaster. Continuing to depend on monoculture will only prove to be harmful to the Central American country, as it cannot continue for countless generations. However, adding permaculture to Nicaragua’s agriculture will turn it into a system of sustainability that will aid Nicaragua in its future both in its economy and its people.

Resources

- "Agro-Biodiversity." *Project Bona Fide*. N.p., n.d. Web. 14 July 2016.
- Brown, Stephen H. "Cocoplum." (n.d.): n. pag. *Lee.ifas.ufl.edu*. University of Florida Lee County Extension. Web. 14 July 2016.
- "Carissa Plant Care – Information On Growing A Natal Plum Bush." *Gardening Know How*. N.p., 30 Sept. 2014. Web. 14 July 2016.
- "Coffee | 1972-2016 | Data | Chart | Calendar | Forecast | News." *Coffee Prices 1972-2016*. Trading Economics, n.d. Web. 11 July 2016.
- "Coffee Prices 1972-2016." *Trading Economics*. N.p., n.d. Web. 11 July 2016.
- "Coffee Rust." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 28 Apr. 2016. Web. 15 July 2016.
- "Copper Sulfate." *Cornell.edu*. N.p., May 1994. Web. 16 July 2016.
- "Endosulfan." *Cornell.edu*. N.p., 1993. Web. 17 Feb. 2016.
- "Environmental Sustainability Issues in Nicaragua." *FSD International*. N.p., n.d. Web. 12 July 2016.
- "Fairy Duster Plant: How To Grow A Calliandra Fairy Duster Shrub." *Gardening Know How*. Becca Badgett, 08 Mar. 2013. Web. 10 July 2016.
- "Fruits and Vegetables of Nicaragua." *Nicaragua Guide*. N.p., n.d. Web. 10 July 2016.
- "History of Coffee in Nicaragua." *History of Coffee in Nicaragua*. N.p., n.d. Web. 11 Feb. 2016.
- "Implementation of the Rotterdam Convention in Nicaragua, Dominican Republic, Colombia and El Salvador." (n.d.): n. pag. July 2013. Web. 17 Feb. 2016.
- "Interactive Base Map." *Project Bona Fide*. N.p., 04 Apr. 2014. Web. 14 July 2016.
- Lindemann, W.C. "Nitrogen Fixation by Legumes." *NMSU: Nitrogen Fixation By Legumes*. N.p., n.d. Web. 11 July 2016.

"Microfinance Opportunities in Nicaragua." *Microfinance Opportunities in Nicaragua*. N.p., n.d. Web. 13 July 2016.

"Nicaragua." *Central Intelligence Agency*. Central Intelligence Agency, 12 Jan. 2016. Web. 11 Feb. 2016.

"Nicaragua." *Culture of Nicaragua*. N.p., n.d. Web. 14 Feb. 2016.

"Nicaragua Economics." *OECD*. N.p., n.d. Web. 11 July 2016.

"NICARAGUA." *Nations Encyclopedia*. N.p., n.d. Web. 20 Feb. 2016.

"Paradise Lot." *Paradise Lot*. N.p., n.d. Web. 10 July 2016.

"Permaculture Design Course." *Project Bona Fide*. N.p., 31 Oct. 2011. Web. 12 July 2016.

Possiblefilm. "Miracle Farms, a 5-acre Commercial Permaculture Orchard in Southern Quebec, Canada." *YouTube*. YouTube, 05 Nov. 2013. Web. 10 July 2016.

Possiblefilm. "The Permaculture Orchard: Beyond Organic - Fall 2014 Update." *YouTube*. YouTube, 26 Nov. 2014. Web. 08 July 2016.

"PTS-containing Products Used in Agriculture." *Countries-PTS - Crops.xls* (n.d.): n. pag. *Oas.org*. 2007. Web. 17 Feb. 2016.

Sage, Emma. "Basic Plant Biology: Keeping the Coffee Plant "Happy"." *The Specialty Coffee Chronicle*. N.p., 8 Mar. 2014. Web. 10 July 2016.

"Sustainable Crop Production." *GRACE Communications Foundation*. N.p., n.d. Web. 11 July 2016.

"TAMARIND." *Fruit Facts*. N.p., n.d. Web. 11 July 2016.

"Tamarind." *Wikipedia*. Wikimedia Foundation, n.d. Web. 10 July 2016.

Toensmeier, Eric, and Jonathan Bates. *Paradise Lot: Two Plant Geeks, One-tenth of an Acre, and the Making of an Edible Garden Oasis in the City*. White River Junction, VT: Chelsea Green Pub., 2013. Print.

"Trade Statistics Tables." *International Coffee Organization*. N.p., n.d. Web. 11 Feb. 2016.

Verdin, Mike. "Central American Coffee Crop." *Agrimoney*. Briefing Media, 8 June 2016. Web. 15 July 2016.

"Weed Control." *University of Hawaii*. N.p., n.d. Web. 10 July 2016.

"World Fact Book: Nicaragua." *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 20 Feb. 2016.