

Agricultural practises and their sustainability around the village Monterrey in the Las Piedras district

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Abstract

The current political climate of Peru has had significant effects on the Madre de Dios region. Many migrants have arrived in the area over the last few decades, and with the addition of the Interoceanic Highway there has been an increase in the agricultural action occurring in Madre de Dios. With efforts by the government to increase the productivity of farmland, there has been an implementation of various agricultural techniques that are detrimental to the sustainability of the environment and the economy. The goal of this research was to gain a better understanding of how farmers in the town of Monterrey, in the Las Piedras district, work their farmland, and to find out how sustainable the agricultural system currently is. I conducted 12 informal interviews with farmers and solicited information from the local outpost of the Ministry of Agriculture. Most farmers grow papayas, watermelons, or corn, using modernized techniques and relying on heavy fertilizer use. Based on my research, these practices are unsustainable for the long run and I suggest holding educational seminars for farmers to implement sustainable techniques such as crop rotation and crop diversity to create a system that will promote the economic, environmental, and social health of the community.

Introduction

The region of Madre de Dios in Peru has had many changes in current years due to the construction of the Interoceanic Highway that was completed in 2011. This highway connects parts of Southeastern Peru to other population hubs in the country and to Brazil's network of Amazonian roads. The increased access to markets resulting from the paving of the Interoceanic Highway has led to a growth in farmers coming into Madre de Dios in hopes of expanding their commercial operations (Goodman, 2014). The new farmers of the area have a role to play in the future of the Peruvian jungle's environmental health, and how they choose to manage their farmlands will certainly influence the environment, society, and

economy of the Madre de Dios community.

The region had farming as part of their economy for centuries, but the current trend in farming techniques involves practices from modern westernized cultures meant to offer quick economic growth. Modern practices by farmers involve the use of slash-and-burn land clearing and the growth of produce that does not effectively utilize the jungle's climate and soils (Zienchuk, 2013). Slash-and-burn is used to quickly clear land and brings most of the nutrients to the surface, facilitating a period of rapid growth potential for several years. While planting these crops allows the farmer to maximize their short-term profits, cultivating one type of plant all year long with the use of fertilization for years on end causes the soil quality to degrade quickly,

rendering it effectively dead and unusable for agriculture.

To make better use of the environment's diversity and climate, it would be better to use some of the amazon's traditional techniques. Traditional shifting cultivation requires plots of rainforest to be leveled to create farming ground, and trees are cut down (instead of burned) and used in the construction of local buildings and houses (Zienchuk, 2013). When it comes time to plant crops, a different crop is planted in each plot, and several are left completely empty. Each year, the position of each crop and the plots left empty are rotated so the soil has a chance to regain its nutrients. Short term profits may not be as high - as the more profitable cash crops are not grown in each plot and some plots are left completely empty. This method does allow for farming practices to continue on the same plots indefinitely without causing any permanent damage to the soil, creating a more sustainable system.

To look more closely at these effect, soil tests show that land near the Tambopata National Reserve, where traditional farming techniques have long been carried out, has higher nitrogen and phosphorus levels than recent agricultural land near Puerto Maldonado (Larson, 2011). This indicates that soil chosen from the areas near farms outside of Puerto Maldonado which use modern techniques have not yet had enough time to return to its original state. One study also involved qualitative information gathering of local farmers and made some notable points. One was that most of the farmers interviewed were immigrants from other areas of Peru, speculating that some came to the rainforest during the 1980s, when government programs facilitated immigration to new agricultural land. These studies show that national agrarian policy clearly dictates some broad agricultural

trends, specifically trends in the expansion of farmable land in the rainforests.

The current system for agricultural growth in the Madre de Dios region is being largely influenced by Westernized culture which is proficient in temperate areas, not suited to the tropical environment of the Amazon rain forest. These intensive farming techniques are more frequently advertised by seed vendors and fertilizer companies. Since these techniques also promote quick production they are also supported by government laws. Since most farmers in Madre de Dios do not have formal agricultural education (68% of the population has basic education, 21% only completing primary school) they often don't know about alternatives to these more common practices (Ministerio de la Produccion Peru, 2016). Education (or a lack thereof) can explain the current state of development. When the only formal agricultural education available to people involves modernized, commercial farming techniques, it can cause the "growth of ignorance" with regards to traditional techniques that might be more sustainable. This has happened to many populations throughout Peru and in Madre de Dios, particularly indigenous populations, who have lost knowledge of traditional sustainable farming techniques and their own cultures. Even though the government approves rapid agricultural production. Many farmers complained about a lack of government aid, which they were perhaps expecting given the agrarian policies through which they originally obtained their land (Larson, 2011). A few referenced NGOs that helped them to develop agricultural methods suited to the low-nutrient rainforest, such as planting nitrogen-fixers. But apart from support by the NGOs, the farmers are left with no resources to help develop better farming practices.

This region is going through a dynamic spurt of economic growth, which is a good opportunity to help implement more sustainable development practices for the community. All sustainable development programs should consider the three spheres of sustainability - environment, society and economy - as well as an underlying dimension of culture (Larson, 2011). To help with the development of a more sustainable community in this new population hub in one of the most biologically rich regions of the world, there should be greater understanding of how the people and the farmers of the Madre de Dios region behave, learn, react, and thrive. Sustainable systems value biodiversity and conservation along with human diversity, inclusivity, and participation.

Methods

To gain a better understanding of how farmers behave when it comes to agriculture, a qualitative interview process was conducted to learn about their agricultural lifestyles. Questions included understanding how long they have lived in the area, and what brought them here if they were from other regions, to learn of the types of crops they are growing, how these choices in crops has changed over the years, and how they gain their knowledge of growing these crops, if any. The interview included questions to learn about the types of chemicals (fertilizers, insecticides, pesticides, and herbicides) that farmers in the area were using, if any. And questions that help to examine the economic trends and benefits of agriculture for people. Lastly, since this interview was an open qualitative interview, there was room to hear concerns from local citizens and their ideas for community improvement – which led to increase examination of how the various social and natural factors of the

community affected their lives and the way in which they managed their land.

To find interviewees in this small town, contact was first made with farmers that already have relationships with the organization that assisted in conducting this research. Then inquiries were made with these farmers about other interview candidates. Another technique employed to find interviewees was to approach the homes in the town of Monterrey, since most people in town own chacras (farmlands), and ask people to partake in the interview. Also, as I made my rounds in the town, I approached every individual that walked by and ask them if they conducted agriculture or knew of anyone that did. Finally, I contacted the teacher at a local school who could connect me with a couple of parents who conduct agriculture. Interviews were conducted either immediately or reschedule to a later date. The interview protocol was printed out with space between questions to write answers. This method was employed instead of using voice recorders to make the interviews more comfortable for the farmers. During all interviews, there was improvisation since the farmers seldom gave the information in the order of the questions. Priority was given to the flow of the conversation to make the interviews more comfortable for the farmers, therefore opening the possibility of gathering more information than just what the questions addressed.

The full interview protocol can be found in the Appendix.

Results

The interviews provided much information regarding the livelihoods of the farmers in Monterrey and the importance of agriculture in their lives. In total 12 farmers were interviewed thoroughly. Although this number may seem small, it included most of the farmers in the Monterrey area, which is

a small town on the Interoceanic highway. The town is mainly made up of three small bodegas, one elementary school, one pre-school, and a couple dozen family homes.

Four of the farmers were born in Madre de Dios and eight from other regions, and half of these migrants were from Cusco. Many of these migrants came to the area about 30 years ago for various reasons, one common reason being the fear of terrorist attacks from Sendero Luminoso, a Maoist group active in the highlands in the 80s and 90s. When the farmers first arrived in Madre de Dios they went into a few certain industries, four worked in logging, three in Brazil nut concessions, two in Mining, the remainder start with farming or were unwilling to share.

Five had done agriculture for less than 10 years (usually in the last five years), while seven farmers had done agriculture for more than 10 years, usually 20+ years). Many of the people in the area chose agriculture because land is available and certain crops are easy to manage. This allows them to have extra food and some extra income. There were also few cases where programs motivated them to start up agriculture, such as a pineapple project. When they began, four of the farmers worked on rented land or other people's land, while the remainder invested in agriculture on their own land. The individuals that currently work on the lands of others or are renting land are looking to be able to obtain their own land – and one individual just recently bought his own land, a small parcel of 5 hectares. The average land size for farmers in Monterrey is about 35.6 hectares, but most individuals only use a small part of their land for agriculture. 66 ha are in agricultural use of 427 total ha (15.4%) Most of the land in the area is still forest or recovering forest. The people in the area who own land keep part of their forest standing because they still

have value (Brazil nut or Aguaje concessions), or more commonly, the gain from agriculture is too little for so much effort and investment.

Most farmers grow papaya and watermelons to make a profit. Farmers also grow corn, rice, yucca, and bananas for they are easy to grow, and they help to complement families' consumption needs. But more importantly for the purposes of this paper, we should look at the fact that seven out of 12 families have changed the type of crops they grow over their time as farmers, adapting to the changing markets and possible crops.

There are three primary reasons people gave for growing crops in these rural areas: short-term monetary gains, personal consumption, and market popularity. Many of the people in the area grow rice, corn, and bananas because they are easy to grow and maintain and they can use them with almost every meal, also the high demand for these in the diets of the region makes them easy sales for extra cash. People also use corn as chicken feed. Corn, like watermelon is also a fast-growing crop, that farmers can see profits of their investments in a short period time of three to five months. And market popularity is a two-part variable, where farmers start growing crops when they hear that certain produce has a high price in the market, or when they see certain crops being grown by their neighbors in Monterrey or other towns.

Once farmers have decided to grow a crop, they go get their seeds from stores in Puerto Maldonado. The farmers also tend to buy cans of watermelon "Super" seeds for they are enticed by the promises of better yields. A few farmers did claim that despite the acclaimed quality of the seed, there was no positive difference in crop yield. Others have received instruction on how to grow crops from specific seed sellers, and therefore rely on these providers to sell

them their seeds. Apparently, when you offer people the instruction on how to grow a certain crop, you've earned their trust as a loyal customer.

With regards to cacao, nine farmers are growing it or are interested in the idea and the rest are not looking to growing it anytime soon. Farmers grow cacao because it provides them with a crop that they can harvest over a long period of time with a one-time investment. There is a market for it, although they say that now it does not sell as well as it used to. Also, with much talk recently about making a push to grow cacao, many farmers have obtained some seedlings to start giving it a shot. Those who are not interested in cacao primarily are not interested because they are currently renting land, and since cacao is a long-term investment it will do them little good in their current situation.

There are a few options that farmers have when it comes to preparing land, one is the use of manual labor and tools like machetes, weed-whackers, hoes, rakes, and so on. Another technique involves the use of herbicides to kill grass and weeds. And lastly, people also rely on burning techniques. 100% of the farmers in the area use manual labor in at least a minimal way. 50% use herbicides, and the main reasons for not using herbicides are because they have heard that it causes damage to the soil, or because of the cost of them. While 50% of the people use burning techniques, the main reasons why some don't involve the danger of losing valuable crops, or that they don't burn because they don't have to burn. The people who use herbicides might also use burning techniques. For steps after clearing the land a couple individuals explained their method of planting seeds a couple meters apart from other crops. Sometimes they would create small mounds and trails to direct water-flow. These techniques were taught to them by either

seed vendors, or through seminars put together by the government or other organizations. Others have learned from instruction by their parents that see agriculture to supplement their lifestyles. Most Cusco immigrants work agriculture upon arriving because they have grown up with farming being part of their lives. And they bring with them their farming techniques.

Some of these farming techniques include how they deal with poor soils and how they deal with pests. There are three primary options for fertilizing plants which include the use of manure and natural composts, the use of chemical fertilizers, and the use of nitrogen fixers. 83% of farmers use manure (mainly because it is cheap from barns and farms, about 2-4 soles per kilo). 75% use chemical fertilizers, mostly buying them from Agroveterinarias in Puerto Maldonado, sometimes from special vendors for specific crops like papayas, watermelons, and pineapples. They also purchase specific fertilizers to help with flowering and bigger roots like Mastergizer by Silcrop. 17% use nitrogen fixers like mucuna and other beans to help the soil, although it's not an extremely well-known practice. Most farmers in the area get their info from the Agricultural stores in Puerto Maldonado, where they buy the product itself. Although comments were made by farmers about being careful with what products they use, sometimes the fertilizers they buy are fake and they lose out on their investment. 17% of individuals who have had instruction in growing their crops got their info on fertilizer use from organizations.

Everyone used pesticides of some kind to get rid of the bugs and diseases that were hurting their crops. They would access these, usually through Puerto stores. No-one claimed to not use pesticides; they only claimed to not be sure where they got the

product from. The main recipients of pesticide use are papayas and bananas. And they use chemical herbicides to also clear the land of grass and weeds. A few of the products use are Monogros by Farmagro, Fuego by Neoagrum, and AminaCrop by Silcrop. They buy these products from stores in Puerto Maldonado as well, and they are used as necessary when pests invade.

Apart from using herbicides to clear land, 100% of farmers owned at least a machete with a variety of other hand tools they used to work the land. 10 farmers own fumigation packs they use to either spread herbicides or pesticides. Two of them said they use weed-whackers in the clearing process. One individual claimed to have been able to rent a tractor from the government. However, I know of at least one other farmer I was unable to interview who does own a tractor in Monterrey. But most people rely on the use of manual labor instead of machinery, and everyone claimed to work the land with few staff – usually about one or two people working the land that included family members. But about 50% of the farmers would hire extra workers when it came to plant the produce or harvest the produce.

Eleven farmers sell their produce to buyers, these are commercial vendors that have employees that travel from farm to farm picking up produce that will be shipped to places like Lima, Arequipa, etc. This is convenient for farmers since they can sell their product in bulk. It has also created another job market for people willing to work picking up the produce. I had the chance to speak with an individual who worked with the vendors to pick up produce. When asked about how much they gain for that work, he said that they make S./80 soles per truckload. If they can fill a truck in one day it is good work, but sometimes it may take up to four days to fill

up a truck, meaning S./20 soles a day, which is considered a horrible wage. Also, their work is also only available during harvest seasons, so the people who work in collecting do not depend on it as a primary source of income.

Five farmers said they take their produce to the Feria Agropecuaria, which is a type of Farmer's market where local growers can sell their goods directly to the consumer. Farmers will do this because they either have produce that vendors will not take, or they are willing to sell their good for slightly higher prices directly to consumers. This number used to be higher, but gains are low for the extra effort, so most farmers will just sell to the vendors and avoid the hassle. I also attended the Feria Agropecuaria and learned that farmers will pay a one-time fee to enter the association of S./100 soles, and then pay S./3 every time they want to sell products at the fair. The effort of the farmers' market was put forward by the city, and it is quite the lively event that occurs every weekend. And lastly, two of the farmers claim they now grow crops only for personal consumption, meaning they have stopped trying to grow food for sale since the gains from agriculture are low, and now will grow food to fill their own consumer needs while making a small effort to sell any extras they have come harvest season.

Farmers in this poor area must work on their revenues to fulfill their immediate expenses, including financing the next crops. While most numbers for investments varied between farmers even for the same crop (due to different practices, different seeds and different types of fertilizers used), it was rather surprising to hear that individuals would spend thousands of soles to start growing their crops, sometimes reaching up to S./10,000 soles per hectare. The average amount spent per hectare is S./3,118 soles, which is a substantial loss

for any farmer when crops don't grow well. People pay for these high initial costs by buying the seeds and fertilizers as soon as they sell their crops, at the same time they would buy sacks of grain foods, and cans of non-perishable food items to hold them out until they are able to harvest again. And for those who start agriculture for the first time had their initial funds from money they had after leaving their home areas, or from years of working concessions or in other people's farms. And unfortunately, farmers are unable to get any actual financing to support their business ventures. Only one farmer claimed to be able to get support starting their farm from a project to promote the growth of pineapples, they obtained seeds and the know-how. Without support most people are unable to start agriculture, and only 58% of people doing agriculture can depend on it to fulfill all costs. Very few are making any substantial profit from the business. None of them are making any sort of lavish profits.

The last two questions for farmers included finding out more about the problems the farming community faces and their opinions on solutions that would better their lives. To briefly summarize the answers to these questions, farmers in the area do not get enough support from the government in developing strong agricultural systems. They have no options to learn about new and innovative farming practices, or even how to properly receive and manage an investment loan. Many of these farmers do not have proper agricultural education and have no ways of getting more agricultural knowledge. Also, it is difficult selling the produce as the farmer's market has become less reliant and commercial buyers are not as frequent as liked. The only solution they had was hoping their younger counterparts to obtain proper agricultural know-how at a university and to be able to run a farm

without the constant failures that today's farmers have gone through as they try out their techniques.

Discussion

Analyzing the sustainability of the farming community in Monterrey is difficult, since there are a variety of techniques that are being used. As with most sustainable assessments that are put in place worldwide, the first step is to figure out how to define sustainability within a community - whether that means examining how strong Monterrey's sustainable livelihoods are, or how sustainably conscious the community's agricultural efforts are.

To reach a good indicator for sustainability, I looked for the strength of both economic and environmental factors, as well as how social variables play into this. While sustainability does focus on environmental protection, it must be done while still benefitting economic and social growth. It is a congruent effort for all aspects of a community to be growing, not putting too much emphasis on environmental protection as with conservation, or too much economic development as with traditional business.

There are a variety of different measurement styles for sustainability. One measure of productivity, Total Factor Productivity (TFP), has been developed by economists as a single measure of the physical and biological sustainability of an agricultural system. TFP, unlike other measurement techniques used by economists, does not take account of environmental externalities which are important in defining biophysical sustainability. For example, the system does not consider the sedimentation of water courses, destruction of wildlife habitat, deterioration and pollution of water courses, are externalities that often originate from agricultural activities, and although not

impacting directly on farming systems in the local areas, they generate additional costs for society that society increasingly will no longer tolerate (Dumanski et al., 1998). This system does not realize that for a system to be sustainable one must take into consideration the social aspects, how people are doing and how their livelihoods are affected, not just growth in the terms of production growth and production costs.

Instead, I used the Framework for Evaluating Sustainable Land Management (FESLM) as a basis for measuring the agricultural sustainability in Monterrey, which reads:

"Sustainable land management combines technologies, policies and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously:

- maintain or enhance productivity/services
- reduce the level of production risk
- protect the potential of natural resources and prevent degradation of soil and water quality
- be economically viable
- be socially acceptable."

These factors are referred to as the five pillars of sustainable land management, and they can be applied for sustainable agriculture. Performance indicators for each pillar are used for assessing the contribution of that pillar to the general objectives of sustainable land management. However, as is the likely case in most situations, only degrees of sustainability can be predicted if only some of the pillars are satisfied, and this results in partial or conditional sustainability. (Dumanski et al., 1998) This method of evaluation was chosen because it does encompass the three major sides of sustainability (economic, environmental, and social) while also looking at how adaptable the sustainable system is.

Maintain or enhance productivity/services:

This pillar relates to a system's ability to produce goods. Factors that play into the sustainability of this pillar include soil fertility trends, crop yield response, availability of labor, adoption of new technologies and techniques, crop variety and availability, weed management, yield trends, and length of rotation. These factors are weighed together to determine whether the current agricultural system of Monterrey can maintain or enhance their productivity.

I began by looking at the biggest strength for agriculture in the area which is crop variety and availability. "Todo crece aca," said one of the interviewees, meaning that everything can grow here in Madre de Dios. While not everything can truly grow here, a huge variety of crops can certainly thrive in this rainforest environment that is home to thousands upon thousands of different plant species. But unfortunately, the soil in Madre de Dios is poor. While there is an abundance of plant life here in the amazon, it is in a constant cycle that keeps most of the nutrients on a thin layer of rich soil at the top of the ground. Seen firsthand, the soil below this thin black layer is often clay-like and very poor for the growth of plants. Another aspect of productivity is yield trends, which are poor in recent years as specified by a couple of interviewees. The watermelon is victim to having poor yields. They are a popular practice in the region for its short-term profit window, but the growing of one type of crop constantly drains the soil of its nutrients, and over time you will see decreasing results from the one crop. Which leads to another negative, the length of crop rotations, which is too long here, heavily draining the soils of their nutrients and causing the use chemical fertilizers.

On the other hand, the community of Monterrey is amenable to the adoption of new technologies and techniques. While

conducting this research much was learned about the different ways people are trying to raise the best crops. The people in the community use a variety of different methods that they have learned through either trial-and-error, some educational instruction by officials, or through techniques acquired by product vendors. So far, the farmers that have had professional instruction in growing crops like pineapples have stuck to that practice because they are confident in their skill to grow those crops. Also, the availability of labor is average, since there is labor when needed, but unfortunately labor costs in Madre de Dios are high compared to other regions since there are other riskier jobs such as mining that are easily obtainable and on average pay better. So the labor force in the area is not used unless necessary. Unfortunately, the interviews cannot help answering confidently the crop yield response time, but I assumed that it is poor as people have asked for there to be more frequent produce pick-ups by commercial buyers.

Upon weighing the different aspects, I have determined that current practices in Monterrey's agricultural productivity is not sustainable. If things continue in the same fashion as they currently are, the soil will be deteriorated, and yield trends will not be maintained, let alone be enhanced. But with further instruction to the farmers on changing practices that will increase productivity there is certainly room for sustainable growth in this first pillar.

Reduce the level of Production Risk

This pillar of a sustainable system focuses on a system's ability to overcome shocks and stressors that would harm the productivity of an agricultural system. Examining this aspect for a sustainable system requires looking at factors like economic status, yield trends, weather trends, catastrophic weather events, time

required in mastering new techniques, resource potential of land, and soil moisture at seeding.

First off, the economic status of most individuals in the town of Monterrey is poor, and most people interviewed have little profit after home expenses from any income activities they do. When it came to finance the initial crop investment, most individuals would pay for that directly from the gains of the most recent harvest. This means that if a harvest season goes badly this year, they might be unable to continue in agriculture. Yield trends are also decreasing over time, meaning the system is already slowly suffering. Fortunately, the people in the area do not suffer from heavy losses from catastrophic weather events, but the road systems outside the Inter-Oceanic Highway are poor and subject to flooding and erosion after harsh rains. The interviewees were unable to give information on resource potential of land or soil moisture at seeding, and those are answers left to more biophysical studies of sustainable agricultural systems. But people can adapt quickly to learning new techniques, and the few individuals that have received professional instruction had only partaken in a few seminars before being able to put their new skills to practice.

Despite their ability to learn and adapt quickly, the current system is not able to support the impact of shocks and stressors. To have a sustainable system it must not only be set up to last across generations under perfect scenarios. Having to face challenges and even catastrophic circumstances is part of any community or business model, and it must also apply here.

Protect the potential of natural resources and prevent degradation of soil and water quality

This pillar relates to protecting current resources, such as to protect current forests

from being destroyed, and to prevent new fields being created in unnecessary situations. Factors in this pillar include length of rotation, degradation risk, degradation trends, and deforestation trends. Most farmers grow one crop on their field, draining the soils here of their nutrients, which leads to talk about degradation trends which continue to harm the fertility of the soil. Farmers have implemented the use of fertilizers and manure to supplement their lands. Fortunately, a growing practice is the use of nitrogen fixers to aid the soil. This practice is not becoming very popular because the use of other plants to aid the soil creates a higher risk of being overrun by pests, farmers said. Then people use fumigation techniques which causes concerns as it damages the soil. At least the high cost of pesticides prevents people from using this technique all too frequently.

According to my interviews, established rural farmers do not contribute to deforestation as greatly as they could be since they are not in a system that promote their economic growth. Labor costs are high. Investment amounts to work the land are too high for people making below average annual income. And the current practices of the business are not set up for long-term growth. People are unable to engage in large-scale deforestation.

Thankfully, because of these economic difficulties in the Monterrey district, the current system for protecting natural resources is conditionally sustainable. Conditionally since people do still engage in small-scale deforestation. But we must be aware that people are only refraining from burning more lands because there is still value to the brazil nut concessions and other concentrated jungle products. If the jungle loses this economic value, people will be driven to continue deforestation efforts even if on small-scale

efforts.

Be Economically Viable

A sustainable system must be economically viable, meaning that the system should be within a market that will result in creating a profit. Factors within this pillar include looking at revenues, management objectives, government programs, organic market demand, availability of labor, and financing.

Starting off with revenues, it is known that agriculture is not a practice that is viable for 45% of the population. And when it does suffice, it does so with little profits which does not help in the system being able to prepare for shocks and stressors. Additionally, revenue arrives to the farmers once every few months once harvest season arrives, which does not help when an individual must pay unexpected expenses that arise due to natural disasters or faults by human action like spreading fires. Government programs are also not in place to assist farmers to develop new products. Over half the farmers complained how there was no technical support by the government to assess their lands and be instructed to grow the best crops they could to help with national demand. Talking about market demand, there is knowledge about organic certification by about a quarter of the farmers. But the markets in the area do not demand for organic products as much as other developed international markets do. Little effort is made to grow the enhanced product. There is workforce available, but unfortunately, labor costs in the area are high, and for the people who would hire directly, there is little to gain from hiring others. Finally, there is a history of financing being very poor in the region for agriculture, and about 25% of farmers directly asked about learning more how to work investments. One reason mentioned by a farmer was that individuals in small

towns like this do not have the proper paperwork to be approved for a loan, despite their ability to have the land to make use of a loan. Others claim that they don't know how investments work and are not sure about how to handle the risks involved. Overall, agriculture in Monterrey, and similarly across the region, is a poor business venture, and not a sustainable system. Profits are low, expenses are high, and people who do focus on agriculture have too many obstacles to overcome with little assistance from the government, even though they are working on one of the most crucial aspects of life - creating food for their communities.

Be Socially Acceptable

The final pillar is important to examine for a sustainable system and it involves looking at the social aspects of agriculture. Factors within this pillar involve personal and family health, viability of farming, availability of farming, off-farm impacts, public awareness of organic farming, age level of community (49.5), and education levels.

One comment from a farmer that helps to answer family health is that the water quality in the area is superb in comparison to other communities. Despite this fact, the interview does not help to answer health levels in the area. As discussed, farming practices are not viable in the area, it is a risky business that limits families in being able to pursue other social goals. But it is very available, many families get involved in agriculture as a side activity to have extra food. The public, as aware as they might be of organic farming qualifications, have not created a market that supports organic practices, creating room for social growth in that aspect. Also, the farming population is already at an elder stage, the average age for farmers being 49.5 years old, and none of them having

formal agricultural education, let alone having secondary school completed. The only positive aspect for the social acceptance aspect of agriculture is that many individuals do practice some farming because they know it is important to be able to have food readily available. Socially, the farming community of Monterrey does not have a sustainable system, but this is an area which I think can benefit the most from improvement, especially when it comes to promoting the educational resource for farmers in the area.

While looking at the community of Monterrey's sustainability through this generic metric for sustainable land management, at first glance I can see that the biggest point of weakness is the social and economic factors. One might suggest that people would see about assisting farmers in making use of larger tracts of land for agriculture, and helping in hiring more workers for the extensive agricultural efforts. The profit from having higher yields would offset the cost of the increased labor. This would also help create more jobs, and since the natural resources in the area is the strongest aspect of the system, it would survive this extensive land use technique. But unfortunately, this basic outlook is at fault to a very common misconception when it comes to creating sustainable systems – it does not account for this system's different environmental needs. The precise measurement of sustainability is impossible as it is site-specific and a dynamic concept (Hayati et al., 2010). So, we should develop higher standards for the environmental quality of Monterrey's rainforest ecosystem. I suggest the best course of action would be to implement programs that assist farmers in gaining the skills and confidence to grow fruits in sustainable fashion. We know that there is a demand by farmers in this small rural agricultural town to receive better

instructions for farming techniques. By giving the farmers lessons on farming techniques such as crop rotation and using nitrogen fixers, there will be a decrease in the use of chemical herbicides and fertilizers while still letting the ground create good yields that will not decrease over the long run in time. Developing crop rotation techniques that also allow for growing a variety of plants will create an economic agricultural system that is more resistant to market fluctuations and shocks, and planning for produce to be harvestable at different points of the year would allow for farmers to cash in on their work at more frequent intervals allowing for the ability to manage funds against other stressors. And one reason why this technique will be more advantageous is because it is one that has been native to the area, it is a technique developed in tropic environments for tropic environments. This is just one sustainable technique out of the many that would do great work here in Monterrey as the people in the area are looking to learn new innovative skills that will promote their community and their families.

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Works Cited

- Dumanski, J., Terry, E., Byerlee, D., & Pieri, C. (1998). Performance indicators for sustainable agriculture. *The World Bank*, Washington.
- Goodman, S. (2014). *The Role of NGOs in Mitigating the Impact of the Interoceanic Highway*. Master Thesis.
- Hayati, D., Ranjbar, Z., & Karami, E. (2010). Measuring agricultural sustainability. In: *Biodiversity, biofuels, agroforestry and conservation agriculture* (pp. 73-100). Springer, Dordrecht.
- Larson, S. (2011). Agriculture in the Amazon Basin: An overview of agricultural practices and impact in Tambopata, Peru. *Earth Systems internship (WIM) paper*.
- Ministerio de la Produccion Peru, (2016). Madre de Dios Sumario Regional, Elaborado por la direccion de Estudios Economicos de Mype e Industria (DEMI).
- Zienchuk, J. (2013). Sustainable Farming In the Amazon Rainforest. Epicure & Culture, <https://epicureandculture.com/sustainable-farming-in-the-amazon-rainforest/>, accessed: 20.8.18

Appendix

Interview Protocol

Hello, my name is Joao Vilca Soto, I work at Finca Las Piedras, it's a farm in the Monterrey sector.

At Finca Las Piedras we are working on a variety of projects to find better farming practices. We are interested in knowing more about agriculture in the region.

I was wondering if I could talk to you more about this. Do you have time now to answer a few questions about your farming history?

If they do not have time, ask if there's another day that will better work for them?

If they do have time, thank them and proceed.

Thank you, as I said, I work with Finca Las Piedras, I'm a student learning more about social sciences and sustainable development. I want to learn more about agriculture is working in the community so we can do research that can help farmers.

Any answers you provide in this interview will be confidential, my supervisor and I will be the only ones looking at them. If you'd like we won't include your name if that will make you feel more comfortable. If there are any questions you'd like to skip, just let me know. And if you want to stop the interview at any point, you have the right to do so.

Let's start with some basic information.

Name:

Age:

Thank you, Mr./Mrs., _____, let's start with the first question:

- 1) Are you from Madre de Dios? If not, how long have you lived in Madre de Dios? From where did you move, and why?
- 2) What did you do when you arrived here?

Farming history:

Awesome! Thank you so much! Now I would like to learn more about your farming history.

- 3) When exactly did you start with agriculture? (Important to know exactly how long they have been doing agriculture) Why did you enter agriculture?
- 4) When you started, were you farming your own land or someone else's?
 - a. Is this land the one you started with?
- 5) What are the first crops you started with? And how much? (in ha)

Farming (Present):

Let's now talk about the present.

- 6) How much land do you currently have/manage?

That's great! Since you have been doing this for _____ years, I want to talk about your choice in crops.

- 7) What types of crops are you currently raising? And how much? Since when? (in ha)
- 8) How did you decide on growing those crops?
- 9) After you decide what to plant, where do you go to get your first seeds?
- 10) Do you grow cacao?

If growing cacao...How did you decide on growing cacao?

If not growing cacao...Have you ever considered cacao? If not, why not? If so, why so?

Land Preparation:

- 11) What steps must you take to convert the new site into farmable land?
 - a. How do you clear land?
 - b. Did you do anything additional after clearing land and before planting seeds?

Fertilizer:

- 12) What crops do you fertilize, and what type of fertilizer do you use?
 - a. When do you apply the fertilizer?
- 13) Where do you get information on how to use these products?

Pesticides:

- 14) What crops do you pesticide with, and what type pesticides do you use?
 - a. When do you apply the pesticide?
- 15) Where do you get information on how to use these products?

Equipment:

- 16) What equipment (tools, machinery) do you use to work the land? (such as weed-whackers, tractors, mochila de fumigacion)
 - a. Do you have access to any heavy machinery that you use?

Labor Force:

- 17) How many people work in the farm right now? Who are these people? (Count with them)
 - a. Is this number different when you cleared the land/planted seeds? If so, how many?
 - b. Is this number different when you harvest? If so, how many?
 - c. Is there any other time when you hire more people? When?

Economics:

- 18) How do you sell your produce?
 - a. If they sell directly to consumer, what markets do they sell to?
- 19) How much do you invest per hectare?
 - a. How did you get funds for the initial investment?
- 20) How much do you expect to get back for each product?
- 21) Are your earnings from agriculture enough to cover home expenses?
 - a. If not, what are other activities you do to supplement your income?

Future:

- 22) What problems do you face as a farmer? (i.e. Not enough technical support, roads are not being maintained)
- 23) How can we solve these problems?

Thank you so very much for your input! This has been wonderful for me, and I hope the same for you. If you know of anyone else who would be willing to share information and help us get a better understanding of the farming community, let me know and we can reach out to them. Gracias!