

The Difficulties for a Prosperous Cacao Industry in the Las Piedras District in the Madre de Dios region of Peru

Fabrizio Colombo Fiore ^{1, 2}

¹ Department of Agricultural and Environmental Sciences, McGill University, Montreal, Quebec, Canada

² Alliance for a Sustainable Amazon (ASA), Las Piedras, Madre de Dios, Peru

Corresponding emails: fabrizio.colombofiore@mail.mcgill.ca & info@sustainableamazon.org

Abstract

The department of Madre de Dios consists of rich forest, yet this forest is being increasingly occupied by gold mining and timber logging. The cacao crop may be a sustainable economic and environmental alternative to these practices. To examine if cacao farming can indeed be a viable alternative, cacao farmers in the Las Piedras district of Madre de Dios were surveyed upon their views on their crop, and the limitations for greater success. The information collected brought to light highly relevant information and current impediments in the production, sales, and bureaucratic sectors in the cacao industry.

Introduction

The department of Madre de Dios in Peru was left untouched up till the late 19th century upon the discovery of Hevea and Castilloa trees in the region for rubber production. (Ulmer, G.L. n.d; Zschock, D.K. 1988). Since then, the department has developed due to timber, gold, and petrol reserves. Thus, the motive for development was, and still is natural resource extraction. Although this was the history for the conception of Madre de Dios, it cannot be the reality for the future. Natural resource extraction is not a sustainable economic or environmental practice. It depletes the land's resources and threatens the region's ecological balance. Even though this agro-economic problem is not unique to Madre de Dios, there exists alternative economic problems that can grant the Madre de Dios economy a greater

degree of independence. One such alternative is cacao farming. For example, the cacao industry has always been in high and consistent global demand. In fact, the global chocolate market is expected to grow at a compound annual growth rate (CAGR) of 4.6% from 2020 to 2027.” (Grand View Research, 2020). Moreover, cacao is a fantastic plant to a prosperous agro-forest plot. For example, it can grow in conjunction with bananas, citrus, tubers, and roots. Furthermore, discarded cacao pods for compost reduces and later prevents the added cost of man-made chemical pesticides and herbicides and prevents its toxic runoff into the local water system. (Berlan, A. & Bergés A., 2013).

Peruvian cacao is an important local cultural food and acts as great seller for shop

owners. It is an excellent cash crop for the Amazonas, San Martin, and Ucayali departments of Peru, yet it is seldom grown in Madre de Dios. (Allianza Cacao Peru, 2019). Despite the economic and environmental attributes of cacao as an essential component in an agro-forest plot, I wish to investigate why it is not as popular and beneficial to Madre de Dios as it theoretically can be. Therefore, this project will explore what the views of local farmers with respect to cacao as a profitable crop to plant and what are the main obstacles they face to start or expand their cacao production.

To achieve this, I surveyed 14 cacao farmers in Madre de Dios; The survey depicts the difficulties, and motivations for continued success in cacao farming. Furthermore, there are technical questions related to the production and sales of each farmer's business. Lastly, the survey will seek out what farmers need the most as a resource to sustain and expand their business as of this moment. Moreover, I met with an agroforestry engineer who has experience working with farmers in this area to discuss my findings. Not only is this information useful in improving the livelihoods of current cacao farmers, but it is also necessary in assessing whether cacao is a viable crop for expansion in Madre de Dios.

My expectations were cacao farmers will mention the profitability and consistent demand of cacao yet complain about the unreliable harvest due to climate change. My expectation was that the agro-forest farmer who has space in their plot to show a great deal of interest in growing cacao as it will not cost them any more land to purchase and will act as an extra source of income. Nevertheless, I expected the agro-forest farmer to express some degree of skepticism as farming is not a

business that provides instant results. Ergo, the asset most prized to lose is the wasted time and land if cacao would not give a successful yield.

Methods

Fourteen cacao farmers were surveyed under the assurance that their identities remain confidential. These farmers live in Puerto Maldonado, Alegria and Alerta in the Las Piedras district of Madre de Dios. The farmers were found by simply asking around in the areas mentioned for names and addresses of cacao farmers. The responses were analyzed to verify for any similarities and anomalies. The responses covering costs and sales prices were gathered to get an estimate of the profitability of cacao in Madre de Dios. According to the range of responses received with regards to the investment required up to the point of harvest, the amount of cacao producible per hectare, and the price that cacao can sell for, it is possible to calculate the lowest, the highest, and the average profitability per hectare. Therefore, the lowest profit is calculated using the highest initial investment, the highest yearly production cost, the lowest harvest, and the lowest sale price. The average profit is used by calculating the average initial investment, the average yearly production cost, the average harvest, and the average sale cost. The highest profit is calculated using the lowest initial investment, the lowest yearly production cost, the highest harvest, and the highest sale price. There is a total of 25 sub part questions. The questions were grouped into basic personal questions, questions about their experience with the cacao crop, questions about production and sales, and questions about what kind support would be most appreciated at this

moment. The questions and interview protocol were overlooked by Johana Reyes Quinteros, co-founder of Alliance for a Sustainable Amazon. All findings were analyzed with the intention of better understanding the cacao farmers experience with starting the business, production, and sales, continuing this job, and their personal sentiment towards this business.

Information about the Interviewed Cacao Farmers

Six out of the fourteen farmers were born in Madre de Dios. The other farmers came from various regions of Peru; Piura, Cajamarca, San Martin, Ayacucho and Cusco. There was a wave of farmers who moved here 50 years ago and a wave of farmers who came 15-20 years ago. The first wave of farmers interviewed came to Las Piedras with the interest of harvesting Brazil nuts. The second wave of farmers came for Brazil nut harvesting too, but that was only complimenting the fact that land was cheaper than other regions in Peru to buy and start a business in agriculture. Farmers in Las Piedras developed an interest in cacao as a cash crop either by word of mouth from a friend, by an announcement in public by the government or an organization. Farmers were attracted to it due to its praise for being profitable, for having a large demand, for being a legal crop, for its adaptability growing among other crops and grows under the shade. Regardless of when the farmer arrived in Las Piedras, all farmers started producing cacao in the last 10 years. Of the farmers surveyed, the mean land area of cacao per farmer is 5.083 hectares, the median is 3 hectares, where the range is 29.5 hectares. The main cooperatives operating in the Las Piedras district is

Cooperativa Copsur and Cooperative Copa ID. The main private buyer is Machu Picchu. Farmers who do not associate with neither of the two latter sellers have a transport company that pick up their product and sell it at the farmers market in the nearby largest city, Puerto Maldonado.

The greatest difficulties in starting cacao production are depicted to be the notable amount of work needed for the first three years. Thus, farmers who tend the fields on their own especially complained about the excessive workload at the start. The young cacao plants are more sensitive than at their cacao fruiting state. Some farmers lost many plants because they did not take care of them properly. Half of the farmers interviewed complained they lacked the necessary knowledge and techniques on maintenance, maximizing yields, and disease prevention. Several farmers also complained that they were missing the proper equipment at the beginning and only accumulated them over the years.

Nevertheless, farmers continue to produce cacao because they believe it has a good market demand and profitability even though this year there is a shortage of demand paired with an unusually low price. They say that they hope it to be only a difficult moment, and that shortly the demand and profitability will return. Most farmers interviewed also have an adoration for the crop itself, they claim that is it a part of their customary way of life now and they like how well it works among other crops in an agroforest system.

One (true) agroforest farmer made the point that even though it may be very attractive to plant marketable trees that you can one day extract to sell its wood. It is not good for the

agroforest system, because upon time when the tree is ready to be cut, it ends up destroying the surrounding cacao trees. Thus, one can instead put trees that will last for a very long time but can still be profitable because they offer a harvest every year. For example, palm fruit trees or Brazil nut trees.

The greatest difficulties for farmers now in production are mainly climate phenomena; extended dry periods and the random cold bursts (a.k.a. ‘frijes’). Both weather events are common to this region, however the frequency in these events have increased and it is believed to be due to climate change (Doan, T. 2009). These cold bursts give a ‘cold burn’ to the cacao pod, turning the beans black before even being exposed out of its shell. Prolonged periods of drought perish cacao trees since their roots are in the topsoil, so they are exceptionally more sensitive to dry conditions. (Silva Cacao, N/A)

The different plagues and diseases are still a huge difficulty for all farmers interviewed. They lack the knowledge and by default, the right materials and techniques needed to control such threats. They demonstrated their wish to learn more information about the different local diseases and modes of prevention and treatment.

The most common response to the question of what resource they would need the most at this moment was technical assistance. Furthermore, they stress the importance to receive such technical assistance periodically, as they claim that they have received someone come once and never come back, and that is pointless.

Next, farmers claimed they need financial assistance, and the most probable means would be a proper loan. Farmers said they would use

this capital to invest in equipment to improve efficiency in their production, in organic inputs, and biopesticides to protect from disease. Several farmers complained about the credit policies, since they are normally based on crop production, the analyst visits the farm and calculates the production of short-term crops (annual crop that return money in less time), because this is considered the guarantee. However, in recent years only short-term crops are considered as collateral. Yet cocoa and other fruit trees that return the money in at least 3 years are not considered as collateral. To get a loan, the farmer needs their land certified, they also need a certificate of being a producer guaranteed by the director of agriculture and they must not have loans in other banks. These are bureaucratic processes that people in rural areas are not typically used to.

More than half the farmers interviewed expressed their dissatisfaction towards NGO’s, cooperatives, and government-led projects. Farmers complain that such initiatives (intended to support the farm) are useless. Farmers claim that workers of the project either show up one time, take notes to fill out their duty, and never show up again. Farmers also claim that they will have an agricultural engineer show up and determine all that they need to improve their farm, and present to them a list of products to improve the farm (in which the farmers need to pay out of their own pocket). These very farmers do not have the extra capital to fund such improvements, so these projects are pointless if the projects itself cannot financially support the farmers to improve their business. Lastly, farmers have lost most of their trust in such projects because they claim that these projects have made them many promises that never ended up being met. In fact, when some farmers were asked what

support they would need from governmental project today, two of them responded that they want nothing to do with any type of external help because they'd rather suffer alone than lose more by trusting in others offering to help.

Investment and return

One of the farmers interviewed had calculated their initial investment (all other farmers simply estimated it). The response was that it costs 10 000 PEN (2550 USD) to start 1 hectare of cacao plantations (only cacao). Until the point of being able to harvest from the trees, which is after 3 years, the responses for total investment ranged from 14 000 PEN to 20 000 PEN. (per hectare) The two most significant factors affecting the cost is disease infestation and cost of manual labour. It costs 4 PEN per plant seedling, and 6 PEN in total per plant if the manual labour and compost is included All farmers attest to the importance of pruning, they claim it protects the farm from various threats and improves the yield greatly. It costs 80 PEN to hire a worker for the day. Other extra but not necessary costs include various types of composts, fertilizers, and chemicals to control disease.

The common means to sell cacao is “en grano”, which means the cacao beans are sold already fermented and dried. This is the most common way but also the most efficient way. Farmers produce a range of 500 to 800 kilos of cacao in grain per hectare per harvest. There is a 14-day harvest period between May and July, a farmer can collect from the same tree once, twice, three-, or four-times cacao fruits that ripened at various times during the harvest

period, and the number of harvests depends on several growing factors.¹ One farmer stressed the importance of properly fermenting the cacao beans when selling them in grain because if not, the price will decrease by 3-4 PEN One farmer commented on the importance to put an effort on selling the cacao ‘in grain’ as fast as possible, because if not stored properly, it can suffer from a fungal infestation and end up completely useless. This is not only stressful and difficult in these current times because many farmers are hoarding their produce because they are waiting for the price per kilo to go up again. The normal price for cacao ‘in grain’ per kilo in the last years has been 8 PEN per kilo. Yet, in May of 2022, the price decreased. For farmers in a cooperative, the price has lowered to 7 PEN per kilo. However, farmers who are not part of a cooperative state that the price has lowered to 6 PEN per kilo. Farmers further elaborated that selling cacao at 6 PEN/kilo is not feasible. Not only do they say that it is not profitable, but some farmers even say that they are losing money from their business at this price.

The minimum investment and maximum investment required till harvest is respectively 14 000 PEN per hectare and 20 000 PEN per hectare. The minimum yearly production costs range from 700 PEN to 4000 PEN per hectare. The minimum amount harvestable per hectare is 500 kilos, and the maximum amount per hectare is 800 kilos. The minimum number of harvests per year is once, the highest is four times, but the average is three times. There will be 12 of each lowest, average, and highest profits. Two factors result in 4 different results for each. Whether it is the

¹ ILSA Agrotechnologies. Nutritional Aspects and Fertilizer Recommendations on Cacao.

first year of harvest, that is, the initial investment is still considered in the costs and the farmer has not broken even yet, or whether the farmer has broken even and only needs to factor in yearly costs. Next it must be factored in whether the price is sold to a private company (6 PEN per kilo) or to a cooperative (7 PEN per kilo). See Table 1 for values.

	Lowest Profit	Lowest Profit	Lowest Profit	Lowest Profit	Average Profits	Average Profits	Average Profits	Average Profits	Highest Profits	Highest Profits	Highest Profits	Highest Profits
	Sale to Private Company	Sale to Private Company	Sale to Cooperative	Sale to Cooperative	Sale to Private Company	Sale to Private Company	Sale to Cooperative	Sale to Cooperative	Sale to Private Company	Sale to Private Company	Sale to Cooperative	Sale to Cooperative
	With debt from Initial Investment	No more investment debt	With debt from Initial Investment	No more investment debt	With debt from Initial Investment	No more investment debt	With debt from Initial Investment	No more investment debt	With debt from Initial Investment	No more investment debt	With debt from Initial Investment	No more investment debt
1 Harvest	-21000	-1000	-20500	-500	-15450	1550	-14800	2200	-9900	4100	-9100	4900
3 Harvests	-15000	5000	-13500	6500	-7650	9650	-5700	11300	-400	13600	2100	16100
4 Harvests	-12000	8000	-10000	10000	-3700	13250	-1150	15850	4400	18400	7700	21700

It is most common to have three harvests per year, thus the profitability of 3 harvests per year will only be discussed. At the lowest levels of profitability, the farmer breaks even after 3 years. At the average levels, which is indeed the most likely case for most farmers in Las Piedras, the farmer breaks even and make 2000 PEN of profit the first year and continue to make an average of 10 475 PEN for the following years. At the highest levels, the farmer breaks even and makes 14000 PEN the first year and continue to make 18400 PEN the following years.

Discussion

The average monthly salary for a Peruvian in June of 2022 is 1667 PEN. (Central Reserve Bank of Peru). The average monthly income

from 1 hectare of cacao cultivations is 872 PEN. With regards to the farmers surveyed, the average land size that a cacao farmer has is 5.083 hectares. This ends up making up around 4432 PEN per month. Additionally, all but two farmers surveyed had other crops that was providing other revenue during the year too. Since there is no more data that I collected that can further support any more streams of income, I would conclude that cacao farming in Madre de Dios is a profitable business. I justify this because the farmer typically breaks even from investment costs on the first year and makes approximately three times more than the average Peruvian per month if they have 5 hectares of land. Nevertheless, a farmer interested in taking up cacao as a cash crop must be aware of the difficult first three years, the threat of diseases, and the consequences of fluctuating climate conditions. Farmers must

be educated on proper growing conditions, proper organic inputs, how to protect the saplings from perishing. But above all, they must be aware of the serious commitment the first three years require. They should expect to have time freed up in their schedule for uncertainty, and money saved up as a safety net. The results collected have met most of the expected results. The one result that was not met was that I said cacao farmers would be content with the consistent demand of cacao. However, in the period whilst I was surveying them, there was a shortage in demand and a sudden low sale price of cacao. I could not find any precise reason for the unusual low price of cacao per kilo. Farmers added it may be due to the Russia-Ukraine war affecting prices of various commodities, it may be due to external factors in the world cacao market, and some farmers believe that the government is simply corrupt and fixing the price. My personal research online showed that prices should technically be higher than usual right now due to a shortage in supply in other regions of the world. (ICCO World Cacao Market 2022) Therefore, it looks like that more factors come to a play when defining the price of cacao and that those factors are not always predictable.

Next, the most relevant and threatening factors to production today are prolonged dry periods, cold spells, and diseases. Thus, farmers require sufficient knowledge on how to work their farm when either of the 3 factors occur. For example, cacao trees can be protected from high temperatures by planting a banana tree beside the cacao tree. In fact, this method of farming can reduce cacao leaf temperatures by up to 4.4 °C and provide greater resilience against pests. (Rajab et al. 2016) On top of that, the companion tree offers ventilation which helps to reduce the incidence

of fungus on cacao and offers another cash crop. Most farmers in the Las Piedras district of Madre de Dios cultivates a variety of crops in their farm. In fact, only two out of the fourteen farmers interviewed grows solely cacao. However, the matter to be contested, is whether these farmers are operating under an agro-forestry system. Agro-forestry system has become a buzzword that is used whenever there is some produce crops and trees grown in the same plot of land. According to the USDA, “Agroforestry is the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits. It has been practiced in the United States and around the world for centuries.” (USDA) The question of whether farmers in Las Piedras truly practice agroforestry boils down to two questions in the survey. Following the question on what crops (aside from cacao) the farmer produces, farmers are asked whether they consider their farm to function as an agro-forestry system and whether they would recommend this system to other farmers. Every farmer who had other crops aside from cacao affirmed they practice agroforestry, that they have been practicing it all their life and undoubtedly recommend this farming system to other farmers. Nevertheless, later in the survey, when asked how many cacao plants per hectare they have. Only 2 out of the 10 alleged agroforestry farmers had several cacao plants per hectare that make sense with an agroforest farm. Agroforestry farms are bound to great variation, so the range of cacao plants per hectare are between 450-750 plants per hectare. (Notaro, M. et al. 2020) One farmer reported 500-600 plants per hectare, the other reported 750 plants per hectare, whilst every other of the alleged agroforest farmers reported between 1105-

1500 plants per hectare. This number of plants per hectare only exist in monoculture plantations. Thus, farmers in Las Piedras could benefit from being reintroduced to the system and how their farm can benefit by employing this system.

The manual labour jobs in Madre de Dios have always been occupied by natural resource extraction activities. It has always been, and allegedly continues to be the most lucrative job available. Thus, leaving a lack of workers for the agro-food system. However, the narrative must change. Any media source: news channels, newspapers, billboards, posters, public service announcements, etc. can all be used to transmit the information on the cons of working in mining and coca plantations, and the pros of making a living from sustainable agriculture. Next, and this should be given high priority, this narrative should be a central message in all educational environments (schools, workshops, adult learning, etc). Lastly, the government can provide incentives for encouraging the shift. They can provide free or rebates on training to get started in cacao farming. They can subsidize land and equipment to get started. The government can also fund the cacao market to make it even more profitable and establish mechanisms to secure the demand to prove that a cacao producer is a more attractive job profession than legal or illegal natural resource extraction jobs.

Starting in the month of May of 2022, the price per kilo of cacao in grain decreased to a low of 6PEN/kilo. According to farmers in Las Piedras, this is very unusual. Not only is it unsustainable, but farmers are losing faith in the cacao market. It may not appear important, but a farmer's faith in the very market they sell

to is vital. One thing that I remarked during my interviews is how much the opinions and attitudes of farmers are influenced by simple word of mouth. First, most farmers arrived at farming cacao by word of mouth of either a friend or a public announcement. Next, most information that farmers told me during interviews were not first-hand information, but instead, something they heard from their neighbor or one of their farmer friends. This concept holds incredible power; it can have the power to have a strong ripple effect and incentivize a farmer to act in a positive manner (for instance, to use only organic compost), or it can influence the farmer to give up believing in the role of a cooperative and abstain from their incredibly potent role as co-partner in a cooperative.

On the note of a cooperative, I have noticed that most farmers lack understanding in the mechanism of a cooperative, and the potential power it holds. In my experience, farmers often mention the word 'cooperative' as if it is some foreign entity, extremely far away both physically and conceptually from themselves. I have noticed farmers interchange the words "project, government, governmental project, public project, public funding, cooperative, funding from a cooperative, association, boss of a cooperative, boss of a project" as if all have very similar meanings. However, the confusion is because of an unwarranted experience that farmers have undergone lately. Through discussions with people who have worked in the Las Piedras district, I have discovered that cooperatives and governmental projects have had their fair share of corruption in the last couple of decades. For example, one farmer shared his experience dealing with one cooperative a decade ago. He explained how an NGO requests funds from the

government, where these funds normally come from a governmental project administered by the Ministry of agriculture. These funds are then employed to start a cooperative, with the intention that the cooperative can end up being its own independent entity with farmers as equal partners in it. The result ended up being that high-level employees in the NGO would take funds from the government project for themselves. It is a front for employees in government or the non-profit sector to take these funds for farmers, for themselves. Imagine that the farmer is coming to one of the monthly meetings, only to find out that it is impossible to acquire more pruning equipment due to lack of funds when just last week there was a million dollars of funding remaining for this year. Obviously, this is a hypothetical example, but it is understandable how farmers can end up being confused and later distrusting in the idea of a cooperative after an experience like what I just depicted.

Many farmers have expressed that they were promised they would receive various forms of support from a government project, support in the form of equipment, in technical assistance, and in credited loans. They further elaborated by saying they never received any of the support promised, or they lost money in the process because some projects necessitated that the farmer invests in the project first. As mentioned in the results section, one farmer had such a bad experience with both cooperatives and governmental projects that when asked what they need most as support from either the government or a cooperative, they responded that they wish to have nothing to do with either of them, and that they wish to only work alone because they feel as if they cannot trust anybody. Another farmer reported how some governmental projects are

unjustifiably strict with their requirements for farmers to abide by certain terms to be eligible to receive the support granted in the project, and that this is simply a mechanism for internal corruption. This may be simply wishful thinking, but farmers would nearly have all of their current difficulties resolved if they understood that they are all equal partners of the entity, and it is their strength in numbers that will grant them funding and the ability to have a buyer that will buy each of their supply at a fair price. Nevertheless, it is important to note the impediment that farmers come from rural areas often lack the knowledge on how to be more legally recognized, and how to use the law in their favour. These farmers may not be putting enough effort in learning about proper acquiescence of credit, how a cooperative function and farmers rights and/or they lack the resources on how to even go about learning such matters. Thus, other socio-economic factors must always be considered. In other words, it can't be said that the quick fix is that farmers in Las Piedras simply learn the power of a cooperative.

There is an increased interest in growing cacao over the last decade in the Las Piedras district. Only two out of the fourteen interviews wish to quite cacao production. One farmer was plagued with too many diseases that they felt they had no control to maintain the health of their plantation. The second farmer simply said they are getting too old for the job anymore. Despite the threat of diseases, climate, and demand shocks, the other farmers continue their business because they find it enjoyable, and profitable. They all said they would suggest cacao farming to a friend, specifically in the form of an agro-forestry system. In this light, I believe cacao farming would expand in

this region. However, there is the problem of corruption and lack of trust with governmental projects and the idea of cooperative. I see this as a bigger impediment, than any of the motives to grow cacao. As I mentioned, farmers faith in the market, and their general attitude toward cooperatives, and buyers is vital. Thus, I believe this outweighs and of the responses collected that animates farmers to move here and grow cacao. Farmers are just one part out of the many actors in the agro-food system. The fact that there is a significant dissonance between the retailers/processors and producers makes it the greatest impediment for cacao expansion in Madre de Dios.

Conclusion

There is an increased interest in growing cacao over the last decade in the Las Piedras district. Only two out of the fourteen interviews wish to quit cacao production. One farmer was plagued with too many diseases that they felt they had no control to maintain the health of their plantation. The second farmer simply said they are getting too old for the job anymore. Despite the threat of diseases, climate, and demand shocks, the other farmers continue their business because they find it enjoyable, and profitable. They all said they would suggest cacao farming to a friend, specifically in the form of an agro-forestry system. In this light, I believe cacao farming would expand in this region. However, there is the problem of corruption and lack of trust with governmental projects and the idea of cooperative. These projects or cooperatives are essential to the improvement of the cacao industry, both in production and selling. In production, farmers learn about products and methods to protect

from the various diseases and changing temperatures that threaten cacao growth. Secondly, as previously mentioned, farmers faith in the market, and their general attitude toward cooperatives, and buyers is vital. Farmers are just one part out of the many actors in the agro-food system. The fact that there is a significant dissonance between the retailers/processors and producers makes it the greatest impediment for cacao expansion in Madre de Dios. Thus, I see this problem as the greatest impediment, I believe it outweighs any of the motives to grow cacao. For this reason, I don't think cacao will expand. It may slowly grow, but it would not grow any where near the rate it could grow if there was transparency within the marketplace, and correct methods to tackle diseases and fluctuating temperatures.

Acknowledgements

I would like to thank Alliance for a Sustainable Amazon (ASA) for making this report possible. Specifically, I would like to thank Johana Reyes (Co-Founder of ASA) and Marta Mosna (Academic Coordinator at ASA) for being of such a big help along every step of the way.

Literature Cited

- Central Reserve Bank of Peru. 2022. <https://www.bcrp.gob.pe/>
- Doan, Tiffany. (2009). Extreme Weather Events and the Vertical Microhabitat of Rain Forest Anurans. *Journal of Herpetology*. 38. 422-425. 10.1670/155-03N.

- ILSA Agrotechnology. Nutritional Aspects and Fertilizer Recommendations on Cacao. http://www.nasmartin.com/wp-content/uploads/2014/03/Plan-de-nutricion_Cacao.pdf
- International Cocoa Organization. ICCO World Cacao Market Report 2022. <https://www.icco.org/cocoa-market-report-for-may-2022/>
- Notaro, M., Gary, C. & Deheuvels, (2020) Plant diversity and density in cocoa-based agroforestry systems: how farmers' income is affected in the Dominican Republic. *Agroforest Syst* 94, 1071–1084 <https://doi.org/10.1007/s10457-019-00472-7>
- Rajab, Y.A., & Leuschner, C. (2016) “Cacao Cultivation under Diverse Shade Tree Cover Allows High Carbon Storage and Sequestration without Yield Losses.” vol. 11, no. 2,
- Silva Cacao. <https://silva-cacao.com/news/humidity-in-cacao-supply-chain-a-balancing-actpart1/#:~:text=Prolonged%20dry%20periods%20are%20not,trees%20will%20start%20to%20perish.>
- Ulmer, G.L. (n.d.) Abbreviated History of Extractive Activities in Madre de Dios. <https://gordonulmer.com/madre-de-dios/>
- USDA. N/A. <https://www.usda.gov/topics/forestry/agroforestry>
- Zschock, D.K. (1988). *Healthcare in Peru: Resources and Policy*. Westview Press. ISBN 0-8133-7434-0.