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Junior Scientists Tandems
Final Report

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Introduction

Above all I want to see my farm full of cacao and take care of our planet. It would be more beautiful if all parcels were managed with care for the environment. (Farmer C)[1]

A forest to protect the environment. That is my aspiration. I am still alive. Although it is no longer for me, it is for my grandchildren, for my children. Others have planted for us, so we must also leave behind our own plantings. (Farmer J) [2]

Inspired by Masanobu Fukuoka's natural farming, Ernst Götsch's syntropic farming, and Sadhguru's "Save Soil Movement," I dreamed in Germany of combating land degradation with environmentally sound food systems that also feed our growing population. Their teachings lead me to dedicate myself entirely to agroecology, a science embodying all their principles. When it became clear that I could be part of CGIAR's Initiative on Agroecology, supported by ATSAF, and use my master's thesis to further my dream, I was particularly grateful. This opportunity took me to Peru.

In Peru, it was even more inspiring to discover that many Peruvian farmers, despite facing significant challenges like poverty, lack of governmental support, and limited access to knowledge, share a profound interest in achieving a balance between nature and food production, as reflected in the quotes from Farmer C and Farmer J. Their vision aligns with my belief that food forests, designed to meet their specific needs, could be a viable solution to many our world's ecological challenges.

In the following sections, I will detail my journey in the Amazon region of Ucayali, Peru. I will share my experiences, the people I met, and how this journey helped me for my future career. I will also provide a snapshot of the result of master thesis -a food forest system tailored to the region's specific local ecosystem and farmer's needs.

Journy in the Amazon: Experiences and Encounters

I wanted an adventure, and I got one. It began with my arrival in Lima in early June. From there, I had to head to Pucallpa in the Ucayali region to start my research stay. Pucallpa, the largest city in the region, is a bustling gateway to the rainforest but also marked by poverty and violence in some districts. Wanting to minimize flying and hoping to witness some astonishing nature along the way, I decided to travel by buses and cars to Pucallpa.

My first Peruvian contact was the taxi driver from Lima's airport to the bus stops. After sharing with him my plans for the Ucayali region, we quickly bonded and decided to go for dinner. Without even knowing, I had my first iconic rainforest dish, caldo de gallina (long-cooked chicken soup; see picture 1.1), which I was soon to experience many times more.

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[1] „Más que todo quiero ver mi chacra llena de cacao […] y cuidar nuestro planeta. Sería más bonito si todas las parcelas cuidar el medio ambiente."

[2] „Un bosque para proteger el medio ambiente. Eso es lo que aspire. Estoy vivo todavía. Aunqzey a no es para mí, es para los nietos, ya sear para los hijos. Otros han sembrado para nossotros, sino también debemos de dejar sembrando."

Next, I boarded a night bus to Oxapampa (see picture 1.2), a beautiful and tranquil city in the cooler, higher rainforests of the mountains. There, I met a friendly older man who offered to take me to Pozuzo to reconnect with my Peruvian friend Jordan I knew from WWOOFing (Worldwide Opportunities on Organic Farms) five years ago (see picture 1.2 and 1.3).

During the pandemic, my friend started a new coffee cooperative with over 100 remote smallholder farmers in the high mountains near Pozuzo. He and I share the dream of developing diverse organic agroforestry systems to combat deforestation and produce high-quality produce. We spent three wonderful days visiting coffee farmers who were integrating pine with coffee and discussing how to further improve their practices (see picture 1.5).

Picture 1: (1) Taxi driver & “caldo de gallina”; (2) night bus; (3) Drive to Pozuzo; (4) Jordan and me; (5) Ripped tire, (6) High mountains on coffee farm.

On our way to visit these farmers, we had a tire blowout (see picture 1.4). Being in such a remote area, and with the spare tire already damaged, we had to remove the rubber part from the rim by hand—a task usually done by a machine. This difficult process took us half the night. Exhausted, we finally went to bed, but I felt like I was in adventure heaven, doing exactly what I wanted: working with farmers in the global south towards a more ecologically sound food system.

After visiting a beautiful viewpoint near Pozuzo (see picture 2.1), I took multiple pickup cars on a 10-hour drive to Pucallpa, my destination for the upcoming months. The further I traveled into the lowland rainforest, the more I felt the ever-increasing heat. Along the way, I witnessed the vast deforestation for cattle ranches (see pictures 2.2 and 2.3).

Picture 2: (1) Viewpoint near Pozuzo with me jumping; (2) First pickup car, always travelling on their back; (3) Reaching the hot lowlands with deforested areas.

During my final leg of the journey, I became again friends with the driver, who introduced me to his neighbor Showlyn, a young motocarro driver with dreams of establishing a sustainable chicken farm on his recently acquired land in the rainforest (see picture 3.1 to 3.3). He planned to earn some money driving his motocarro in Pucallpa for initial investments. Becoming friends with him was incredibly fortunate for me. Despite me being from Germany, he wasn't after my money. He was just looking for a friend. Thanks to him, I found a small house with a garden in a safe district of Pucallpa for just 100 € monthly including glass fiber internet (see picture 4.1 to 4.9). The house was surrounded by hardworking, very friendly but poor families. He helped me explore the city and furnished my empty house with essentials like a bed, fridge, stove, fan, and other furniture at reasonable prices.

Settling into my new home, I initially experienced a "honeymoon" phase—everything was new and fascinating. However, as I worked intensively on my laptop to plan and coordinate interviews with the cacao farmers for about 2 months, everyday challenges became apparent. It was the hottest period of the dry season, with daily temperatures far over 40°C. The persistent heat left me drenched in sweat from morning until night, almost 24 hours a day. My house, more like an open barn with a rusty metal roof, quickly accumulated dust. After a single day, it felt like I hadn't cleaned in a month, though this is quite normal in Pucallpa.

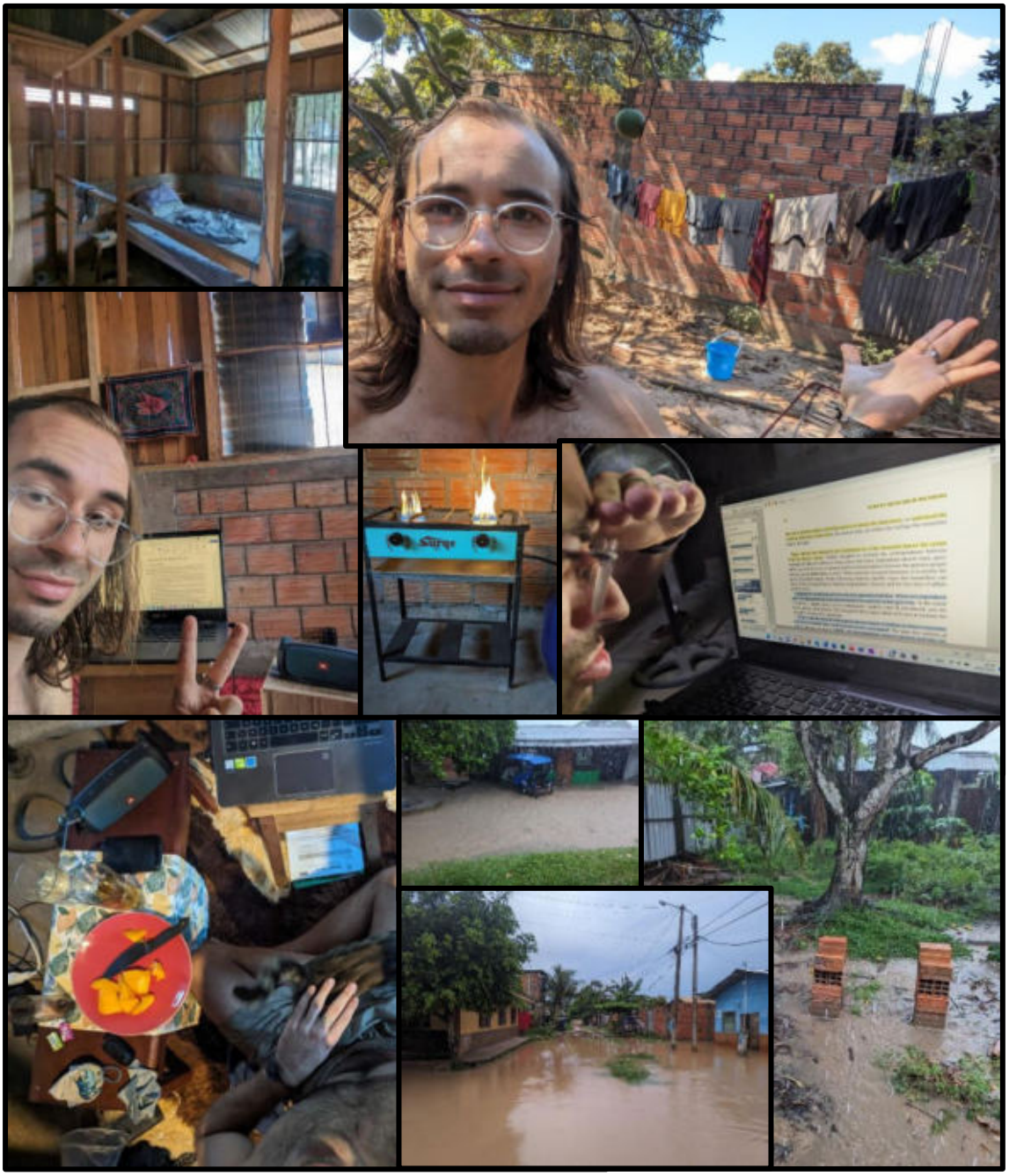
The garden, however, had great features: a delicious mango tree, two coconut palms, cocona plants, star fruit, papaya, and a cashew tree (see picture 4.8).

I also felt isolated while working on my PC, often alone in my house for weeks. The constant poverty of my neighbors, who often earned around 1.5 euros an hour, was a daily reminder of their struggles. Living in such thin-walled houses meant I could hear everything, including arguments about needing money for work despite being in pain. Street dogs barked loudly all night long. My good friend Showlyn also had to leave Pucallpa for Lima due to severe health problems, so also locals struggle who are accustomed to it. Illness and death were much more prevalent than in Germany.

Picture 3: (1) 1 € high quality lunch with Sholyn; (2) Sholyn taking me on his motocarro; (3) Sholyn and his younger cousin in my house; (4) Mari selling barbecue and juane on the street; (5) Mari's birthday and family.

Overall, the heat, high dust levels and a less balanced diet than I was used to in Germany led to various health problems, including neck and back pain, and diarrhea after eating bad fish once again. So, at the end, I was living like a typical family in Pucallpa despite the possibility to also rent a more luxurious place. However, living like this seemed the right thing to do to really understand the lives and needs of the local people but it was hard. Furthermore, compared to the families, I was one crucial point missing: a family that cares for each other in

a country where this is often the only support you have as the government is not helping at all as I was told constantly. This led to a phase of despair for me.



Picture 4: (1) My house and my bed in Pucallpa; (2) My garden in the dry season after I washed my clothes with my hands; (3) Me working in my house; (4) My small stove representing the extreme heat; (5) Me working in my house; (6) I was working on the ground and ended up with a few stray cats accompanying me; (7) My neighbor was flooded, (8) My garden during the rainy season; (9) My street after the rain with the blue house that is always flooded.

A turning point came when I started to engage with my neighbors on a much deeper level. For example, a friendly lady across the street started to help me dust my house and wash my clothes in their washing machine after my long periods of intense work and physical pain. This lasted only a few weeks until her house flooded with the onset of the rainy season, leaving her sick and their washing machine, the only one on the street, broken (see picture 4.7).

Picture 5: (1) Working on cacao farm; (2) Unloading fertilizer for the cooperative; (3) Chicken sleeping next to toilet (4) Harvesting cacao; (5) Unloading fertilizer; (6) Depulping cacao; (7) Bryan and his family.

Most loving was my neighbour Mari, a mother of three, who spends 18 hours a day either caring for her children, doing housework, or preparing barbecues to sell on the streets to fund her eldest daughter's university education. It was sad that she got robbed twice during my stay, but she always kept her beautiful smile. After four months, I entered a phase of acceptance. I

began visiting Mari's family daily in the evenings, accepting to enjoy Juane and grilled chicken every day. In return, I was surrounded by wonderful people, and it felt like also having a Peruvian family (see picture 3.4 and 3.5). Furthermore, visits to the doctor and the right medication were also helpful. Weekly contact with my family in Germany helped me get through this intense time. After all, I started experiencing positive moments again, like at the beginning of my trip.

By October, the interviews were coordinated, and I spent most of my time in Curimaná, a small, calm town deeper into the rainforest and a cacao trading center. My situation improved again significantly. It was slightly cooler, there was less dust, and I could finally enjoy the company of the cacao cooperative's technical team and farmers with their unique stories. All the farmers were very comforting and friendly. On my first few visits, I was taken by motorbike to the farmers, who are usually in remote areas with poor internet connection. Towards the end, I managed to visit the farmers myself, hitchhiking or walking to reach them.

In addition to just doing my research, I worked on a cacao farm for a day, helping with the harvest and depulping for fermentation. I worked with the cooperative team, experiencing the manual labor of carrying 80-100 kg sacks of cacao and unloading fertilizer for CGIAR's Agroecology Initiative experiments. Brian’s family, part of the technical staff, provided me with a sense of home and family also in Curimaná (see picture 5.1 to 5.7).

After six months in Curimaná and Pucallpa, I completed my data collection and research stay.

Thanks to presenting at ATSAF’s Tropentag, I connected with Armin, the project manager of Panguana, one of the oldest research stations in the Peruvian rainforest. There, I finally had

Picture 6: (1) Armin, a friend and me; (2-5) Various spiders, insects and a scorpion in the protected rainforest.

some time off from work to explore other sides of Peru. During the nights, we went into the forest with a spider expert to map biodiversity, which was incredible (see picture 6.1 to 6.5).

I concluded my adventure in Peru with my friend Jordan who I met at the beginning of my trip. We discussed once again future collaboration possibilities. Delia, his wife's aunt and a wonderful grandma and cook, offered me a place to stay for free. At her place, high in the coffee mountains near Villa Rica, I started to analyze my interview's data. There, thanks to Delia, I enjoyed one of the happiest times in my life (see picture 6.1 to 6.4).

From all the people I met and all the experience I gained this is just a snapshot. I had to leave out so many stories like from the one-eyed, limping orange juice seller who always had warm words, to all the neighbors who, despite harsh conditions, always smiled. Generally, it seemed that the strong family values and community belonging made these people happier than many Germans living in relative luxury in every other parts of their live.

Picture 7: (1) Jordan and me again. (2) Delia cookoing some German "Semmelknödel"; (3) Delia and me eating "caldo the gallina"; (4) My place for free at Delia's house. Small but it had everything!

Methodology and Data Collection

For my study I used a mixed-method approach within an agroecology framework, combining quantitative farm profiling with qualitative farmer interviews. The quantitative analysis captures the farmer's food profiles, i.e. their production system and consumption patterns. For this, we conducted a production survey with the main farmer and a consumption survey with the chef in 20 households using close-ended questions.

The qualitative interviews explored farmers' perceptions, opportunities, limitations, and interest in diversifying with regional species. For this, we conducted 10 semi-structured interviews paired with zig-zag transect walks on the farms. These interviews, featuring open-ended questions, allowed farmers to discuss their food profiles and environmental opportunities and limitations. Furthermore, we collected GPS points and photographs of key features and species during the transect walks to enable a detailed, virtual farm tour.

Overall, the idea was to use this comprehensive overview of production, consumption and farmer's perception to provide specific species and their basic configuration that support the transition to a diverse food forest which is tailored to the household's needs (see figure 1). However, this innovative approach turned out to be much more complicated than expected, as synthesizing such a wide range of data from so many different angles can be quite tedious, notwithstanding the many data collection issues involved in reaching such remote farmers.

Intersecting complex mixed method-approach within an agroecology framework

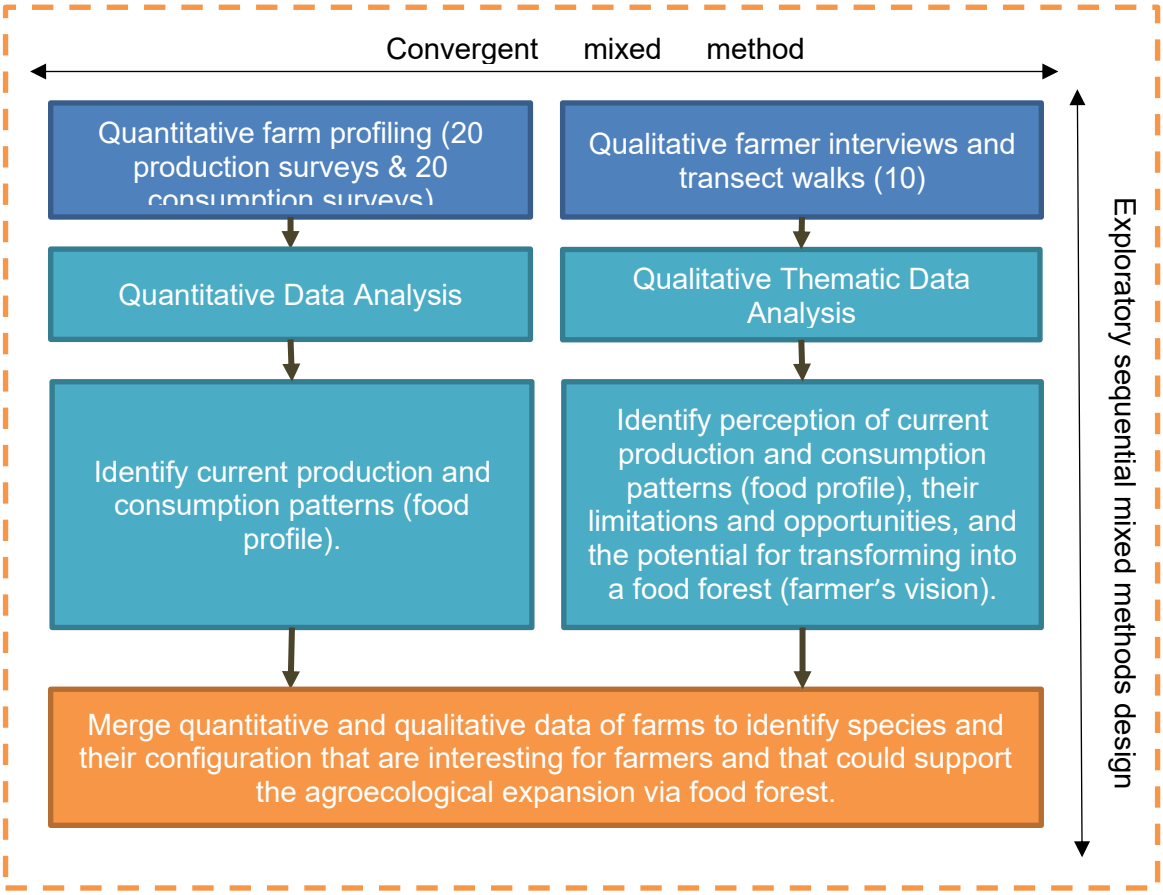


Figure 1: Methodology

Designing a Food Forest System: Tailoring to Farmer's Needs

After all, we used the insights of the quantitative and qualitative interviews to create comprehensive lists of species. We represented the farmer's needs through their farming experience primarily gauged through production data collected from the production surveys. To this we added the household's needs that are represented by the food they eat, a core aspect of culture. This is best indicated by the consumption surveys. To complement these needs, we used the qualitative interviews to explore deeper values associated with species choices, specifically to illuminate the reasons behind farmers' preferences within the constraints of their environment, which has been shown to be complex and multifaceted. Lastly, we used the qualitative interviews to reveal the farmers' vision for their farm and checked how it could match the idea of a food forest system. Ultimately, their vision showed indeed a multi-layerd strategy represented by food forest. Their collective intentions to integrate timber and fruit trees, find ecological balance, and protect adjacent natural resources demonstrate a good alignment with the concept. However, their vision would be cacao centric paired with an emphasis of more timber species than fruits.

Figure 2: Quantifying code cloud of farmers' vision.

This enabled us to formulate a first draft of a cacao-centric food forest system specifically tailored to the farmer's interviewed:

The envisioned food forest is structured with cacao as its keystone species, forming the heart of the system. Integrated within the cacao plots, we strategically place Capirona trees at intervals of approximately 30 meters. This spacing accounts for farmers' concerns about

reduced productivity due to shading while still providing the necessary shade. However, we would increase the number of trees with capirona and other suitable trees by planting them at least in the centre of each shady tree (so also every 30 m), these should be regularly coppiced so that they do not overtop the cacao. This will act as a mulch, reducing the need for weed control and better protecting the soil from heat in summer and erosion in winter. In addition, we intersperse among the cacao Guaba trees, valued for their contribution to soil health and additional shading properties. Zapote and Piyuayo will be included for their non-competitive nature and compatibility with the cacao microclimate. Marañon (cashew) and Caimito are being considered as possible options for feeding wild animals such as birds and monkeys, apart from the possibility of using them for human consumption to further strengthen the nutrient cycle with manure.

Beneath the canopy, the forest underlayer hosts poultry and livestock; Gallina, Cuyes, and Pato roam freely, with Broiler Chicken in designated areas to avoid mixing. Furthermore, we add a couple of bee hives as they are economic viable based on the high honey price of the region with relatively low labour input. The nitrogen-fixing Frijol de Palo is integrated as a shrub-like element to further enrich the soil. Furthermore, we integrate high-value crops like Pineapple, Turmeric, and Ginger in substantial quantities, leveraging their suitability to the shade and profitability in the market.

As an agroecological intervention, areas within the cacao plots undergo successional strong disturbance cycles. Here, we introduce Maize and a variety of beans—Frijol Chiclayo, Frijol Chaucha, Frijol Ucayalino—to support self-sufficiency and dietary diversification. Yuca is also a part of this cycle, adding another layer to the crop diversity. Bordering these disturbed zones, Plantains such as Bellaco or De Seda are cultivated, taking advantage of the peripheries' unique conditions.

For the outer edges, valuable timber species such as Mahogany (Caoba), Cedro, Ishpingo, and Copaiba are sited, offering long-term ecological services and further protection for the food forest. They can serve as living barriers in river-near areas to protect the cacao plants from flood damage through floating logs and other heavy remaining in the water. Furthermore, we would surround the whole cacao plot with a line of citrus trees and in the case of sandy soils, prone to waterlogging, which are usually found in close proximity to the river, we would surround it with plantain. Both would protect our cacao plot from surrounding pesticide application and specifically the citrus trees would benefit from their symbiosis with the honeybees. Furthermore, the increase in the number of citrus trees corresponds to the farmer's vision. Hilltops should be protected by a dense forest layer that are enriched with our timber species. Bolaina, currently the most economical timber species and an early successor, could help to establish these forests and later protect their borders by creating a small corridor around them. However, they provide too little shade to be used effectively as shade trees for our cacao plots. These hilltop forest structures are crucial to protect against erosion and to protect areas that are particularly susceptible to drought. They also bring fresh soil with high nutrient availability for the plants in our cacao plots during the heavy rains.

Overall, we would pay much more attention to water flow management and erosion control. When weeding in the rainy season, we should always leave a few centimetres of weeds standing. The weeder should never go so deep that the topsoil is loosened, a common practice amongst farmers to reduce weeding. However, the heavy rains and flooding cause severe

erosion in the region, which is one of the main reasons why we have seen 10-15 year old cacao plots with very low plant health. Next to this, we strengthen our look for protecting all water sources to buffer during the drought in dry season. This would mean that we increase our efforts to carefully plan buffer zones of around 10 m on each side for all water bodies like creeks with a diverse range of shade giving trees. Valuable timber trees typical for climax and late-successional stages seem to be the best options. These include for example Caoba, Cedro, Quina Quina and Shihuahuaco which are set up with some early and mid-successional tress such as the Fabaceae copaiba and Ishpingo, Pashaco rojo or Capirona according to preferences. Between the buffer zone and the cacao plot, we could also plant some Bolaina rows to achieve economic gains and better protect our valuable trees in the buffer zone. Finally, in areas susceptible to waterlogging, we plan to establish Aguajales, transforming these challenges into productive wetland systems where our ducks can thrive alongside many wild birds.

To summarize, this thoughtful configuration aims to create a biodiverse, economically viable, and ecologically sound food forest that aligns with the aspirations and practices of the local smallholder farmers. The selection of species is represented by what farmers produce, consume and perceive as an opportunity in their unique environment.

Summarizing Remarks

I started my career with a bachelor's in mechanical engineering and business administration at RWTH Aachen before deciding that I could do much better by working for the environment. This led me to my master's degree in sustainable resource management at TU Munich, where I eventually dedicated myself entirely to agroecology and regenerative agriculture. This might not be typical, but I now strongly believe that we need more young people to become changemakers in the way we treat our environment. Working on food systems is exactly the intersection between humans and nature. They provide livelihoods and enable the lives of us all while severely altering our environment. I hope I can inspire at least one more person to follow my steps.

As my quotes from the farmers at the beginning show, there is definitely interest agroecological food systems. That was beautiful to see, and I thank ATSAF for enabling this experience and all the people who supported me during my stay. They helped me fully become a specialist in agroecology in the global south and provided me with experiences with farmers in the Amazonian region as close as it can get.

Specifically, I want to thank Alejandra Arce, Philipp Mennig, and all the farmers and technical team from the cooperative: Brian, Alex, Roger, Graciela, Charles, Don Pedro, Don Juan, and many more (see picture 8). The farmers who want to bring change by finding more harmony with nature exist.

Overall, I concluded that it is much less about developing new technology or making it more efficient. If you apply the wrong principles, you only become more efficient at the wrong things. If we want to make lasting and positive change in the global south, we need to talk to these farmers, live a little with them, and develop concepts based on their needs while considering their economic, ecological, and social environments.

Ultimately and above all, we must be there for them constantly on site, gain experience together and continuously provide them with knowledge and time during the whole process in

order to be successful collectively. This also means putting up with the heat, the dust, the swarms of mosquitoes and everything else that is part of their lives.

Picture 8: Collage of the interviewed farmers and the technical team Banaqui Curimaná