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Agroforestry and Agroecological Transitions: between Ethnography and Evaluation of Practices in Colombia

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THESIS APPROVAL

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I, Massimo De Marchi, as supervisor of the student Elisabeth Masneri, hereby APPROVE the thesis entitled

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Declaration of Mobility

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Elisabeth Masneri

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Signature

A Porto, per aver vissuto con me il rurale e per avermi insegnato quanto sia insulsa la dicotomia natura-cultura.

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Abstract (English)

This thesis seeks to establish a connection between agroecology and agroforestry, as developed in the framework overview. While much of the existing research emphasizes the ecological benefits of agroforestry, the socio-economic dimensions and their connection to agroecology remain underexplored. This thesis aims to investigate agroecological transitions within the municipalities of Santuario and Carmen del Viboral in Oriente de Antioquia, Colombia, using the Characterization of Agroecological Transitions (CAET) from the Tool for Agroecology Performance Evaluation (TAPE) developed by the FAO. The research is pivotal as, firstly, it addresses the specific agroforestry academic gap and secondly the application of CAET to assess agroforestry and tree-based agroecological transitions has not been fully explored yet. By applying TAPE to eight diverse case studies, this study critically evaluates the tool's effectiveness and limitations within these contexts. Through a combination of ethnographic narratives and quantitative assessments, the research provides a nuanced understanding of TAPE's strengths and weaknesses when applied to agroforestry transitions in the specific geographic and socio-cultural setting examined. The selected case studies illustrate the complex, non-linear, and transformative processes that characterize agroecological transitions, revealing the potential of these practices to foster resilience and can challenge conventional neoliberal socio-economic narratives. The findings underscore the crucial role of social and economic factors in shaping successful agroforestry and agroecological practices, emphasizing the importance of context-specific strategies for promoting sustainable transitions to resilient agroecosystems. Finally, this thesis contributes to the broader discourse on agroecology by offering practical insights into the challenges and opportunities of integrating social and ecological dimensions, with a particular focus in the annexes on regeneration in agroecological agroforestry transitions.

Abstract (Español)

Esta tesis establece una conexión entre la agroecología y la agroforestería, un área que, aunque reconocida académicamente por sus beneficios ecológicos, ha sido insuficientemente explorada en cuanto a sus dimensiones socioeconómicas, las transiciones hacia sistemas agroforestales, y su capacidad para ser socialmente justa y verdaderamente agroecológica. No todas las prácticas agroforestales cumplen con los principios de la agroecología, ya que algunas pueden involucrar deforestación o no respetar la justicia social, aspectos que han sido poco estudiados en la literatura actual. Esta tesis tiene como objetivo principal investigar las transiciones agroecológicas dentro de los municipios de Santuario y Carmen del Viboral en Oriente de Antioquia, Colombia, utilizando la Caracterización de Transiciones Agroecológicas (CAET) del Instrumento para la Evaluación del Desempeño Agroecológico (TAPE) desarrollado por la FAO. La investigación utiliza un enfoque de métodos mixtos: la parte cuantitativa emplea la CAET, una herramienta nueva, prometedora y estructurada. Complementariamente, la parte cualitativa incorpora historias de transición etnográficas que exploran en profundidad las experiencias y desafíos de la lucha agroecologica, desde la voz de los campesinos, de las campesinas y de las sembradoras la lucha para agroecologica. Así, a través de una combinación de narrativas etnográficas y evaluaciones cuantitativas, la investigación proporciona una evaluación crítica y una comprensión matizada de las fortalezas y debilidades de TAPE cuando se aplica a transiciones agroecológicas y agroforestales en el contexto geográfico y sociocultural específico examinado. Los resultados de la tesis ilustran los procesos complejos, no lineales y transformadores que caracterizan las transiciones agroecológicas, revelando el potencial de estas prácticas para fomentar la resiliencia y desafiar las narrativas socioeconómicas neoliberales convencionales. Los hallazgos que enfrentan cada día lxs campesinxs y presentados en la discusión subrayan el papel crucial de los factores socioeconómicos como la presencia de mercados alternativos y redes comunitarias en el éxito de las prácticas agroforestales y agroecológicas, destacando la necesidad de políticas públicas y reformas integrales para el campo colombiano. Finalmente, esta tesis contribuye al discurso más amplio sobre agroecología al ofrecer perspectivas prácticas sobre los desafíos y oportunidades de integrar las dimensiones agroforesteras, con un enfoque particular en los anexos sobre la regeneración en las transiciones agroecológicas agroforestales.

“***To free ourselves, we must feed ourselves***.”

- (Penniman, 2020)

*“**Soy una compostista, no una posthumanista**: todos somos compost, no posthumanos. El límite que es el Antropoceno/Capitaloceno significa muchas cosas, incluso que una inmensa e irreversible destrucción está realmente en marcha, no solo para los aproximadamente once mil millones de personas que estarán en la tierra a finales del siglo XXI, sino también para miríadas de otros bichos. (...) La recuperación aún es posible, pero solo en alianzas multiespecies.”*

- (Haraway, 2019)

1. Introduction

Agriculture is both affected by climate change and a major contributor to it, mostly due to high greenhouse gas emissions produced in agricultural areas (FAO, 2023c). Global emissions from agriculture and land use account for approximately one-third of the total emissions from all economic activities (Crippa et al., 2021). When considering the entire food system, including pre- and post-production processes, as well as marketing, consumption, and waste management, the emissions attributable to the food system are estimated to range between 20% and 40% of total anthropogenic emissions (Crippa et al., 2021; IPCC, 2022). Food production also consumes 70% of total water withdrawals (de Vos et al., 2021; FAO, 2023a), threatening biodiversity and depleting fertile soil layers (FAO, 2023c). The FAO's (2023b) study has employed true cost accounting (TCA), a method that uncovers the hidden costs of unsustainability in agrifood systems, calculating these costs to be $12.7 trillion in 2020, driven primarily by unhealthy dietary patterns, environmental degradation, and social challenges. Moreover, the global food system exacerbates socioeconomic disparities by favouring large-scale industrial plantations at the expense of small- and medium-scale agriculture, leading to the loss of livelihoods for millions of small-scale farmers (Van der Ploeg, 2009).

In this context, the IPCC (2022, 2023) emphasizes that "business as usual" is no longer a viable option; without transformative change, we risk catastrophic consequences by 2050. They highlight that the greatest future challenges in food, land use, and climate change are intrinsically linked to high food costs, socioeconomic disparities, and uncertainties related to soil processes and their connections to the diverse livelihoods of different social groups. Similarly, the FAO (2023b) warns that the lack of measures to improve sustainability, productivity, and resilience in agriculture could severely affect food production in already vulnerable regions. To address these challenges, agroecology is proposed as a transformative approach capable of improving yields and resilience while mitigating climate change impacts (FAO, 2023a).

However, reports from the IPCC and FAO often lack the political discourse and analytical frameworks to fully call out the systemic origins of the agricultural crisis. They often overlook the underlying dynamics that contribute to food insecurity, high food prices, biodiversity loss, and land degradation. To address this gap, McMichael (2015) introduces the concept of the "food regime," which describes the global capitalist order that governs food production and consumption. This framework helps us understand the contemporary corporate food regime, where transnational corporations, rather than states, direct markets through financialization. This regime has led to the relocation of manufacturing and agriculture to the Global South, where transnational corporations contract local farmers to supply supermarkets in the Global North (McMichael, 2015). This process, which Van der Ploeg (2009) calls the "food empire," has resulted in the monopolization of food production and the subjugation of small-scale farmers to agro-industrial inputs, leading to depeasantization and the erosion of their traditional knowledge and autonomy.

Moore (2015a, 2015b) challenges the power structures of capitalism by proposing the theory of "*world-ecology*", which considers nature as dialectically co-produced with capital and power. This perspective highlights the importance of rethinking economic relations in terms of natural cycles and flows, challenging the extractivist logic that dominates the current food system. Emerging movements for food sovereignty and agroecology respond to the failures of the Green Revolution and the depletion of cheap food sources, advocating for a return to more sustainable and equitable agricultural practices (Altieri, 1989; Rosset & Altieri, 2017). Agroecology, as an integrated approach to agriculture, connects ecological principles with social justice, offering a viable and empowering alternative to the dominant industrial model. This thesis explores agroecology and agroforestry as interconnected solutions to the global food and ecological crises. By applying the TAPE methodology, a novel approach to assessing agroecological transitions, this research focuses on eight case studies in Colombia's Oriente region of Antioquia. These cases illustrate the complex, non-linear, and transformative processes of agroecological transitions in challenging the conventional neoliberal socio-economic paradigm. Through a combination of ethnographic narratives and quantitative assessments, this study aims to critically evaluate the potentials and challenges of these transitions, providing insights into how agroecology can serve as a bridge between the biological and social dimensions in the climate crisis.

2. Research Questions and Objectives

In the framework of this thesis, I will address the academic gap in the study of agroforestry transitions, particularly in relation to the social and economic dimensions of these transitions. While existing research has often focused on the ecological aspects of agroforestry, the integration of socio-economic factors remains underexplored. On the other side the relation between agroecology and agroforestry is not sufficiently explored. Furthermore, the Tool for Agroecology Performance Evaluation (TAPE) developed by FAO has yet to be specifically applied to assess agroecological transitions in agroforestry or tree-based approaches. This thesis seeks to fill this gap by conducting a pivotal study that applies TAPE to eight case studies, thereby evaluating its applicability and effectiveness in these contexts.

The research will focus on eight case studies that represent a spectrum of agroecological transitions in the Oriente region of Antioquia, Colombia. These case studies range from complex agroforestry regeneration initiatives to more traditional tree monocultures, living fences, and *fincas* (farms) with scattered trees undergoing agroecological transition. By applying TAPE across these varied contexts, this study aims to determine whether the tool can effectively capture the nuances of agroecological transitions involving agroforestry practices.

This thesis is structured around the following research questions:

1. **What are the primary barriers to implementing agroecological practices in the Oriente region, particularly concerning agroforestry practices?** This question seeks to identify and analyse the key obstacles that farmers and other stakeholders face when attempting to adopt agroecological practices, with a particular focus on agroforestry. Understanding these barriers is crucial for developing strategies to promote more widespread adoption of sustainable practices.

2. **Do agroecological transitions that incorporate agroforestry practices achieve better outcomes, as measured by TAPE?** By comparing the outcomes of agroforestry-based transitions with other types of transitions, this question aims to assess the effectiveness of agroforestry practices in achieving the goals of agroecology, as evaluated by the TAPE framework.

3. **What are the challenges and specificities of applying TAPE in this territorial context, particularly in relation to agroforestry transitions?** This question will explore the practical and methodological challenges of using TAPE in the specific socio-economic and environmental context of the Oriente region. It will also examine how well TAPE can be adapted to measure the outcomes of agroforestry transitions.

The overarching objective of this thesis is to apply the CAET (TAPE) methodology in the municipalities of Santuario and Carmen del Viboral (Oriente de Antioquia, Colombia), marking the first application of TAPE in this region. This research is pivotal as it will provide practical insights into the strengths and limitations of TAPE when applied to agroecological and agroforestry practices.

The study will employ a mixed-methods approach, combining quantitative assessments using the CAET-TAPE framework with qualitative insights derived from ethnographic portraits of the agroecological transitions. The quantitative analysis will identify the level of agroecological transition achieved by each case study, while the qualitative component will provide a critical examination of the socio-economic and cultural factors influencing these transitions. By integrating these two approaches, this research aims to offer a comprehensive understanding of the case studies' agroecological transitions and the applicability of TAPE in similar contexts.

3. Theoretical Frame and Literature Review

a. Agroecology Framework

I. Definition and History

The term "agroecology" is marked by its multiple definitions and its evolving historical significance. Initially introduced in the late 1920s and 1930s (Wezel et al., 2009; Wezel & Soldat, 2009), the term has undergone significant shifts in both definition and application over the past 80 years. Today, agroecology is recognized as encompassing a science, a movement, and a practice (Wezel et al., 2009), emerging as an alternative paradigm that challenges the limitations of the current food system. In this section, we will trace its history and present some of the definitions that will help elucidate agroecology in its various facets.

The historical roots of agroecology can be traced back to the early 20th century, when it was originally used to describe the application of ecological methods to traditional agriculture (Bensin, 1928). Wezel et al. (2009) refer to this period as one of the major historical phases: the Old Age of Agroecology (1930s–1960s). During this time, agroecology was primarily defined through its connections to agronomy and ecology, focusing particularly on crop management and pest control. The research conducted during this period laid the groundwork for understanding the interactions between plants, animals, and the environment within agricultural settings (Wezel et al., 2009).

Subsequently, the so-called "*Expansion of Agroecology (1970s–2000s)*" occurred (Wezel et al., 2009, p.505). Starting in the 1970s, agroecology expanded beyond a purely scientific discipline to encompass a broader movement and set of agricultural practices. During this period, agroecology gained prominence as a critique of the Green Revolution and the industrial agricultural model, highlighting their adverse effects on small farmers and the environment (Rosset & Altieri, 2017, p.25). Pioneers like Miguel Altieri advocated for agroecology as a mean to restore ecological balance and promote farmers' autonomy: "*increase their access to land, resources (...) and become socially organized to secure governance of resources, equity of access, and benefits of markets, inputs, products, and income derived from harvests*" (Altieri, 1989, p.45). In this period, the concept of "agroecosystems", which views farms as ecological systems, became central: "*Agroecology can thus be defined as the science that studies the structure and function of agroecosystems from the perspective of their ecological and cultural* *interrelationships*" (León Sicard & Altieri, 2010). By the 1980s, agroecology had evolved into a comprehensive framework for studying and promoting sustainable agricultural practices (Wezel et al., 2009): "*Solving the sustainability problem of agriculture is the primary aim of agroecology*" (Altieri, 1989, p.37).

Therefore, over time, agroecology has evolved into both a broader scientific discipline and a social movement. This evolution is described as a shift from a purely ecological perspective to one that incorporates social, cultural, and political dimensions: "*Agroecology has opened the door to the study of cultural components—symbolic, socioeconomic, political, historical, philosophical, and technological—that influence farming fields, often with equal or greater impact than purely ecological variables*" (León-Sicard et al., 2014, p.57). Thus, agroecology emerges as the ecology of food systems: "*We define agroecology as the integrative study of the ecology of entire food systems, encompassing ecological, economic, and social dimensions*" (Francis et al., 2003, p.100)

When agroecology encompasses such a broad scope, we are compelled to look beyond simple associations between ecology and agriculture in the short term or the annual economy of an agroecosystem. This approach seeks sustainable agriculture that is long-term, culturally and geographically situated, and local, creating bridges between the past, present, and future. Agroecology is thus conceived as:

> "*a science that draws on social, biological, and agricultural sciences and integrates these with traditional and farmer knowledge. (...) At the heart of the agroecological strategy is the idea that an agricultural system should mimic the functioning of local ecosystems, thus exhibiting tight nutrient cycling, complex structure, and enhanced biodiversity*" (SOCLA & TWN, 2015, p.7).

II. Agroecological Transitions and Critical Agroecological Multitudes

In this thesis, I fully embrace agroecology as a political proposition, "*as a critical proposal*" (Val & Rosset, 2022, p.10). According to Val & Rosset's classification (2022), agroecology can be divided into at least three interrelated dimensions:

1. The technical-productive: material agroecology, as a science and disciplinary field.

2. The political-organizational: immaterial, symbolic, and mobilizing agroecology.

3. The ontological-epistemic-experiential: agroecology as a way of being, living, and producing.

They also distinguish between neoliberal agroecology and reformist agroecology. The former refers to an agroecology that attempts to select certain agroecological principles for incorporation into the industrial model, but without significant changes between industrial agriculture and neoliberal agroecology. The latter represents a process of substitution, shifting from chemical inputs to bio-inputs, which makes some progress toward overcoming monoculture but remains far from the agroecology advocated by social movements (Giraldo & Rosset, 2018; Val & Rosset, 2022).

These two distinctions align well with Gliessman's (Gliessman, 2016, 2018; Gliessman et al., 2007) approach to agroecological transition, which is structured into five levels. The first level involves increasing the efficiency of industrial/conventional practices to reduce the use and consumption of costly, scarce, or environmentally harmful inputs. This level corresponds to the neoliberal agroecology described by Val & Rosset (2022), as it does not represent a genuine departure from the industrial farming model.

At the second level, conventional inputs are substituted with more sustainable alternatives, such as bio-inputs, organic fertilizers, and biopesticides (Gliessman, 2016). This level is not inherently problematic if viewed as a step in the transition; many successful campesino-led transitions to agroecological systems on farms begin by focusing on input substitution. However, this is often perceived as the final goal, particularly by institutions, governments, and foundations (Anderson et al., 2021). This is where it can be termed "reformist agroecology" which does not adequately address the systemic problems of power and capital concentration in our food system (Giraldo & Rosset, 2018). A pragmatic example of this is organic farming, with its set of commercialized pesticides and certification standards, which can be carried out in conventionally designed agro-systems devoid of ecological zones, trees, ponds, or hedges—all intended to continue the commodification of food and the consolidation of the capitalist food market (De Marchi et al., 2022).

The third level involves reconstructing complex ecosystems, where not all land is cultivated, but there is space for ecological infrastructure, and connections exist with non-agricultural natural areas (Gliessman, 2016). Various agroecological practices, such as polyculture[1], nutrient recycling within the farm system, and Integrated Pest Management[2] are introduced to foster the development of an intentional agroecological system transition (Rosset & Altieri, 2017, p.47). However, level three still largely remains relatively rare (Anderson et al., 2021). With the fourth level of transition, it becomes possible to re-establish a direct link between food producers and consumers through alternative economies and solidarity between rural and urban, peasant, and non-peasant communities. The fifth level encompasses broader social, cultural, economic, and policy transformations, including agrarian reform, food sovereignty, and land redistribution, with the co-construction of a new sustainable, global, and just food system through a participatory multitude of agroecologies (Gliessman, 2016). As Anderson et al. (2021) emphasize, focusing their work on the fourth and fifth levels of agroecological transition, food system transformation is a non-linear process that is uneven, uncertain, non-linear, and context-specific: "*Progress is ever-evolving and may only be coherent in retrospect. Thus, a large-scale transformation of food systems is actually many transformations*." (p.31).

In this vein, we can discuss "transformative agroecologies" (Anderson et al., 2021) "emancipatory agroecologies" (Giraldo & Rosset, 2023) or "agroecological multitudes" (Giraldo, 2022) as "*agroecologies born of a vast wealth of traditional knowledge and practices, producing self-sufficiency independent of external inputs, culturally and ecologically adapted to their environment*" (Val & Rosset, 2022, p. 23). These are deeply political agroecologies, agroecology as "*presentist utopias*" (Giraldo, 2022, p.8), which configure multitudes of alternative, geo-localized proposals aimed at the radical transformation of the economic and social system. Agroecologies do not offer recipes but provide examples and principles, principles and examples tested by those who inhabit agroecology (Val & Rosset, 2022). Through the *campesino-a-campesino* school, it is the campesinos themselves who practice specific, localized practices that "*spread the desire*" (Giraldo, 2022, p.102), promoting their way of living agroecology. This alternative path, addressing the food sovereignty of peoples and peasants, can only be undertaken through class struggle, co-produced through nature (Moore, 2020). In this context, Rosset and Martínez Torres (2016), drawing on Van der Ploeg's (2009) "peasant condition", argue

[1] Growing multiple crop species in the same area to increase biodiversity and reduce pest outbreaks.
[2] Using biological control agents, crop rotation, and resistant varieties to reduce reliance on chemical pesticides.

that agroecology can help peasants reclaim their identity, leading to a re-peasantization, granting them autonomy and freeing them from market relations and debt cycles.

Thus, agroecology represents a comprehensive approach to agriculture that integrates ecological principles, social justice, and political advocacy. The political implications of agroecology are profound, as it challenges the dominant industrial agricultural model and its underlying power structures while offering viable, empowering alternatives:

> "*Peasant-based agroecological approaches are an integral part of many agrarian struggles for land and market reforms, as well as peasant movements against land grabs and extractive industries. For them, agroecology is not just a scientific or technological project, but a political project of resistance and survival*" (Altieri & Holt-Giménez, 2016, p.2).

III. Agroecology in the landscape, high quality nature matrices

One of the transformative implications of agroecology is its landscape-scale approach, which integrates food sovereignty with biodiversity conservation and ecosystem services. A fundamental pillar of agroecology is diversity (FAO, 2018b), as highlighted by (León-Sicard et al., 2024):

> "*Agrobiodiversity is the very foundation upon which agroecology is built. It provides the mechanisms that allow agroecosystems to be managed sustainably through a set of beneficial interactions between their elements (e.g., mutualisms that occur in pollination, mycorrhizae, or in crop associations*" (p. 1).

This aligns well with the new paradigm of conservation, as articulated in *Nature's Matrix*, which emphasizes the importance of supporting agroecological and food sovereignty movements (Perfecto et al., 2019; Perfecto & Vandermeer, 2010). Unlike traditional conservation strategies that primarily focus on so-called "hot spots" where biodiversity is thought to be concentrated, this paradigm broadens its focus to encompass the larger physical, biological, cultural, and political landscapes. Advances in ecological research have shown that local extinctions are natural and unavoidable, making it imperative for biodiversity conservation to prioritize enhancing migration rates over simply reducing extinction rates (Perfecto & Vandermeer, 2010). Moreover, given the high fragmentation of ecosystems globally, migration rates among fragmented habitats are heavily influenced by the type of agroecosystem present within the surrounding matrix (Perfecto et al., 2019). Therefore, a long-term plan for biodiversity conservation must operate at the landscape level, focusing not only on preserving the remaining patches of native vegetation but also on constructing migration-friendly landscapes. Such landscapes are most likely to emerge from the application of agroecological principles, best implemented by small farmers with secure land tenure (Perfecto et al., 2019). For example, small-scale, traditional farms create complex mosaics of crops and fallow fields that support high levels of biodiversity, even though these landscapes may not resemble native vegetation. These agroecosystems are crucial in creating migration-friendly landscapes and serve as models that could be replicated, especially in political systems that prioritize food sovereignty (Perfecto et al., 2019).

True biodiversity conservation is more likely to be achieved through collaboration with rural social movements and the millions of small-scale farmers advocating for food sovereignty, rather than through land acquisitions for protected areas or land grabbing (Perfecto et al., 2019). Additionally, conservation efforts, to be effective, must prioritize the protection and enrichment of ethnobiodiversity. The loss of traditional and contemporary knowledge related to agrobiodiversity—such as uses, beliefs, management systems, taxonomy, and language—poses a significant obstacle to successful biodiversity conservation and sustainable development (Thaman, 2008). Effective biodiversity conservation requires that local communities integrate traditional conservation strategies with modern scientific models within co-management systems. In the Zapotec Mountains of Oaxaca, for instance, the cultural significance of local species, landscapes, and agricultural practices underscores the importance of integrating biocultural knowledge into conservation efforts (Vásquez-Dávila et al., 2022). This connection between biodiversity conservation, agroecology, peasants, and class struggles moves us away from anthropocentric and Malthusian narratives that depict humans as the primary adversaries of the Earth. Instead, it acknowledges the rich history of biocultural heritage, indigenous knowledge, and agrobiodiversity that we are capable of managing. This perspective leads to an ontological shift toward reintegrating humans within ecosystems and agroecosystems. As Giraldo (2022) notes:

> "*There is a need to understand that humans are not irredeemable ecocides. Throughout history, our species has helped enrich life in the biosphere, and much of that beneficial effect is the work of agriculture. Revisiting environmental history with agroecological eyes helps us understand that the required civilizational*

transformation does not mean 'passively conserving,' but actively transforming and nurturing ecosystems to dynamically sustain life" (p. 17).

b. Agroforestry Framework

I. History and Definition of Agroforestry

In the 1970s, with the failure of the Green Revolution to benefit low-income farmers and the increasing problems of deforestation and land erosion, the International Development Research Centre (IDRC) of Canada initiated a crucial step towards developing agroforestry. In July 1975, John Bene was commissioned by the IDRC to identify gaps in global forestry research, assess the interdependence of forestry and agriculture in low-income tropical countries, and propose research to optimize land use. Although initially focused on tropical forestry, Bene's team concluded that priority should be given to integrated production systems that combine forestry, agriculture, and/or animal husbandry (Bene et al., 1977). This led to a shift from forestry to broader land-use concepts with immediate and long-term relevance. Consequently, the IDRC Project Report recommended the establishment of an international organization to support, plan, and coordinate worldwide research on combined land-management systems of agriculture and forestry. In response, the International Council for Research in Agroforestry (ICRAF) was established in 1977, institutionalizing the ancient practice of agroforestry for the first time (Nair, 1993).

The most widely recognized definition of agroforestry is provided by ICRAF:

> "*Agroforestry is a collective name for land-use systems and practices in which woody perennials are deliberately integrated with crops and/or animals on the same land-management unit. The integration can be either in a spatial mixture or a temporal sequence. There are normally both ecological and economic interactions between the woody and non-woody components in agroforestry*." (Lundgren & Raintree, 1983, p.2).

Nair (1993), a leading academic in agroforestry, highlights in his work, Introduction to Agroforestry, that from the '70s to the '90s already there were plenty of agroforestry definitions but that consistent ones all pointed out two characteristics:

- Deliberate Integration: "*the deliberate growing of woody perennials on the same unit of land as agricultural crops and/or animals, either in some form of spatial mixture or sequence*" (Nair, 1993, p.13).
- Significant Interaction: "*there must be a significant interaction between the woody and nonwoody components of the system, either ecological and/or economical*" (Nair, 1993, p.14).

However, as Somarriba (1992) points out, the term "*significant interaction*" can be ambiguous and vary based on spatial-temporal arrangements, prompting a more specific definition:

> "*Agroforestry is a form of multiple cropping which satisfies three basic conditions: 1) there exist at least two plant species that interact biologically, 2) at least one of the plant species is a woody perennial, and 3) at least one of the plant species is managed for forage, annual, or perennial crop production*." (Somarriba, 1992, p.238).

These definitions often serve as prescriptions for land use, potentially overlooking agroforestry's capacity to create complex landscapes with diverse species habitats. Leakey (1996) emphasizes the need to embed agroforestry within an ecological framework, suggesting integrating the pervious agroforestry definition:

> "*Agroforestry should be reconsidered as a dynamic, ecologically based natural resource management system that, through the integration of trees in farm- and rangeland, diversifies and sustains smallholder production for increased social, economic, and environmental benefits*" (Leakey, 1996, p.6).

Overall, these definitions cover a wide range of agroforestry systems. Nair, in particular, identifies 36 categorizations of systems, some of which can be further subdivided into more categories (Nair, 1993). The International Centre for Research in Agroforestry (ICRAF) offers a comprehensive overview of the most widespread agroforestry systems, from the simplest systems with few species and low management intensity to highly complex systems with high biodiversity and intensive management (Miccolis et al., 2016):

- Silvopastoral Systems, which are focused on livestock production through the integration of pastures and trees.

- Agrosilvopastoral Systems, which involve the simultaneous presence of agricultural and forestry species alongside livestock farming.
- Agrosilvicultural Systems, which refer to the combination of annual crops and the association with forestry species.
- Successional or Biodiverse Agroforests, which are considered the most diversified SAFs, similar to natural forest ecosystems, characterized by high biodiversity and management based on the natural succession of species.
- Agroforestry Homegardens, which are a type of SAF that combines trees with other agricultural species and/or medicinal and domestically useful animals, essential for family food security.

II. Traditional Agroforestry Systems

Although agroforestry has been academically defined and studied since the 1970s, these systems have been practiced for millennia and are commonly referred to as Traditional Agroforestry Systems. Traditional Agroforestry Systems (TAFS, from now on) have long played a crucial role in shaping and maintaining the biodiversity of landscapes around the world. These systems reflect an ecological wisdom developed over millennia by Indigenous and local communities, what Ferrara, Ekblom, and Wästfelt (Ferrara et al., 2022) describe as "*biocultural heritage*", defined as space-time heterarchies formed through repeated feedback between human ecological processes and ecosystem responses. This perspective views landscapes as a dynamic co-created by human and non-human interactions across time, emphasizing the intrinsic value of agroforestry diversity in linking food sovereignty, ethnodiversity, and biodiversity (Giraldo, 2022; Guterres, 2006). Thus, agroforestry is not a novel concept; it has long been a widely utilized practice that integrates socio-cultural dynamics with ecological systems into a singular, cohesive unit.

However, this rich tapestry of space-time heterarchies created by various TAFS has been challenged by broader socio-political forces that prioritize economic gain over ecological diversity. The transition from biodiverse management of landscapes to homogenized systems mirrors the historical processes of plantations, extractivism, colonialism and finally Green Revolution (Giraldo, 2022; Haraway, 2019; Moore, 2015a; Van der Ploeg, 2009). And as Hecht (2014) points out, the knowledge systems embedded in traditional practices such as TAFS are among the least visible and most vulnerable. They play a vital role in maintaining the intricate agro- and biodiversity essential for sustaining the futures of both rural and urban areas, with indigenous knowledge continuing to form the backbone of natural resource management.

Examples of TAFS are found worldwide, predominantly in the tropics across Asia, Africa, South America, and the Pacific islands, each with distinct designs and practices (Viswanath & Lubina, 2017):

- **South America**: In the Amazon, populations have practiced polyculture agroforestry for approximately 4,500 years, contributing to the dominance of edible plants in the region's rainforest. This suggests the Amazon is an anthropogenic landscape shaped by Indigenous agroforestry practices (Maezumi et al., 2018). In Mexico there are a variety of TAFS (Hernández, Macario, & López, 2017; Vásquez-Dávila et al., 2022), an example is the *kuojtakiloyan* or "productive forest" that represents an ancient form of successional agroforestry that rotates annual crops with secondary tropical forest (Isabel Moreno-Calles et al., 2013). These systems are dynamic, fostering biodiversity and cultural sovereignty by integrating over 250 plant species, of which 96% are considered useful for food, medicine, ornamentation, fuel, and trade (Nigh & Diemont, 2013).
- **Europe**: European TAFS, such as hedgerows, windbreaks, wood pastures, and silvopastoral systems like streuobst (Herzog, 1998), include practices with less complex spatial and temporal patterns than tropical systems (Nerlich et al., 2013; Viswanath & Lubina, 2017). The Mediterranean *coltura promiscua* ("promiscuous cultivation"), for instance, mixed fruit and timber trees with crops like cereals and vegetables, maintaining high agrobiodiversity until the 1960s when industrialization led to its material disappearance and immaterial oblivion (Ferrario, 2021).
- **Africa:** Across Africa, TAFS vary from the oases in North Africa, with their three-layer structure of date palms, fruit trees, and annual crops (Santoro, 2023), to Zimbabwe's homesites, where 60% of households engage in tree planting activities (Campbell et al., 1991). In Benin, traditional agroforestry parklands maintain woody species richness, contributing to biodiversity conservation and reducing reserve pressures (Fifanou et al., 2011).
- **Asia:** In India, home gardens are prevalent, particularly in Kerala, where they serve as the dominant farming system. These small (about 0.5 hectares) multi-strata agroforestry systems are rich in species diversity, meeting essential needs

like food, fuel, and timber (Viswanath & Lubina, 2017). In Indonesia, the Kebun-Talun system is a rotational cropping system combining crops and trees, allowing for natural regeneration and enrichment planting after the harvest (Bertsch, 2017).

- **Pacific Islands:** In Micronesia, mixed tree gardens are among the earliest forms of agriculture, typically featuring coconut-dominated permanent agroforest systems (Manner, 2014). These systems provide timber, food, and culturally significant items. In Hawai'i, adaptive agroecosystems crafted by Native Hawaiian cultivators include the kalu'ulu arboriculture and the ama'u zone, a managed native forest (Ladefoged et al., 2009; Lincoln et al., 2018).

III. Benefits of Agroforestry

Agroforestry offers numerous benefits, from increasing food security and mitigating climate change to enhancing biodiversity and soil health. According to Smith et al. (2019), agroforestry has the potential to boost food security for 1.3 billion people while reducing soil erosion by 50% and increasing soil carbon by 21% (Muchane et al., 2020). Additionally, it helps adapt to rising temperatures by increasing forest canopy cover and providing shade and evaporative cooling (Anabaraonye et al., 2024; Lasco et al., 2014).

Moreover, agroforestry has several ecological benefits (Miccolis et al., 2016) as:

- regulates water flow and stabilizes supplies in the face of both intense rainfall and drought (Santoro et al., 2022; Simelton et al., 2015) due to improved permeability, water holding capacity, and drainage (Kumar et al., 2020) thanks to trees that take up water from deep soil layers and recycle it in upper soil layers through water redistribution, making it available to nearby shallow-rooted crops (Bayala & Prieto, 2020). Agroforestry systems also influence groundwater recharge, favoring water infiltration speed and quality (Bargués Tobella et al., 2014; R. P. Udawatta & Gantzer, 2022).
- conserves soil, maintains soil fertility and structure (Udawatta & Gantzer, 2022), and reduces runoff of organic carbon, nutrient, and pollutant losses in soil by 9%, 49%, and 50%, respectively (Zhu et al., 2020). It also increases soil erosion resistance (Pan et al., 2022). For instance, agroecological practices like leaving plant residues in place after weeding and pruning can limit the impact of erosion to around 13% of the cultivated area in tropical agroforestry (Blanco Sepúlveda

& Aguilar Carrillo, 2015). Even in semi-arid climates, agroforestry can reduce erosion by 19.1% and 37.1%, respectively (Jinger et al., 2022).

- enhances nutrient cycling, agroforestry systems that mimic natural ecosystems are more effective in nutrient cycling than monocultures, thanks to root action and continuous organic matter input (Miccolis et al., 2016). Even when compared to natural regeneration areas, multistrata agroforestry systems are proven to produce great amounts of litter, adding nutrients to soil–plant system; what's interesting is that it is the anthropogenic management, mainly pruning, that guarantees the soil regeneration, using nutrient cycling for restoration while also lowering costs on external fertilizers (Froufe et al., 2020).
- increases biodiversity and provides wildlife habitats, agroforestry integration into farming systems increases species richness compared to monoculture cropping systems (including tree-dominated monospecific systems) that led to higher biodiversity and ecosystem services (Santos et al., 2022; Udawatta et al., 2019). However, many factors affect biodiversity in agroforestry systems, such as the density, diversity, and management of trees and shrubs (Boinot et al., 2022). Agroforestry systems that mimic secondary succession forests act as alternative habitats for threatened species in landscapes of habitat loss and degradation (Miccolis et al., 2019; Udawatta et al., 2021; Yashmita-Ulman et al., 2021).
- helps combat desertification (Marinelli, 2010) and can be used to afforest ecosystems prone to desertification (Kulik et al., 2023; Tewari et al., 2007).
- provides shade and creates microclimates, potentially reducing temperature by up to 4°C on the hottest days (Gosme et al., 2016; Karvatte et al., 2020). It also protects sensitive crops from direct sunlight and increases air humidity (Lin, 2007).

Agroforestry transitions have the potential to connect ecological benefits with socio-political and economic ones, such as:

- production, agroforestry generates food, commodities, wood, raw materials for shelter and for artisans, energy, medicinal plants, forage, honey and cultural and spiritual goods (Miccolis et al., 2016; Montagnini et al., 2015).
- food sovereignty: agroforestry can increase food security by providing access to a diversity of nutritious foods, increasing purchasing power through savings on food expenses, and supplying food during periods of temporary scarcity

benefitting local food systems (Jacobi, 2016; Montagnini et al., 2015). In Cuba, agroforestry agroecosystems guarantee 80% food sovereignty of the families involved in this type of agriculture, while maintaining a high-quality landscape matrix (Cordero Acosta et al., 2022). While in Mexico, traditional agroforestry systems make up 55% of the food eaten by the communities (Hernández, Macario, & López-Martínez, 2017).

- space optimization, agroforestry optimizes space use, like agroforestry *huertos caseros* that respect natural successionality can be more productive per unit area than conventional agriculture, capturing more resources and exhibiting a more closed nutrient cycle (Montagnini & Metzel, 2017).
- reduced need for external inputs, agroforestry reduces and optimizes the use of external inputs by increasing nitrogen input through nitrogen-fixing trees and tree biomass production and decomposition, while also utilizing nutrients from deeper soil layers with deep-rooted trees (Nair, 2007). Additionally, it helps detoxify the land and water from previous intensive management practices and regenerates it, as deeper tree roots reduce agricultural pollutant transport in the soil profile, contributing to soil and water pollution mitigation (Pavlidis et al., 2020).
- economic risk reduction and economic resilience, agroforestry reduces economic risk and is less sensitive to negative price and climate variations, generating diverse sources of income (Castillo Gamez et al., 2022). In Brazil, afforestation in buffer zones near agricultural lands has been shown to increase producers' incomes as nearly 50% of areas recovered with agroforestry are economically exploitable (de Mendonça et al., 2022). Moreover, long live cycle trees are often called “the bank account of farmers”, providing extra income during bad harvest years (Appiah & Nyarko, 2015).
- gender equality, there is strong gender connotation in agroforest work as gathering, managing and processing forest products are considered men’s labour, while men also dominate associated knowledge systems (Colfer, 2013). However, some studies suggest agroforestry helps women; for example, women's income is higher than that of women in conventional farming (Oparinde et al., 2023) and the easy access to home-grown timber and firewood from pruning frees women from work and consequently time can be invested for other productive activities (Kiptot & Franzel, 2011).

- pest and disease resistance, the Green Revolution's monoculture system has simplified agroecosystems, making them less resilient to diseases and thus more dependent on pesticides. In contrast, the complexity of agroforestry systems enhances resilience to pests and diseases (Monteiro et al., 2024). As an example, vineyard agroforestry systems benefit pest management by providing habitat for natural enemy insects, mites, and vertebrates, controlling bacterial and viral infections by managing insect vectors (Favor et al., 2024).
- agrobiodiversity Maintenance, agroforestry promotes the maintenance of agrobiodiversity and traditional knowledge. In Mexico, agroforestry highlights the nature-culture unit, where biodiversity influences cultural peculiarities and ethnobiodiversity (Vásquez-Dávila et al., 2022). In Brazil, transitioning to agroecological agroforestry links heritage, cultural identity, autonomy, and belonging (Levidow, 2024). While in Madagascar, agroforestry is known as “the land that lasts” and an ethnographic study showed how agroforestry is deeply connected to community identity and oral history narratives, creating a sense of collective memory, responsibility and belonging (Osterhoudt, 2018).
- increase farmer autonomy, agroforestry reduces dependence on imported goods such as food, fuels, and medicines, which were traditionally provided by highly agrobiodiverse agroforestry systems (Thaman, 2008) and prioritizes local resources and traditional knowledge (Miccolis et al., 2017).
- flexibility and adaptability, agroforestry is flexible and can be designed to match a family's resources, management capacity, and needs (Miccolis et al., 2017).

IV. Challenges for Transitioning to Agroforestry

The challenges and the transition to agroforestry have not been extensively studied academically, however this section outlines the most significant problems in adopting agroforestry, categorized by theme.

- **Structural Land Problems**

One of the most pressing challenges in transitioning to agroforestry is the lack of secure and long-term land tenure, a structural issue faced by many farmers globally, not just those considering agroforestry. In the context of agroforestry, this problem is linked to specific issues, making it a unique challenge. Land access issues limit the willingness and ability to invest in perennials and trees because, as long-term crops, their cultivation is at odds with the uncertainty of land rights (Lawin & Tamini, 2019). Furthermore, even with secure land tenure, limited land ownership often leads farmers to prioritize annual food crops over trees or other commercial crops (Achmad et al., 2022).

- **Regulatory and Market Access Challenges**

The initial costs of establishing agroforestry systems are high, and the return on investment is generally long-term. Even when land tenure is secure, agroforestry practitioners face financial pressures due to the costs of maintenance and expenses associated with agroforestry, while waiting for the perennial plants to mature. This situation often contrasts sharply with market norms, which prioritize short-term economic gains (Hastings et al., 2021). These financial barriers discourage farmers from adopting agroforestry practices, as they prioritize immediate cash returns from conventional crops (FAO, 2013; Simelton et al., 2015). In addition, there is a lack of financial incentives, rural credit, and marketing opportunities specifically tailored to the adoption of agroforestry systems. This underscores the need for more supportive financial mechanisms (Sollen-Norrlin et al., 2020). Agroforestry transitions are further constrained by supply chain limitations and the availability of skilled labour. The ability to pay competitive wages for skilled labour in agroforestry systems is crucial for the success of these transitions (Glover et al., 2013; Lillesø et al., 2018; Pattanayak et al., 2003).

- **Knowledge and Education**

Access to relevant information and guidance is a significant barrier for agroforestry practitioners, who often struggle to obtain the comprehensive resources necessary for successful implementation (Simelton et al., 2015). The erosion of indigenous knowledge and the undervaluation of local agroforestry practices, exacerbated by colonization and the rise of monocrop agriculture, further complicate this issue (Hastings et al., 2021). Formal education plays a critical role in shaping farmers' perceptions and management of agroforestry systems. Farmers with higher levels of formal education tend to have a better understanding and implementation of agroforestry practices, highlighting the need for improved educational opportunities in rural areas (Achmad et al., 2022).

- **Institutional and Political Challenges**

To protect, valorise, and adopt agroforestry systems, it is necessary to develop adequate and specific planning instruments and policies that consider the range of ecosystem services provided by agroforestry, beyond the economic value of agricultural products (Santoro et al., 2022). However, such measures are often lacking, with agroforestry practices frequently falling through the gaps within organizations that separate agriculture and conservation, leading to institutional fragmentation. This fragmentation results in practical hurdles, such as disqualification from agricultural tax exemptions or federal farm benefits due to the ambiguous governmental categorization of agroforestry (Hastings et al., 2021). Moreover, there is often a disconnect between farmers' needs and government priorities, particularly concerning agroforestry adoption. This disconnect leads to limited support from local leaders and policymakers, contributing to the low adoption rates of agroforestry systems despite their potential benefits (Simelton et al., 2015).

- **Cultural Challenges**

Farmers often engage in subsistence agroforestry as part of their economic orientation and cultural identity. Cultural preferences and identities, such as the role of gender in species selection, contribute to the complexity of agroforestry adoption and practice, particularly in societies where traditional farming practices are deeply ingrained (Achmad et al., 2022). Furthermore, following the discourse on development associated with the Green Revolution, agroforestry is sometimes misconsidered as an outdated practice. This misunderstanding leads to resistance from farmers who perceive it as inferior to modern farming methods, creating a barrier to adoption (Sollen-Norrlin et al., 2020).

In conclusion, the challenges associated with agroforestry adoption are intertwined with complex power dynamics and privileges. Who gets the privilege to adopt agroforestry? Access to resources like self-funding, partnerships, and land inheritance significantly facilitates agroforestry adoption (Hastings, Wong, & Ticktin, 2021). Therefore, it is essential to implement structural changes that promote equitable access and participation. Such changes can foster just agroforestry transitions through knowledge co-creation and by addressing the power dynamics and sociopolitical implications inherent in agroforestry adoption.

V. Gap in Agroforestry Research

In this section, I discuss the academic gaps in agroforestry research by highlighting various gaps collected from different papers and summarizing the findings of Hastings et al. (2023), who investigated trends in agroforestry research over the past four decades.

The four-decade literature review by Hastings et al. (2023) highlights a significant shift in the framing of agroforestry research. In the last decade, the focus has moved from development to biodiversity and climate change, with recent years seeing agroforestry increasingly presented as a climate solution. While the academic community has collected substantial data on the ecological and climate benefits of agroforestry, the socio-cultural impacts have been largely overlooked (Franco et al., 2003; McAdam et al., 2009; Pancholi et al., 2023). As discussed in the TAFS section, biocultural traditional knowledge is the least visible and most vulnerable component in agroforestry (Hecht, 2014). Many TAFS worldwide are perfectly adapted to their local environments, yet they are often undocumented and lack scientific validation (Pancholi et al., 2023). This gap is mirrored by the absence of traditional agroecological knowledge connected to agroforestry in the literature, although there have been some mentions in recent years (Hastings et al., 2023). Interestingly, the term "knowledge" has become increasingly popular in agroforestry research, suggesting a growing focus on knowledge transfer and engagement with people involved in agroforestry (Hastings et al., 2023). However, the literature review trends indicate a higher tendency of academic studies to focus on the ecology and management of specific agroforestry practices rather than how these practices impact development outcomes or policy mechanisms (Hastings et al., 2023).

Furthermore, the concept of transition to agroforestry has been under-analysed, presenting an important opportunity to fill the gap and investigate what contributes to socially just transitions to agroforestry (Ollinaho & Kröger, 2021; Hastings et al., 2023). Although we have a solid understanding of the ecological performance of various agroforestry systems, we lack insights into how these systems can be implemented by rural farmers. This gap can only be addressed by incorporating the social justice dimension of agroforestry systems, focusing on equity, intersectionality, and the structural changes necessary for a true transition to agroforestry.

Moreover, participatory and co-production research methodologies have been found to be lacking in agroforestry literature (Hastings et al., 2023). Addressing this gap through participatory research methods would be a significant step forward. However, as Nair (2007) pointed out, agroforestry is generally a long-term process that conflicts with the current academic system's "*publish or perish*" paradigm. The often-short-term nature of agroforestry research and the unrealistic deadlines imposed by institutions compel researchers to produce short-term studies and claims that are not well-suited to agroforestry.

It is evident that there is a significant underrepresentation of social research in the global literature on agroforestry. There is still much to discover, and without this component of research, we can only understand the biological benefits, regeneration, ecosystem services, and climate change adaptation and mitigation. Without the social dimension, we do not know how to implement these transitions equitably, making scaling up difficult. Therefore, it is essential to connect agroecology and agroforestry in this research to provide a reference for how agroecology has addressed scaling up, the social aspects of agroecosystems, and protection against co-optation in recent decades.

c. Agroecology and Agroforestry

In the previous chapters, I outlined the frameworks of both agroforestry and agroecology, providing a comprehensive understanding of each concept's history and principles. This chapter aims to explore the relationship between agroforestry and agroecology, highlighting how they can be integrated, where they diverge in practice, and the broader socio-political context in which they coexist.

Firstly, it is important to recognize that first and second level of agroecological transitions can occur without the inclusion of trees or agroforestry practices (Gliessman, 2018). But the first or second level of transition are not real agroecological transitions; real transitions start at level three with the redesign of agroecosystems, and the redesign of agroecosystems require agroforestry. Agroecology, as both a scientific discipline and a social movement, seeks to transform agricultural systems by reducing external inputs, enhancing biodiversity, and fostering social justice and local knowledge (Wezel et al., 2020). Agroforestry, when implemented according to agroecological principles, can significantly contribute to creating sustainable and resilient agricultural systems based on ecological and social equality. However, it is crucial to recognize that not all agroforestry systems align with agroecological principles.

Existing research and definitions on agroforestry describe current practices without reference to prior land use, meaning that two agroforestry systems could appear identical, yet their establishment could cause opposite climate and ecological impacts (Terasaki Hart et al., 2023). As Ollinaho and Kröger (2021) demonstrate, agroforestry practices can vary significantly in their ecological and social justice outcomes, which they categorize into "good," "bad," and "ugly" agroforestry practices. Good agroforestry promotes decentralized production, empowers farmers, and aligns closely with agroecological principles, contributing to environmental sustainability and social equity. For example, the MST (*Movimiento dos Trabalhadores Rurais Sem Terra*) in Brazil practices agroforestry to achieve farmer autonomy and appropriates agroforestry as a social, cultural, and economic means to construct alternative social markets (Hashimoto Iha, 2018). Conversely, bad and ugly agroforestry practices often reinforce existing inequalities and contribute to environmental degradation, even as they are promoted under the guise of agroforestry. For instance, industrial-scale operations with limited intercropping or crop rotation ("bad agroforestry"), where timber emerges as the predominant product, exacerbate land and income concentration dynamics and contribute to the degradation of natural ecosystems (Ollinaho & Kröger, 2021). An example of this is "*agrobizforestry*" in Côte d'Ivoire, characterized by high-rate monoculture agroforestry plantations granted by the state to large multinational companies. This model excludes farmers from forestry profits and continues to operate under a post-colonial logic of economic exploitation for the benefit of the state and private companies, allowing the entry of agribusinesses (Dieng & Karsenty, 2023). Under the "ugly" category, there are all practices involving the clearance of primary forests to establish planted forests, resulting in the conversion of primary or secondary forest ecosystems into mixed landscapes comprising various productive species like coffee, banana, and eucalyptus, or oil palm monocultures, often through the displacement of local communities and ecosystem degradation (Ollinaho & Kröger, 2021). Sometimes, carbon storage programs fall under this mechanism (Carbon Trade Watch, 2013).

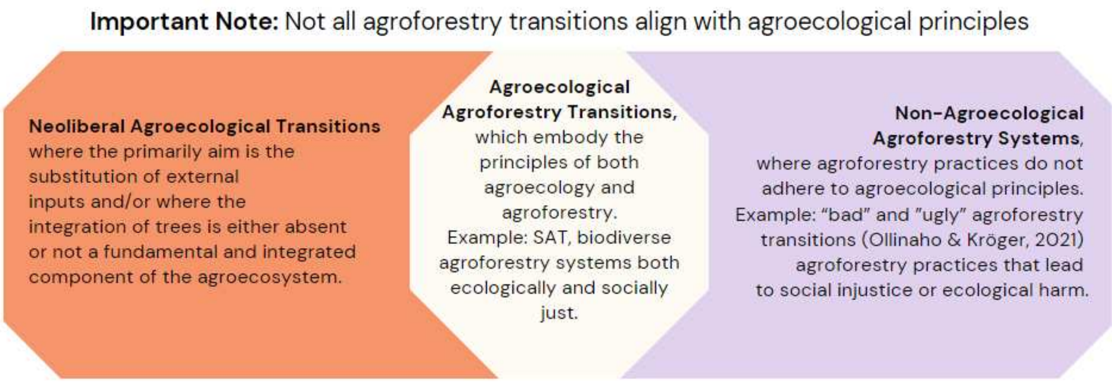


Figure 1, Different Pathways of Agroecological and Agroforestry Transitions. This diagram illustrates the spectrum of various trajectories that agro-transitions can take, highlighting the distinctions between agroecological transitions with no tree integration, the opposite as non-agroecological agroforestry systems and the connection of agroforestry and agroecology in the middle, resulting in socially and ecologically just agroecological agroforestry transitions. It *underscores the critical point that not all agroforestry practices align with agroecological principles, emphasizing the importance of integrating social and ecological justice in these transitions. Created by author with Canva.*

Figure 1 reflects this diversity within agroforestry and agroecological practices, showing a spectrum ranging from non-agroecological to agroecological systems. The good agroforestry practices are those that adhere closely to the values of agroecology, integrating complex, biodiverse, and socially just systems. These systems replace external inputs with natural processes and emphasize the role of local knowledge and community control, thereby contributing to what Loring (2023) calls the "*broader paradigm shift in food systems*":

> "*The existing, industrial paradigm for designing food systems is attuned largely to the material aspects of our food systems: how much each practice produces, how much carbon they sequester, how profitable they can be, etc. The emerging paradigm, however, is elevating the organizational aspects of our food systems: who is in control of these solutions, how much capital do they enclose or emancipate, and whether they leave space for cultural pluralism and self-determination*" (Loring, 2023, p.2).

Agroecology, particularly in its most emancipatory form, is a key part of this paradigm change (Giraldo & Rosset, 2023). However, the transformative potential of agroecology is always under threat from co-optation dynamics by powerful institutions and corporations, as noted by Giraldo and Rosset (2018). They argue that the institutionalization of agroecology, since 2014, has led to attempts to dilute its radical, political roots. This co-optation risks reducing agroecology to a technocentric approach focused on production and innovation, stripping it of its connection to social movements and people's struggles (Alonso-Fradejas et al., 2020; Giraldo & Rosset, 2018). A similar co-optation process is occurring within agroforestry when it is viewed merely as another technological practice toward financialization and production without addressing its traditional, cultural, social, and political ecology dynamics. As Ollinaho and Kröger (2021) suggest, the focus on agroforestry transitions must expand beyond farm-level technical studies to include broader political and economic aspects, such as socio-ecological sustainability and equity. Analysing agroforestry transitions within the global food system framework reveals the power dynamics at play and helps identify which transitions truly advance ecological and social justice. By understanding and integrating the principles of both agroecology and agroforestry while remaining vigilant to the risks of co-optation, we can work towards creating agricultural landscapes that are ecologically balanced, socially just, and economically sustainable. This holistic approach is crucial for addressing the challenges of food security, climate change, and environmental degradation in this "*civilizational multidimensional crisis*"[3] we are living in (Lander, 2020). Moreover, as we embark on this journey, it is essential to remember that the framing of our food systems will ultimately shape their outcomes. By adopting a framework that prioritizes diversity, equity, and sustainability, we can contribute to the ongoing paradigm shift towards more just and resilient food systems.

[3] '*It is a multiform, multidimensional crisis of a civilisational pattern that in synthetic terms can be characterised as anthropocentric, patriarchal, colonial, classist, racist, and whose hegemonic patterns of knowledge, science and technology, far from offering solutions to this civilisational crisis, contribute to deepening it. These various dimensions of the hegemonic civilisational pattern are by no means independent of each other. On the contrary, they feed on and reinforce each other. The anthropocentric and patriarchal dogmas of progress and development, the fantasies of the possibility of endless growth on a limited planet, are rapidly undermining the conditions that make the reproduction of life on planet Earth possible'*. (Lander, 2020, p.14)'

4. Methodology

This research employs a mixed-methods approach, integrating both qualitative and quantitative techniques. The methodological framework is based on the Tool for Agroecology Performance Evaluation (TAPE) developed by the Food and Agriculture Organization (FAO, 2019). To enhance and complement this quantitative framework, ethnographic methods were utilized to identify and analyse agroecological transitions and social factors within campesino communities. These methods include participant observation, semi-structured interviews as outlined in the Contextual Agroecological Evaluation Tool (CAET) from TAPE and walking interviews.

Since I spent three months in Santuario municipality (Antioquia, CO) for my internship practice, I decided to undertake my research in the Oriente Antioquia region, focusing on the municipalities of Santuario and Carmen del Viboral. Interview participants were purposively selected from the *campesinos* and *campesinas* known in the organic markets of the two municipalities who agreed to be interviewed, leading me to conduct research on eight case studies of agroecological transitions. Two of these case studies involve agroecological transitions that employ agroforestry systems for the regeneration of degraded farmlands, while the other six involve agroecological transitions that have, to varying degrees, incorporated relationships with trees and buffer zones, but do not have structured agroforestry systems. The fieldwork was conducted between February and May 2024 in the municipalities of Santuario and Carmen del Viboral. Following the fieldwork, data was systematized from June to August 2024.

I learned about the FAO's TAPE (Tool for Agroecology Performance Evaluation) methodology through my advisor. Since TAPE has only been applied twice in Colombia (Barrios Latorre et al., 2023; Castañeda Casas, 2024) and neither instance was in the Antioquia region, I considered it timely to test this methodology in an exploratory pilot study involving eight case studies in this area. As the first study of its kind in the region, this research can be considered a pivotal test, essential for understanding the capabilities and potential limitations of TAPE in this context. While TAPE has been used for assessments with some published results, there is limited literature on experiences from its application or critical evaluations of it (Namirembe et al., 2022). I focused exclusively on the Contextual Agroecological Evaluation Tool (CAET) rather than the entire TAPE evaluation process for several reasons:

1. **Time Constraints**: Balancing the internship and research was challenging, so I decided to concentrate solely on the evaluation process of agroecological transitions, allowing for a more in-depth examination. The research focuses on the transition and how agroforestry transitions differ from agroecological transitions, evaluating CAET method and agroecological transitions more specifically and critically.

2. **Technical Access Issues**: TAPE is combined with the Kobo Toolbox application, allowing the contextualization of questions in collaboration with the FAO team for part 1 and 2. However, despite contacting the FAO, I was not granted access to Kobo and the necessary tools and programs that would have expedited data management for a potential phase 2.

3. **Familiarity with *Campesinos* and Sensitive Topics**: As shown by other studies within the limited literature on the application of TAPE (López-Rojas et al., 2024; Martina Veneri, 2022), these studies left phase 2 incomplete due to the sensitive and challenging topics it addresses, such as economic issues. Furthermore, although FAO (2019) suggests that it takes between 1 to 4 hours to complete phases 1 and 2 of the interviews, I believe more time is required to administer the entire questionnaire and to build sufficient trust with the campesinos to obtain truthful and comparable responses useful for the research (López-Rojas et al., 2024). Personally, I did not feel in a position to ask highly specific questions about economic matters.

a. Data Collection

Therefore, data collection is based on phase 0 and phase 1 of TAPE methodology, complemented by qualitative participant observation and walking interviews. Interviews with *campesinos* and *campesinas* typically lasted between three and six hours and were always conducted at the interviewees' farms. Each meeting was divided into three parts: first, interviews typically commenced at the farmer's home, on the porch outside, with an explanation of the research purpose and how the farmers' responses could contribute to the study. Next, a walking interview was conducted, involving a general presentation of the interviewee's history, spaces, and agroecosystem, with a focus on agroecological transition. Walking interviews, unlike sedentary interviews, generate spatially specific narratives providing detailed insights into the agroecosystem and emphasizing the importance of environmental elements within the narrative (Evans & Jones, 2011). After the agroecosystem tour, I administered the semi-structured CAET interview (Annex 1) to the farmers, slightly modifying the language to ensure it was familiar to both the interviewee and the interviewer. Additional specific questions regarding the number of trees, environmental challenges, and climate change were also included (Annex 1). The integration of quantitative data from the CAET tool and qualitative data from walking interviews and observations is crucial for this research. For instance, while quantitative scores from CAET provide a measurable indicator of the agroecological transition, qualitative data offers insights into the underlying reasons and contextual factors influencing these scores. For example, if a farm scores low on "resilience", qualitative interviews can reveal if this is due to market access issues, climatic challenges, or socio-cultural factors. Another example, conducting the walking interview before the sedentary interview proved useful for assessing CAET practices, such as vegetative cover. This approach highlighted the difference between the campesino and campesinas' perception and the actual amount of vegetative cover, which was sometimes overestimated and other times underestimated. The only exception to this procedure was with Tierra Yai case study, where I simply administered the questionnaire. Having worked for three months in this agroecosystem, I already possessed a thorough understanding of the space and detailed place narratives (Annex 2). Moreover, throughout my stay, I took notes on insights relevant to the aim of this research, such as farmers' problems related to climate change, general issues of farmers in the region, and approaches to tree management. I also participated in meetings with campesinos and campesinas in the municipality of Santuario (Annex 3) and kept a diary recording my experiences, including informal conversations and hands-on tasks.

b. Tool for Agroecology Performance Evaluation (TAPE) methodology

Three main events shaped the development of TAPE as a methodology. First, on December 14-15, 2017, a methodological construction workshop on agroecology was held (GTAE, 2018). This workshop highlighted that while there are many existing methodologies to evaluate agroecology, they are not comparable, necessitating unified criteria to allow for comparisons of agroecosystems. Despite substantial evidence demonstrating the positive impact of agroecology, results remain fragmented due to heterogeneous methods and data (GTAE, 2018). A year later, the 2nd International Symposium on Agroecology in 2018 marked a paradigm shift from dialogue to action on scaling up agroecology, alongside the 26th Committee on Agriculture, this led to a call for standardized tools and protocols to evaluate agroecology (FAO, 2018a).

Following this trajectory, the FAO led the development of the Tool for Agroecology Performance Evaluation (TAPE) through a comprehensive and collaborative process, involving over 2,100 participants from 170 countries (FAO, 2019). This process included reviewing existing frameworks, conducting internal consultations, and engaging over 450 participants over four months (Mottet et al., 2020). An international expert workshop in Rome in October 2018 further refined the draft indicators and a Technical Working Group then developed a draft analytical framework, which was tested in case studies. Finally, regional workshops were conducted to build capacity and finalize the framework and an online data collection tool (FAO, 2019).

TAPE is a methodology based on five steps (0, 1, optional 1-bis, 2, 3) to assess the multidimensional performance of agroecology. The foundational concept is that agroecological transition is a complex dynamic, intertwined with social, cultural, and territorial dynamics. Therefore, it must be articulated at the levels of farm, community, and territory (FAO, 2019; GTAE, 2018). TAPE converges multiple evaluations of interrelated factors, primarily based on the 10 elements of agroecology proposed by the FAO (FAO, 2018b) and the SDGs. These elements provide a multidimensional approach consistent with the agroecological proposal.

In this thesis, I will use steps 0 and 1 of TAPE. Step 0 involves a general description of the main characteristics and socio-economic, environmental, and demographic contexts of the agroecosystems, and the context in which they operate. This includes a description at the local/regional scale of relevant policies, legal frameworks, and socio-cultural, historical, and environmental drivers that could influence agroecological transitions. This step is carried out through a literature review and meetings with campesinos, community leaders, and individual case study households.
Step 1, the Characterization of the Agroecological Transition (CAET), aims to understand the advancement of the agroecosystem in its agroecological transition. It covers the 10 elements of agroecology (FAO, 2018b), disaggregated into 36 descriptive indexes to encompass all facets of each element. For example, element 5, "Resilience", is subdivided into four indexes: "stability of income/production and capacity to recover from perturbations", "mechanisms to reduce vulnerability", "indebtedness", and "diversity of activities, products, and services, covering economic, social, and ecological resilience".

Each index is evaluated using a modified Likert scale, a descriptive scale with five levels of transition (scores from 0 to 4), which are used to calculate the percentage of agroecological transition for each element. This provides a global overview, highlighting the strengths and weaknesses of each agroecosystem and their correlations (FAO, 2019). The overall score of transition (CAET) is derived from the percentage of each element, categorized as follows: score > 70% as "advanced in agroecological transition", score between 60–70% as "in transition to agroecology", score between 50–60% as "incipient agroecological transition", score < 50% as "non-agroecological" (Mottet et al., 2020). Applying different weights to indices of Step 1 CAET, either doubled or halved depending on their perceived importance, is a possibility to better fit the local context based on knowledge of the territories and producers (Lucantoni et al., 2022). In this thesis, I did not apply different weights to maintain the standard application of TAPE. Finally, for this step, the information is graphically represented in an AMOEBA diagram to provide a comprehensive view of the objectives met for each indicator and each agroecosystem.

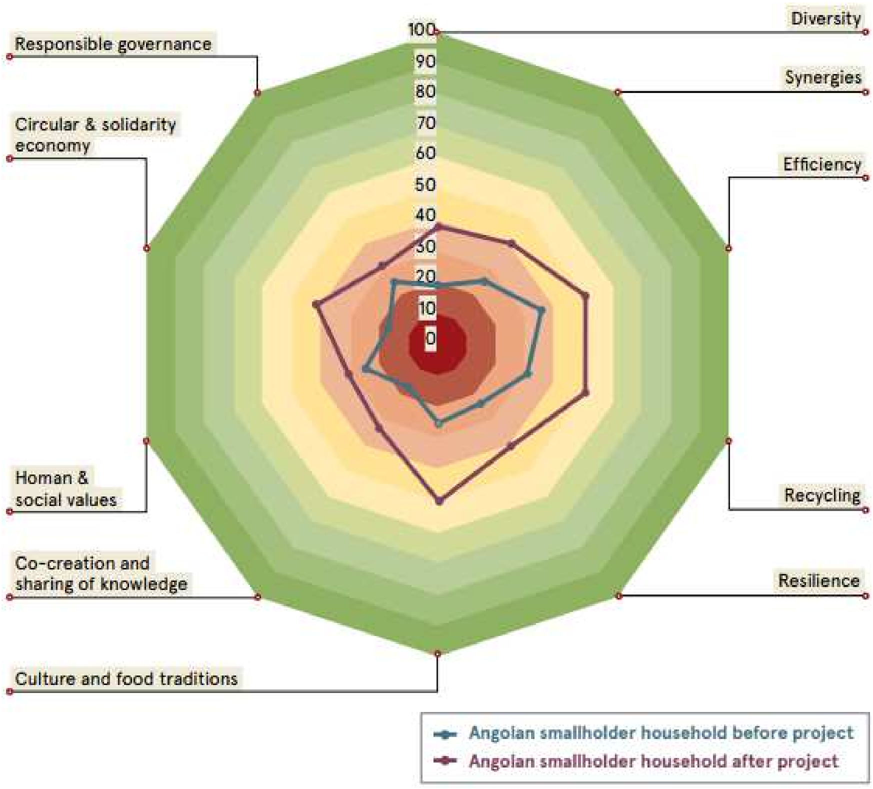


Figure 2, example of AMOEBA diagram from FAO (2019, p.20): "Visualization of the results of the CAET for a vulnerable smallholder farm in a degraded agricultural area of Central Angola."

c. Ethical Considerations

Ethical considerations were a key part of this research. All participants were provided with detailed information about the study's purpose and methods, and their informed consent was obtained prior to data collection. To ensure confidentiality, participants' identities have been anonymized, except for the names from Tierra Yai, who explicitly requested to be acknowledged in the thesis as my internship tutors. The study also addressed ethical challenges, such as the sensitivity of economic questions, by allowing participants to skip any questions they were uncomfortable with and ensuring that interviews were conducted in a respectful and non-intrusive manner.

5. Delimitations, Limitations, Assumptions

One potential limitation of this study is the selection of interview participants, which might introduce selection bias. To mitigate this, efforts were made to include a diverse range of *campesinos* and *campesinas* from different socio-economic backgrounds and with varying degrees of agroecological transition. Additionally, conducting research in a limited geographic area (Santuario and Carmen del Viboral) limits the generalizability of the findings, which are therefore not meant to be generalized. Challenges in data collection included language barriers, such as understanding the slang used by older *campesinos*, and the reluctance of participants to discuss sensitive topics. Addressing this reluctance is crucial as researchers must avoid neo-colonial patterns or extractivism dynamics, even with immaterial things like information and knowledge (Burman, 2018; Gorman, 2024). Accepting boundaries and being sensitive to social relationships and emotions that arise is an important part of social research (Parvez, 2018).

This study is undoubtedly a pilot process with numerous deficiencies. Firstly, it requires a significantly larger number of cases, ideally focusing on all farms in the municipalities of Santuario and Carmen del Viboral, or the entire region of Oriente Antioqueño. The study should also encompass the complete TAPE process, including steps 2 and 3, to enable comparison of results with other regions worldwide that have already been examined using this methodology (Barrios Latorre et al., 2023; Castañeda Casas, 2024; Lucantoni et al., 2023; Mottet et al., 2020; Wordofa et al., 2024). However, due to time constraints, I focused solely on step 1 and selected case studies, adding in-depth narratives. Although the sample size is inadequate, the aim of the research is not to generalize data for the region but to conduct a pilot process, provide insights into the region, and examine specific case studies. This approach seeks to introduce these themes into research, addressing the significant gap in the study of agroforestry transitions and the limited critical analysis and application of the TAPE methodology. To compensate, I adopted a narrative and ethnographic approach, offering deeper insights into the actual history of agroecological transitions within the case studies, and providing a sociological snapshot of the rural lifestyle in the municipalities of Santuario and Carmen del Viboral.

Time constraints and logistical challenges were largely beyond my control. The lack of personal transportation and the need to navigate between the rural areas of the two municipalities took longer and was more time-consuming than anticipated. While the

FAO suggested interviews should last a maximum of one hour, I often invested an entire day, including travel, with interviews lasting a minimum of three hours and sometimes requiring multiple sessions to ensure detailed data collection. This time investment, however, gave me a deeper understanding of the mobility issues faced by the local population, as 7 out of 8 participants did not own private transportation to sell their products. Additionally, spending more time with the campesinos allowed me to explore their social dynamics and environmental challenges more comprehensively, which will be discussed in the results section.

Another factor beyond my control was the social dynamic. For instance, I had more time and case studies with men, as they typically had more availability and willingness to converse, not being burdened with both work and caregiving responsibilities. For example, in Santuario, I had another potential case study beyond the eight considered, but I could not conduct an interview because the participant was a woman in a restrictive, patriarchal relationship, preventing her from accommodating me for a walking interview. These social factors, influenced by the structural and systemic condition of patriarchy, were research limitations that I could not control, resulting in data loss but providing valuable insights into the social conditions affecting women.

6. TAPE Step 0 - Description of contextual factors of the territory

a. Colombian Framework

The Colombian political and social rural situation is a puzzling case that is complex to reconstruct. Focusing on agroecology, I will cover in this part the rural situation and the recent rural policy change resulted from the peace negotiation by the Colombian government and the FARC (Revolutionary Armed Forces of Colombia).

I. Rural Colombia: Conflicts, Inequalities, Policies, and Agroecology

Colombia's significant food imports each year to meet domestic demand highlight the country's loss of food sovereignty, a trend common in Latin America (OXFAM, 2017). This issue is exacerbated in Colombia due to the violent displacement of small farmers and land inequalities. Extensive literature focuses on the inequality of land distribution in Colombia, as it is one of the most unequal in the world (Duque et al., 2023). The most recent data on land inequality in Colombia have been collected and systematized by Instituto Geografico Augustin Codazzi (IGAC, 2023). According to the IGAC data, 65.8% of rural properties are categorized as micro-plots, 17.1% as mini-plots, 6.6% as small properties, 9.7% as medium properties, and only 0.8% as large estates. This data shows a predominance of micro and mini plots (respectively 65.8% and 17.1% of rural properties), but their representation in terms of total area is minimal (micro plots only represent 4% of the total rural area, while mini plots occupy 7% of it), suggesting an unequal territorial distribution. On the other hand, larger estates hold 44% of the rural private property area in Colombia. This disproportion is well represented by the Gini coefficient for land distribution, estimated at 0.89, meaning that 1% of national owners of rural properties hold 49.8% of the total rural area, corresponding to 24.783.413 hectares out of the total 49.718.778 hectares (IGAC, 2023).

Precedent data about land inequalities distinguish the use of those lands, pointing out that most of the rural Colombian lands (34.4 million hectares, 80%) are dedicated to livestock, even though it has been estimated that there are just 15 million hectares suitable for this activity in all of Colombia (OXFAM, 2017). Regarding the last 20% of productive rural lands used for crop farming, 35.4% (3 million hectares) are dedicated to the production of agro-industrial crops, mainly coffee, oil palm, and sugarcane (OXFAM, 2017). This land inequality is critical for food sovereignty as small farmers are the ones who maintain food sovereignty in the country, as small farms usually allocate more than 60% of their land to agricultural production, primarily for self-consumption, while large estates usually use their land for livestock and export production (OXFAM, 2017).

This land inequality has a history as agricultural policies have been biased against peasants, favouring large landowners, who had political influence, excluding rural communities from land access, and promoting an agricultural development that seeks to keep yields at significant levels, centralizing production processes. All of which has particularly intensified the armed conflict in terms of deaths, displacement, and dispossession of *campesinos* and *campesinas* (García Trujillo, 2022; Mateus Moreno, 2016). Specifically, among the victims of the conflict whose occupations are known, six out of ten were *campesinos* (Grupo de Memoria Historica, 2013). Moreover, the extortion, forced disappearances, threats, and sexual violence in the rural areas forced *campesinos* to abandon their lands. This strategy, perpetrated by paramilitaries, has been the most used method for the occupation of territories, reaching 8.3 million hectares dispossessed or forcibly abandoned (Grupo de Memoria Historica, 2013). The lack of an inclusive agrarian policy that addressed land access for peasants, forced displacement, and the growth of agro-industries has had historical consequences for the loss of food sovereignty (Mateus Moreno, 2016).

Recently, history has tried to change these decades-long patterns. Between 2012 and 2016, peace negotiations were held in Havana, and the Santos government and the FARC signed the Final Peace Agreement on September 26, 2016. By decision of the parties, it was subjected to a plebiscite on October 2, 2016, which was slightly rejected with 50.21% of the votes (García Trujillo, 2022). But the week after the plebiscite, what Pastrana Buelvas & Valdivieso (2023) called the "Colombian spring" began, where Colombians, including diversified social groups like students, victim groups, religious organizations, ordinary citizens, and unions, occupied the streets to demand renegotiation for peace. After some modifications, the parties signed a new agreement on November 24, 2016, which was directly submitted and ratified by the Congress.

The Peace Agreement is studied as one of the most precise and comprehensive peace agreements in the world as it creates various precise state obligations (García Trujillo, 2022). Regarding agriculture, the first call in the document is for an Integral Agrarian Reform (Reforma Rural Integral - RRI) and investments in rural areas, especially for marginalized and historically neglected areas (Gobierno de la República de Colombia &

Fuerzas Armadas Revolucionarias de Colombia Ejército del Pueblo, 2016). The first pillar of RRI is land access to help solve inequality in Colombia:

> "*With the purpose of achieving the democratization of land access, benefiting campesinos and especially landless campesinas or those with insufficient land, and the rural communities most affected by poverty, neglect, and conflict, by regularizing property rights and consequently decentralizing and promoting an equitable distribution of land, the National Government will create a Land Fund for free distribution*." (Gobierno de la República de Colombia & Fuerzas Armadas Revolucionarias de Colombia Ejército del Pueblo, 2016)

The Peace Agreement set a goal to allocate 3 million hectares with "*acceso integral*" to peasants without material access to land, obliging the state not only to allocate lands but also provide basic goods and supports to ensure that the land will be productive. The agreement continues from 1.1.1 to 1.3.4 with a list of comprehensive agreements covering beneficiaries, priority criteria, time indications, and state obligations that cover various themes related to rurality, from rural education to rural infrastructure and connectivity, from solidarity and cooperative economy to gender equality (Gobierno de la República de Colombia & Fuerzas Armadas Revolucionarias de Colombia Ejército del Pueblo, 2016, p.14-34).

Since the signing of the Peace Agreement in 2016, several resolutions, plans, and laws have been approved for the implementation of the first point of the agreement, aiming to establish a Rural Reform that involves agroecology.

Agroecology in Colombia developed in the decades of the 1970s and 1980s, driven by increasing environmental awareness against the damaging effects of the Green Revolution (T. León-Sicard et al., 2017). The movement initially emerged as a social movement and a set of practices, and later it was incorporated into academic spaces and universities (FAO, 2021). One of the most important agroecological processes in Colombia is the creation of Peasant Schools and Schools of Rural Promoters, which are bottom-up, non-formal educational strategies carried out by farmers for farmers to help develop and expand campesinos' agroecological knowledge and practices (T. León-Sicard et al., 2017).

As previously discussed, the conflict has had a significant impact on rural communities, which saw agroecology as a means of survival through the feminization and reorganization of family and community campesino agriculture (ACFC - Agricultura Campesina Familiar Comunitaria) (FAO, 2021). *Campesinas* have been the most affected and deprived by the armed conflict (Grupo de Memoria Historica, 2013). Rural groups of women used agroecology as a form of survival and a practical alternative to improve and resist, such as the *Vamos Mujer* project in Antioquia, which aims to improve the quality of life of women through agroecological production (Berrío Ramírez et al., 2009). Therefore, agroecology in Colombia not only fulfills productive and ecological functions but has also served a historical purpose in the conflict, strengthening family agriculture and preserving campesino culture (Acevedo Osorio, 2018). Acknowledging the historical importance of bottom-up social processes in Colombia, agroecology holds the potential to be the future for *campesinos* in the post-conflict present and future, thanks to its political and social implications: "*Agroecology is not merely an agricultural alternative; it is an ethical-political proposal to confront capitalism, to rebuild the social fabric broken by decades of violent de-peasantization through the formation of counter-hegemonic agro-food networks*" (Russi et al., 2020, p.12). This connection between agroecology as a social movement and practice, and its role in the post-conflict present and future in Colombia, is well represented by the "Bosque de Paz" program. The main objective of this program, approved in 2017, is to restore areas affected by the armed conflict through reforestation and conservation of forests, and the promotion of agroecological practices that integrate agricultural and forestry production, contributing to food security, biodiversity conservation, and social reconciliation (Ministerio de Ambiente y Desarollo Sostenible, 2017).

In the same year, the Technical Table for Family Agriculture was established to discuss how to create a participatory law for Family Agriculture. As a result, more than 18 working sessions, a national workshop, and six territorial meetings were held with the participation of over 350 people from local governments, social organizations of campesinos, indigenous and Afro-descendant communities, academia, international cooperation, and NGOs (Vivas García & Acevedo Osorio, 2023). This participatory process led to the creation of Resolution 464 - 2017 from the Ministry of Agriculture and Rural Development, which focuses on strategies for the strengthening and protection of ACFC, highlighting the important role of agroecology. Specifically, the document presents agroecology in strategic axes 5 and 6, respectively, the promotion of agroecological practices and knowledge, and the promotion of agroecological practices in areas of special environmental significance, discussing agroecology as a central piece in public policy for ACFC in Colombia, integrating science, sustainable practices, and a social movement to achieve a fairer, more sustainable, and resilient agriculture (Ministerio de Agricultura y Desarrollo Rural, 2017).

However, despite the comprehensive set of agreements in the peace agreements and ACFC policies, during the presidency of Iván Duque from 2018 to 2022, the transitional justice system and the rural integral reform were criticized and effectively abandoned the peacebuilding agenda (García Trujillo, 2022). The direct consequence was that violence increased again, as the de-armed FARC caused a power vacuum in various territories which, without state support, started to be controlled by other armed groups (Ejército de Liberación Nacional ELN, Grupos Armados Organizados GAO, Grupos Armados Organizados Residuales GAOR) (Pastrana Buelvas & Valdivieso Collazos, 2023).

With the election of Gustavo Petro in 2022, the first leftist president in the history of Colombia, the window for rural reform and peace agreements reopened:

> "*The peace agreement with the FARC was not fulfilled after signing. No three million hectares have been delivered, nor have seven million hectares been titled, and it has been exactly five, six, seven years since the signing of the agreements that had a planned period. I ask the Minister of Agriculture and the Government present here to hold the land meeting*." (Presidencia de la República de Colombia, 2023).

To this end, the Colombian government passed the so-called "Total Peace policy" in November 2022, through Law 2272 of 2022, which extended and modified Law 418 of 1997, defining peace policy as a state policy. Total Peace Policy advances negotiations with the ELN and specifically forecasts advancing the implementation of the Peace Agreement with the former FARC-EP, with a special emphasis on rural reforms and dialogues towards peace agreements with other armed groups, including the ELN (Botero et al., 2023; Pastrana Buelvas & Valdivieso Collazos, 2023). Moreover, in the National Development Plan (NDP) 2022-2026 (Departamento Nacional de Planeación - DNP, 2023) there is a clear statement to implement the Total Peace policy, including the rural integral reform. In the plan, agroecology is incorporated, stating that:

- "*The agroecology law will be adopted to transition from conventional agriculture to agroecological production to increase soil productivity, reduce environmental degradation, and increase climate resilience*" (DNP, 2023, p. 201).
- "*There will be incentives and direct support for associated young campesinos, agricultural and/or fishing producers, such as land titling, technological innovation, promotion of agroecology, generation of production circuits and chains, among others, within the framework of rural policy*" (DNP, 2023, p. 332).
- "*The practice of agroecology will be encouraged based on traditional knowledge and in coordination with the Public Agricultural Extension Service; as well as fishing and aquaculture, as sources of development and decent employment*" (DNP, 2023, p. 348).

The first significant legislative step forward through the construction of the cited NDP 2022-2026 Agroecology Law is Resolution 1 of 2023, which modifies Article 65 of the Constitution to expressly recognize campesinos as subjects of special constitutional protection, with their particular relationship with the land, food sovereignty, campesino territoriality, and cultural distinctions from other social groups. This resolution is cited as the basis for the recent development of the agroecological law proposal, aimed at promoting agroecology and creating a technical table to formulate a National Agroecology Plan (PNA), which will define the guidelines to foster and support agroecological practice nationwide. The bill was presented in 2022, and now, in 2024, we are currently in the post-presentation phase for the second debate. The latest amendments prioritize the National Agroecology Plan with a focus on food sovereignty, strengthening local food systems, biodiversity conservation, and promoting family and community agriculture (Senado de la República de Colombia, 2024).

Even though the agroecology law is being discussed, there is still much work to do to reform the Colombian rural world and pass the integral rural reform, as the president of FENSUAGRO (Federación Nacional Sindical Unitaria Agropecuaria) said within the international conference of La Via Campesina 2023, held in Bogotá:

> "*The president talks about food sovereignty and agrarian reform, but as we have said, the Colombian Congress is not strong enough in favour of this government to pass an integral agrarian reform law like the one we propose. At this time, the instruments in force are the National Agrarian Reform System, which is related*

to Law No. 160, adopted in 1994; and the Peace Agreement, signed in 2016. That is what is being done” (Martínez Nury in LVC, 2023).

There is therefore a problem in the government coalition that includes both reformist elements and traditional political figures who resist significant changes to the social, political, and economic structures that support their power. This hampers the government's ability to push through integral reforms. Moreover, the unexpected departure of Cecilia López, the minister responsible for rural reform, in early 2023, created uncertainty about the future of the policy (Botero et al., 2023).

Year	Number	Description
1994	Law 139	Establishes the Forest Incentive Certificate (Certificado de Incentivo Forestal - CIF), providing up to 50% of planting and maintenance costs for reforestation. Initially managed by various entities, now administered by FINAGRO.
2010	Decree 2372	Regulates the registration of private properties with forests or agroforestry as natural reserves within the National System of Protected Areas (SINAP).
2016	C.E. 2323	**Final Peace Agreement**: Signed between the Santos government and the FARC on September 26, 2016, and ratified by Congress on November 24, 2016. Includes the Integral Agrarian Reform (Reforma Rural Integral - RRI) to address rural inequality and transform the countryside through land redistribution and state obligations for rural development (Gobierno de la República de Colombia & Fuerzas Armadas Revolucionarias de Colombia Ejército del Pueblo, 2016).
2017	Resolution 464	Establishes public policy guidelines for Peasant, Family, and Community Agriculture (ACFC), emphasizing the promotion of agroecological practices as a strategic axis in rural development (Ministerio de Agricultura y Desarrollo Rural, 2017).
2017	Resolution 470	**Bosque de Paz Program**: Aims to restore areas affected by armed conflict through reforestation, forest conservation, and promoting agroecological practices to enhance food security and generate income (Ministerio de Ambiente y Desarrollo Sostenible, 2017).
2022	National Development Plan 2022-2026	Incorporates agroecology, outlining objectives to adopt agroecology law for transitioning from conventional to agroecological production, provide incentives to young campesinos, and encourage agroecological practices based on traditional knowledge (Departamento Nacional de Planeación - DNP, 2023).
2023	Resolution 1	Amends Article 65 of the Constitution to recognize campesinos as subjects of special constitutional protection, focusing on

	their relationship with land, food sovereignty, and cultural distinctions (Senado de la República de Colombia, 2024).
N.D. /	**Agroecology Law Proposal**: A bill still under consideration, including the **National Agroecology Plan (PNA)** to prioritize food sovereignty, local food systems, biodiversity conservation, and support for family and community agriculture. The bill is currently in the post-presentation phase for the second debate (Senado de la República de Colombia, 2024).

Table 1. Summary of Laws, resolutions and decrees connected to agroecology, agroforestry, campesinado and RRI in Colombia. Elaboration by author.

II. Antioquia and Oriente: Overview of Colombia's Most Rural Region

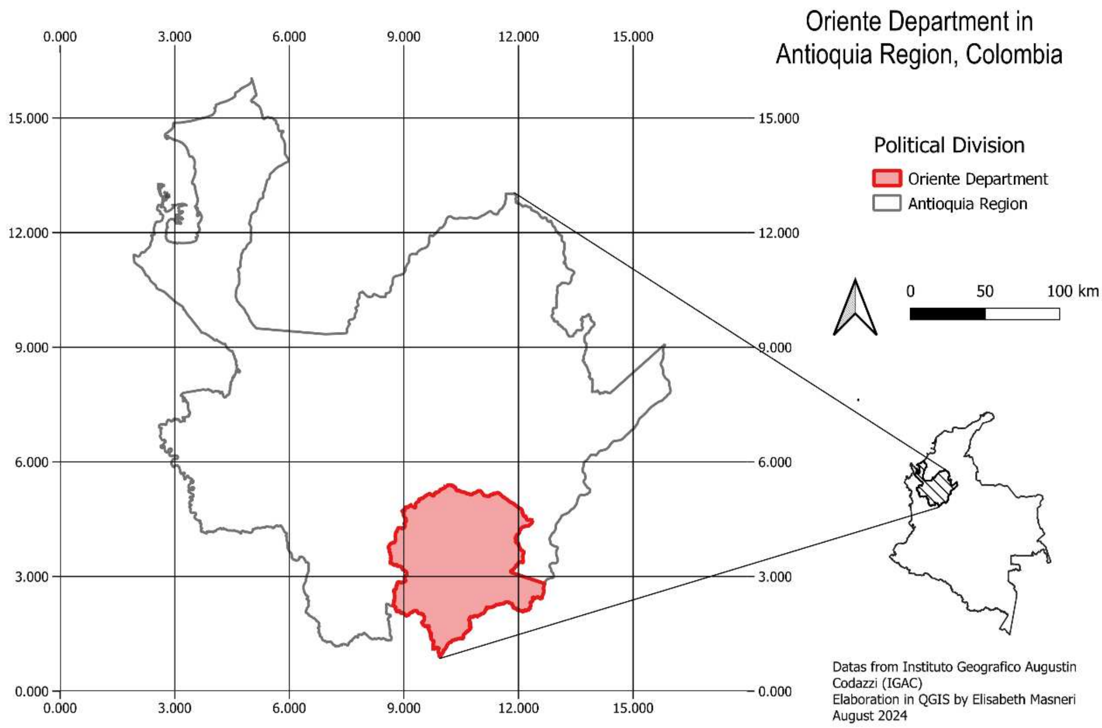


Figure 3, Geographical location of the Antioquia region and the Oriente department, Colombia. Source: author's elaboration in QGIS.

Antioquia, the region with the largest rural population in Colombia, accounts for 11.83% of the national rural population (DANE, 2020). It also holds the highest number of registered rural properties in the country, with 341,168 properties, representing 9.41% of the national total. Notably, 80% of these properties are classified as microplots, characterized by a high degree of fragmentation (IGAC, 2023). The Gini coefficient for Antioquia is the highest among all regions in Colombia, standing at 0.87. This indicates that the top decile of landowners possesses 7.96 times the area they would have if the land were distributed equitably among all property owners in the department (IGAC, 2023). Antioquia is also notable for having the highest number of cattle and ranks second in flower production (OECD, 2015). Thus, the region maintains a strong agrarian tradition while simultaneously experiencing the intensification of the Green Revolution and the neoliberal model. This duality is evident in the significant output of flowers and livestock. Moreover, Antioquia, particularly in the Oriente department, where the two municipalities of the case studies are located, is one of the areas in Colombia where conflict has been particularly intense. This region has seen systematic violence from armed actors, with massacres, threats, forced displacements and selective assassinations (Rojas Pérez, 2020). The intensification of the neoliberal model, armed conflict, and rural depopulation are all factors that devastate the local agrarian economy and reduce the rural population in Oriente, adversely affecting the social and cultural fabric of the campesino communities (Pérez Fonseca, 2014). In eastern Antioquia, this does not necessarily mean that agricultural production has decreased. As detailed in the study by Bastidas Marulanda (2022), while the area devoted to food agriculture declined between 1960 and 2014, there has been a shift towards the production of flowers and foliage. Oriente accounts for 32% of the department's flower production and Carmen de Viboral, contributing 54% in production of the region, is the most representative municipality of this shift from food sovereignty and self-consumption to neoliberal export-oriented agribusiness (Bastidas Marulanda, 2022).

III. Santuario

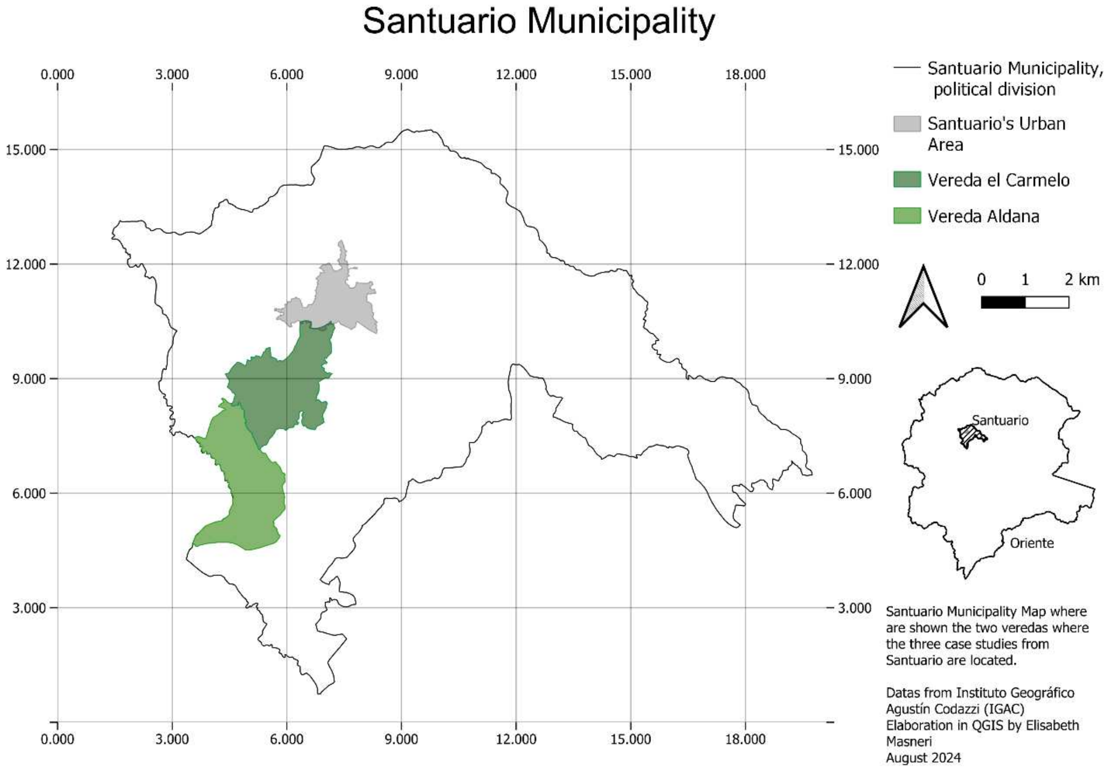


Figure 4, Geographical location of the municipality of Santuario and the rural areas where the case studies from Santuario are located. Source: author's elaboration in QGIS.

Three of the case studies are located in the rural sector of the municipality of El Santuario, situated in the Oriente subregion of the department of Antioquia. The municipality of El Santuario is situated at an altitude of 2,137 meters above sea level, 52 km away from Medellín, the departmental capital. The area is mountainous and belongs to the Central Cordillera. The land is distributed between temperate and cold climates, with an average annual temperature of 18.1°C and an average annual precipitation of 1,923 mm, associated with the Intertropical Convergence Zone (ITCZ), following a monomodal regime (IGAC, 2022b).

According to IGAC data (2022), the municipal area is 83.411 km², with 10,892 urban properties and 5,220 rural properties. The municipality comprises 36 veredas[4] (CCOA,

[4] Valle Luna, La Paz, Guadualito, Las Palmas, Bodegas, Bodeguitas, La Aurora, La Tenería, El Carmelo, El Retiro, Las Lajas, Aldana, San Eusebio, El Morro, El Roble, Pantanillo, Vargas, La Cuchilla, Pavas, El Señor Caído, Lourdes, Salaito, Potrerito, El Salto, San Matías – Granada, Palmarcito, Buenavista, Valle de María, Alto del Palmar, La Serranía, La Floresta, Morritos, Portachuelo, San Matías, El Socorro, and Campo Alegre.

2018b). Based on data from the 2018 Census (DANE, 2018), the estimated total population for 2023 is 37,801 inhabitants. In El Santuario, the rural sector predominates, covering 72.84 km² (97.12% of the total area), leaving the urban area with 2.16 km², which represents 2.88% of the total area (CCOA, 2018). Agriculture, livestock, hunting, forestry, and fishing constitute the second-highest GDP area after the manufacturing industry, with 97.77 million pesos (Gobernacion de Antioquia, 2022b). The predominant crops based on production include carrots (36,800 hectares), beets (17,070 hectares), tomatoes (9,065 hectares), sugar cane (5,830 hectares), coffee (5,242 hectares), potatoes (4,680 hectares), cabbage (3,840 hectares), and lettuce (2,260 hectares) (UdA, 2022b). Regarding livestock production, the National Census shows that in 2021 the municipality accounted for 11,773 bovines distributed across 1,124 farms (UdA, 2022).

Historically, El Santuario has been a significant producer of maize and beans. Analysing data from Duque, Manjarrés, Mejía, and Rojas (1984), it is evident that, on a per-strata basis, potatoes occupy the largest cultivation area per exploitation. Carrots are followed by beets, cabbage, maize, and beans. The research indicates that except for maize and beans, all other crops are cultivated cleanly (Duque et al., 1984). However, clean agricultural processes have been disrupted by the intensification of agriculture and the extensive use of agrotoxics in the area. El Santuario is considered the municipality with the highest incidence of agrotoxics in the eastern region of Antioquia (P. Giraldo et al., 2022). A study conducted in Vereda El Salto in El Santuario estimated that the presence of Metamidophos in cabbage plants exceeded the maximum permissible limits set by the Codex Alimentarius and that the runoff water and two sites near the water stream of El Salto contained residues of the product (Giraldo et al., 2022). Another investigation in El Santuario, specifically in the veredas of El Carmelo, Aldana Arriba, and Aldana Abajo, revealed that farmers use mixtures of various products of toxicological categories I and II, and that there is improper handling of agrochemical products by producers in these veredas, putting at risk the health of people and the environment (Vélez Jaramillo et al., 2021). The issue of agrochemicals and their impacts was also highlighted by the *campesinas* of El Santuario whom I interviewed. During the meeting and workshop organized by Colectivo Ruralidad and Aso Comunal (2024), in which I had the pleasure of participating, the *campesinos* of El Santuario collectively created a diagnostic of the problems faced by the *campesinado* of El Santuario and the related proposals for their management. In the social dimension, the problem of risks associated with farming activities affecting the health of farmers emerged, while in the environmental dimension, it was noted that there is a misuse of agrochemicals and climate change impacts connected to a lack of environmental education and water source care. The proposals on this topic were to encourage agroecological practices and watershed protection and to strengthen environmental education and compliance with regulations. Other problems of the *campesinado* of El Santuario in the social dimension that emerged, and which I heard frequently in the interviews, include limited recognition of peasant knowledge, work, and products; insufficient conditions to guarantee peasant rights; lack of generational continuity, as young people do not usually farm or see opportunities in the countryside; undervaluation of the role of peasant women; increased migration of peasant families to the city; loss of knowledge and spaces for transmission between generations; high input costs; many intermediaries; extremely low and unstable prices, resulting in low profitability for peasant families; low appreciation of peasant work; weakening of the social fabric; and impacts of the armed conflict on the personal, family, and community trajectories of the peasant population, among many others[5].

In relation to agroecology as a possible solution, there is only one “clean agriculture market” in the municipality, which is managed by women who practice "cleaner" cultivation methods. This market includes women who engage in agroecological farming, such as the two cases that will be presented subsequently. This market is supported by the Environmental Association Aire Libre, the municipality of El Santuario, and Cornare. It is held every Sunday in the main square and provides Santuarian women with a space to sell their products directly, without intermediaries.

[5] Consult Annex 3 for a comprehensive overview of the problems and proposals for the rurality of El Santuario, constructed through a participatory bottom-up process by the campesinos.

IV. Carmen del Viboral

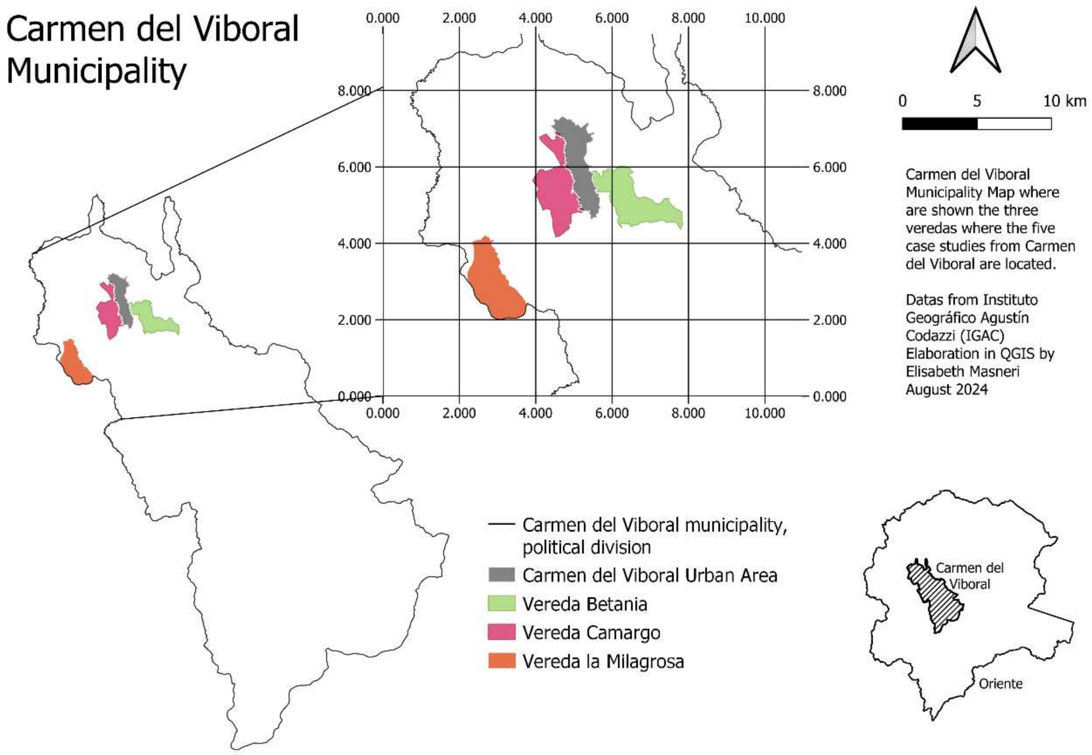


Figure 5, Geographical location of the municipality of Carmen de Viboral and the rural areas where the case studies from Carmen de Viboral are located. Source: author's elaboration in QGIS.

The other five case studies are located in the rural sector of the municipality of El Carmen de Viboral, situated in the Oriente subregion of the department of Antioquia. The municipality of El Carmen de Viboral is situated at a mean altitude of 2150 meters above sea level, 44 km away from Medellín, the departmental capital. The area is mountainous and belongs to the Central Cordillera. The land is distributed between temperate and cold climates, with an average annual temperature of 16.7°C and an average annual precipitation of 2,700 mm, associated with the Intertropical Convergence Zone (ITCZ), following a monomodal regime (IGAC, 2022a). The municipality's territory is notable for its abundant water resources, including several streams such as the Santo Domingo River and the Cimarrona, La Rivera, Salado, San Lorenzo, and Viboral creeks (IGAC, 2022a).

Based on data from the 2018 Census (DANE, 2018), the estimated total population for 2023 is 63,761 inhabitants. The municipality comprises 55 veredas[6] (CCOA, 2018a).

[6] Vereda El Ciprés, Corales, San Vicente, La Esperanza, Palizadas, La Represa, El Brasil, Mirasol, Morros,Dos Quebradas, La Aguada, Santa Inés, Vallejuelito, La Florida, La Linda, Mazorcal, Las Acacias, La Madera, El Retiro, El Roblal, Agua Bonita, Santa Rita, El Porvenir, El Estío, La Cristalina, Santa Domingo, La Cascada, La Honda, El Cocuyo, Campo Alegre, Betania, Camargo, Belén, Chaverras, San Lorenzo, San José, Boquerón, Guarinó, La Chapa, Quirama, La Sonadora, El Cerro, La Milagrosa,

According to IGAC data (2022a), the municipal area is 83.411 km², with 11.879 urban properties and 1.565 rural properties. In El Santuario, the rural sector predominates, covering 445,56 km2 (99,56 % of the total area), leaving the urban area with 2,44 km2, which represents 0,54% of the total area (CCOA, 2018a). Agriculture, livestock, hunting, forestry, and fishing constitute the highest GDP area with 206,09 million pesos (Gobernacion de Antioquia, 2022a) with a total of 1.529 hectáreas en cultivos permanentes (IGAC, 2022a). The predominant crops based on production include floriculture-horticulture (860 hectares, predominantly hortensia and crisantemo), potatoes (435), cabbage (3,840), strawberries (125), carrots (49,5), avocado (132) and tomato (15) (UdA, 2022a).

Historically, El Carmen de Viboral has been renowned for its ceramics artisanry and factories. A significant portion of the town's economy revolved around the production of ceramics, and even subsistence farmers in the 1950s moved to work in the factories, leading to a disconnection from the land (Giraldo Osorio, 2022 citing Betancur, 1993). When the ceramics factories faced crises in the 1950s and again in the 1990s, many former campesinos returned to farming with the boom in agriculture. This shift involved, among many other changes, the mass planting of *cargamanto* beans, introduced during the Green Revolution, and led to a loss of crop diversity and the use of agrochemicals for large-scale farming (Giraldo Osorio, 2022).

I did not have the privilege to participate in a diagnostic workshop addressing the problems faced by the *campesinado* in El Carmen de Viboral, as I did in El Santuario. However, there is more literature available on this municipality, and I have gathered some of the issues *campesinos* have shared with me during interviews. Given the proximity of the two municipalities, campesinos often face similar challenges as those in El Santuario. Nonetheless, there are some specificities unique to El Carmen de Viboral, one of which is the significance of floriculture. From the previously presented data (UdA, 2022a), it is evident that the horticultural sector, particularly floriculture, is of great importance and carries significant weight within the local economy, far surpassing vegetable production. This has led the agricultural sector to be the largest contributor to the local GDP, as noted earlier (Gobernación de Antioquia, 2022a). However, it is important to state that this GDP is not generated through food sovereignty and security but through monoculture of

Guamito, Aguas Claras, El Salado, Samaria, Las Garzonas, Viboral, La Aurora, Alto Grande, Rivera, La Palma, Cristo Rey, Aldana.

flowers for decorative and commercial purposes, primarily for export. This characterizes it as an industrial product because it is cultivated on a large scale and requires intensive labour (Gutiérrez Alzate, 2023). The intensive use of water is also significant, as floriculture demands large quantities of water for the preparation of pesticides, impacting both groundwater and surface water and altering the hydrological cycle. Moreover, the practice of floriculture brings territorial changes, both in landscape and culture, affecting campesinos who, by changing their production methods, abandon traditional practices and knowledge, creating a rupture in their history and ways of life (Gutiérrez Alzate, 2023).

Another significant issue in this region is the rapid land use change, particularly the so-called "*subdivisión predial*" (property subdivision), which divides private property and impacts urban and environmental loads on the territory. A recent study (Torres-Alape et al., 2024) demonstrated that after 2020, property subdivision increased, with protected areas becoming the most affected category, with around 398 hectares impacted. These areas often include buffer zones around streams, raising alarms about potential conflicts related to land use and water quality. Over time, these land use changes will create imbalances in the supply and demand for water and increase exposure to hydrometeorological threats such as floods and torrential flows (Torres-Alape et al., 2024).

These issues are complex and deeply intertwined with historical processes within the capitalist alimentary regime. However, agroecology could make a significant difference in the resistance of *campesinos*' material and immaterial practices and stances, as we will see in the case studies. Through agroecology, they actively resist floriculture, land changes, and depopulation. Within El Carmen de Viboral, there is a *campesino* market every Sunday, supported by the local government, where various agroecological producers sell their products without intermediaries. Additionally, there is the agroecological restaurant and store Hojarasca, which sells local agroecological products.

7. Results

a. Qualitative results: Portraits of Agroeco-transitions

I. Doña L.: "*Como uno tiene la cabeza tiene el arado*"[7]

Doña L. was born on the farm she now manages as a single mother, practicing agroecological farming. Recalling her early experiences, she shared how, as a young woman, she briefly worked in a lingerie manufacturing company like many other women in El Santuario. However, her heart was always with the land. "*I would look out the window and see the countryside... and thought,* "*I won't stay here in this company any longer.' This isn't what I like. I'm like a bird, without a cage*" she said, explaining her decision to return to the farm. Remaining on the farm, she dedicated herself to dairy farming, selling milk, for many years, with the help of a cooperative, utilizing shared resources. However, as the cooperative was privatized, she adapted by selling raw milk independently: "*Now I sell on my own; I'm a raw milk seller, selling on the streets.*"

Approximately 20 years ago, Doña L. began her transition to agroecology by planting lettuce and cabbage without agrochemicals. Initially met with scepticism, even by those close to her, she remained determined: "*I'm going to take the risk... If it turns out well, great, and if not, I won't do it again*". Encouraged by positive feedback from local restaurants appreciating the chemical-free produce, she expanded her efforts. Shortly afterwords, an UMATA (Municipal Units for Agricultural Technical Assistance) officer soon suggested and supported the idea of a local market in Santuario where other women could have a space for their products. "*They wouldn't even let me unload the crates; everything was sold. We did super well, and every eight days, I increased the planting.*" she recalls.

Agroecology, she says, has transformed the land: "*Before, only pasto estrella (Cynodon nlemfuensis) zarza (Rubus ulmifolius), and fennel would grow here; that's all there was. And now, with organic matter, look how it has changed.*" However, the transition wasn't without challenges. The use of agrochemicals in surrounding farms created difficulties, particularly with pests. "*Here, campesinos mix up to four different chemical components in a single spray… many suffer from blood cancer, prostate cancer…" To combat these*

[7] All Doña L. citations from Doña L., April 23, 2024. See Bibliography.

issues, she learned to create her own organic insecticides: "A bio-factory has four components, and with three, you can manage". Her practices focus on nourishing the soil to produce resilient crops, using companion planting to naturally manage pests and optimize yields. "*For example, I plant garlic, leeks, and cruciferous vegetables together… I also plant cilantro and cabbage together; one repels the parasites of the other.*". However, the journey has been particularly challenging as a woman in a male-dominated environment. While agroecology requires significant labour and attention to detail, Doña L. highlights how patriarchal structures exacerbate these challenges. "*I would like to find someone who knows what to do and does it, but here men don't like to be told what to do by a woman. Who's in charge, the work that needs to be done, or me? No, the plant is in charge*".

This issue is not unique to Doña L., it reflects a broader trend in rural Colombia where women disproportionately shoulder the burden of unpaid care work. According to DANE (2020), rural women work an average of 12 hours and 42 minutes per day, with 62% of this time being unpaid. In contrast, rural men work 11 hours and 31 minutes daily, but only 27% of their work is unpaid. This disparity is evident in Doña L.'s life, where the responsibility of caring for her sick aunt fell entirely on her, significantly impacting her ability to manage her farm. These challenges coupled with COVID-19 pandemic and climate change, has strained her efforts. "*Before, you knew when to plant, and summer and winter arrived in very specific periods. Now it's no longer like that*." The severe drought between January and May 2024 was particularly hard on her farm. "*The soil in El Santuario holds a lot of water, but it doesn't withstand drought… That's definitely a part of climate change*."

Even with these challenges, Doña L. remains committed to her practices, driven by the quality of the food she produces: "*The pleasure of eating a tomato without chemicals is a privilege not everyone has*".

Category	**Details**
Household Information	
Number of Residents	3 - Doña L., her son (young), Doña L.' mother
Number of Producers	1 (Doña L.)
Other workers (no resident)	2 (1 full-time, 1 part-time)
Location	Vereda El Salto, Santuario
Household Size	0,80 hectares

Main Productions	Cow's milk, goat's milk, lettuce, cabbage, Swiss chard, celery, curly parsley, tomato.
Selling	Sales through home delivery, at the Santuario women's market, and to a local restaurant.
Cultivated Crops and Plants	
Vegetables	Cherry tomato, curly parsley, rosemary, Bogota spinach, lettuce, Swiss chard, celery, cabbage, basil, thyme, cassava, sunflower, celery, amaranth, squash, zucchini, purslane, yacón.
Trees	Chachafruto (*Erythrina edulis*), zapote (*Quararibea cordata*), dividivi (*Caesalpinia coriaria*), avocado (*Persea americana*), arazá (*Eugenia stipitata*), guava (*Psidium guajava* manzana and de leche varieties), Siete cueros (*Polylepis quadrijuga*), Nacedero (*Trichanthera gigantea)*, Lemon (*Citrus limon*)
Others	Botón de oro (*Tithonia diversifolia*) (biomass, pollinators), altamisa (*Artemisia vulgaris*) (natural repellent), *Bougainvillea*, chamomile (*Matricaria chamomilla*).
Animals	Goats, cows, native chickens, fighting cocks, ducks.
Management Practices	
Crop Management	Crop rotation every 8 days, intercropping, minimal tillage.
Pest Management	Prevention (through diversity), use of products from on-farm biofactories (using farm-sourced ingredients, purchasing only molasses).
Water Management	Pump, key lines designs.
Fertilization Practices	Use of goat manure as fertilizer, goat urine collected and used as fertilizer, cow dung for fertilizer, and liquid vermicompost.
Socio-environmental challenges	
	Neighbouring farms using agrochemicals, climate change, economy and machismo in rural areas.

Table 2, Doña L. summary table.

II. Doña P.: "*A mi toda la vida me ha gustado demasiado la tierra*"[8]

Doña P. is a *campesina* from the northern region of Antioquia, specifically Santa Rosa. Born into a family of cattle ranchers, she married young and moved to El Santuario in 1997 with her husband, who also managed cattle. "*We lived on a farm, and I helped with the cattle too, injecting the cows, milking them*" she recalls. After a few years, they separated, and she secured a farm in El Santuario's Aldana Abajo vereda with her father and children. This marked the beginning of Doña P.'s agricultural journey: "*My children went off to study, and I was left very much alone. So I thought I had to do something to support myself. That's when I found an agroecology course with the FAO, and I liked it a lot. I've always loved the land; I come from a campesino family.*" It was this course, combined with her deep connection to the land and *campesino* culture, that drew her to agroecology. Doña P. explains that agroecology is not far removed from how her father

[8] All Doña P. citations from Doña P., April 24, 2024. See Bibliography.

initially managed their crops, illustrating how it serves as a space for the preservation and resistance of biocultural memory within the campesino community (Toledo & Barrera-Bassols, 2008):

> "*(Speaking of her father) He would get up daily with his little tools to work the land. Even though we lived on a cattle ranch, he maintained a small plot with potatoes, corn, beans, and vegetables. I remember he made 'caldo' (a kind of organic broth) as fertilizer, which he applied with a pine branch. We played in that potato field, where lulo trees (Solanum Quitoense) would even grow among the potatoes.*"

Following the FAO course, an opportunity arose to sell her products at the campesinas' market in El Santuario. Since 2009, she has been selling there her vegetables, eggs, and even the worm humus and bokashi she prepares using cow manure. She also sells raw milk from her cows to her neighbours. Initially, she sold it in El Santuario, but transportation costs left her with minimal profit. Now, she sells it to her neighbours for 2000 pesos per Liter, although supermarket milk in Colombia typically costs around 4000 pesos per Liter. Despite producing organic milk from pasture-raised cows, Doña P. says: "*What the campesino produces isn't valued*."

Over the past 20 years, the market has greatly supported her, and her sales have been successful. Doctors in El Santuario even recommend her products for people undergoing chemotherapy: "*I may not have much education, but with this, you bring life to people, you bring health. What a blessing it is to know that so many people have eaten vegetables planted by my hand*". However, in recent years, the agriculture secretary has neglected the market, rarely checking if the products are organic. Additionally, the new municipal administration charges them for the use of municipal tables: "*There's very little support. We need a new space, proper tents, and better support. This week, we paid a fee of 5000 pesos just for transporting tables. I haven't seen any support from this administration, not even a single incentive for us*."

Another challenge for Doña P., who manages the cattle, hens, agroecological garden, sales at the market, and deliveries all by herself, is finding workers: "*Finding people to work here is very difficult; men are very machistas and say, 'That's not how it's done, you'll lose it.' Working with men is hard; some flat-out refuse to work for a woman. Older people who know how to work say it's annoying to work for a woman*.". These difficulties, rooted in *machismo*, place the burden of work on a single woman and intertwine with the decline of campesino culture and the loss of generational continuity in the countryside.

"*It makes me sad because my children, my daughter, they know how to milk the cows. I've told them, 'When I die, what will become of all this?' and they say, 'Mom, stop talking about such things.' That really gets to me*.". She also reflects on the dual issue of migrations of *campesinos* to cities and the rapid land use change and property subdivision for building infrastructure in rural areas: "*A lady who has always lived in El Santuario told me that these veredas, Carmelo and Aldana, used to be the largest producers of beans, and now you don't see beans no more. It's all just houses of people coming from the cities, with less and less water and land.*".

Through agroecology, Doña P. resists an economic system in the countryside that encourages the loss of campesino culture and practices. As Van der Ploeg (2009) explains, "*la descampesinización refers to a weakening, erosion, or even disappearance of campesino practices and the rationality associated with them*" (p. 65). The main axes of *descampesinización* include greater dependency on Green Revolution technologies, involvement in global capitalist market relations, debt cycles, and displacement from lands, often reconfigured for agribusiness and infrastructure development. These forces are deeply present in El Santuario and Carmen del Viboral, as highlighted earlier. Agroecology helps build autonomy from capitalist markets through social movements and the (re)invention and (re)configuration of peasant practices in material and immaterial spaces (Rosset & Martínez-Torres, 2016). Doña P.'s story is a testament to the resilience of *campesino* culture in the face of these challenges:

> "*So many campesinos leave and get lost in the world because they don't have what others have, and that makes them feel so bad. I've never felt bad about that. For me, living in the countryside is a blessing, and I don't like living in cities. But seeing people who have lost their sense of life, that really disturbs me*."

Category	**Details**
Household Information	
Number of Residents	3 - Doña P., her daughter and her son (young).
Number of Producers	1 (Doña P.)
Other workers (no resident)	None
Location	Vereda Aldana Abajo, Santuario
Household Size	0,64 hectares
Main Productions	Eggs, milk, cheese, vegetables.
Selling	Sales through home delivery to neighbours and at the Santuario.
Cultivated Crops and Plants	
Vegetables	Spinach, cabbage, three varieties of potatoes (purple, Dutch, and native), curly parsley, lettuce, Swiss chard, celery, cabbage.

Trees	Lulo (*Solanum quitoense*), guava (*Psidium guajava*), avocado (*Persea americana)*, eugenia (*Eugenia stipitate*), papaya (*Carica papaya*), cherimoya (*Annona cherimola*)
Others	*Lupinus* (nitroge fixer), rue (*Ruta Graveolens*).
Animals	60 hens, 4 cows, 2 calves.
Management Practices	
Crop Management	Crop rotation every 8 days, intercropping, minimal tillage.
Pest Management	Prevention (through diversity), self-made extracts and broths (caldo de ceniza - ash broth, caldo de ajì – chili broth, potabon, sulphates and magnesium.
Water Management	Water is hand-irrigated using spring water, reservoir with water-purifying plants, water channeled for the cows in grazing land.
Fertilization Practices	Vermicompost, chicken manure, and cow manure.
Socio-environmental challenges	
	Neighboring farms using agrochemicals, climate change, no generational change and machismo in rural areas.

Table 3, Doña P. summary table.

III. Natalias: "*Agriculturas para la vida*"

TierraYai is an agroforestry regeneration project located in the Vereda del Carmelo, Santuario, initiated around ten years ago. It represents a collaborative effort led by Natalia V., an agro-environmental technician and Natalia S., biologist focused on conservation, both experienced in agroforestry. The process of regeneration started in 2012, on a land that suffered from extremely intensive agricultural practices, including the use of agrotoxics and chemical fertilizers, which resulted in severe overworking and erosion. The land had been reduced to a wasteland—littered with waste, stripped of its natural resources, and with its ecosystem severely disrupted. In 2013, the first step towards regenerating TierraYai was the establishment of living fences:

> "*We planted pure living fences around the farm, mainly with acacias (Genus Acacia), wax olive (Morella pubescens), chirlobirlo (Dodonaea viscosa), and quimula. (...) We started working the soil by planting non-native trees, primarily acacias. Acacias helped immensely because they were the only resilient species. Not all trees thrive in degraded soils, which is a major issue in large reforestation projects. You can't simply reforest; degraded soils require specific species to recover*" (Natalia V., April 26, 2024).

Slowly, the transition and regeneration happened and in 2020 the Natalias planted the first syntropic agroforestry and from then on, they never stopped.

The transformation of TierraYai has involved substantial efforts to restore its ecological balance through a combination of agroecology, syntropic agriculture, regenerative agriculture, and permaculture—approaches they collectively refer to as "*agriculturas* *para la vida*". These methods align food cultivation and sovereignty with biodiversity conservation and ecosystem regeneration, positioning TierraYai within the emerging paradigm for conservation (Perfecto et al., 2019).

Central to TierraYai's approach are biodiverse, successional agroforests that are complex and require intensive management. In these agroforests, constant pruning of biomass trees is essential, with the biomass then organized on the soil—starting with larger woody parts in contact with the soil, followed by smaller woody pieces, and finally finer cover such as leaves and grasses. The Natalias emphasize that agroforestry is "*10% planting and 90% management*", focusing on nutrient cycling and soil fertility. Pruning not only generates biomass and stimulates nutrient recycling but also allows light to penetrate the lower layers, encouraging new growth (Dos Santos Rebello & Ghiringhello Sakamoto, 2022). Thanks to pruning, high levels of growth hormones (auxins and gibberellins) are secreted and distributed by the mycorrhizae of pruned plants, acting as a network of communication (Simard, 2021). Moreover, the management practices at TierraYai have a significant epistemic role: "*We have disconnected from the cycles; we forgot our roles, like seed dispersers and process accelerators. In university, we study the nutrient cycle, the water cycle, but where am I in the water cycle? Where am I in seed dispersal?*" (Natalia S., April 26, 2024). This type of "*agricultura para la vida*" reintegrates people into natural cycles, helping to accelerate soil regeneration and biodiversity conservation.

The indicators of regeneration and biodiversity at TierraYai are evident. There has been a significant return of mesofauna and microfauna, with the presence of fungi standing out as a key indicator of soil health. Fungi thrive with the abundance of organic matter and accelerated nutrient cycles. Natalia V. shares, "*Fungi have made me fall in love with this agriculture. Organic farming rarely shows fungi, but when you place wood on the soil, you see incredible diversity. This speaks volumes about soil quality.*" (Natalia V., May 5, 2024).

This ecosystem serves as an example of how food sovereignty can be connected with the multi-regeneration of natural cycles such as nutrients and migrations. Although the Natalias have sold their products in the past, they are currently focused on their own food sovereignty and that of their families. They are also dedicated to teaching these methods, offering workshops, and promoting syntropic agroforestry processes both within and beyond the Antioquia region. Their awareness of the challenges in rural areas is reflected in their teaching methods:

> "*For decades, society has been telling campesinos that they are ignorant, that they do everything wrong, and that they just need to listen to technical advisors. (…) We've told them (as a society) that what they knew was wrong. But 70 years ago, before the Green Revolution, agriculture here was likely different. Chemicals didn't exist, but in just 70 years, we've reached so deeply into the marrow - 'nothing from before works, learn this'- that now telling them we're going to teach them again feels almost insulting. What we need to do is help them remember, not teach. There's surely a memory in the older generation of having seen their parents, their grandparents, and this shard of hope, of memory, but here we are in 2024, and the subsidies still support conventional agriculture. The loans that banks offer are for conventional agriculture. Go ask a campesino to ask for a loan at a bank to do this, they won't give it. But ask for a loan to buy chemicals, and they will. And then, if they go into debt? Oh, they went into debt. And then they lose their land. (sigh)*" (Natalia S., April 26, 2024).

According to Giraldo (2022) classification, there exists a second bloc of agroecological transitions that could be defined as "*emerging agroecologies*". These include all processes of *re-campesinization*, where people motivated by the ecological, economic, and political crises of the monoculture model make transitions and invent new forms of agroecology. The Natalias are examples of neorurals who, coming from Medellín, changed their lives, actively regenerate the countryside, and practice new forms of agroecology as a concrete path toward deurbanization (Giraldo, 2022). The Natalias, as neorurals, are not *campesinas*, and they define themselves as "*sembradoras*": "*We are rural inhabitants; I am a sembradora (planter), Nati (V.) is a agricultora (farmer), but being a campesina is something else*." (Natalia S., April 26, 2024).

The Natalias are also very conscious of their privileges and the many difficulties of these emerging agroecological processes. Generally, neorurals can transport their food independently to the market or the city because they own a vehicle, without needing intermediaries. They also have more flexibility to experiment with what works and what doesn't, which is particularly important in an agroforestry context. At the same time, being women in the countryside, as neorurals, is not easy due to *machismo* and the difficulty of integrating into already established campesino communities. Furthermore, going against the grain, building an agroforestry system as a women duo, experimenting, does not align with how subsidies and resource management work in the globalized capitalist world. As Natalia S. notes:

> "*What we're doing here doesn't align with how the world works. No one wants to sponsor this type of agriculture (…). It's challenging for us to make an investment*

to create an agroforest over there; we can't do it at this time. If we can't do it, as people who work, who have jobs, who don't have children, and whose house is already built, how can we expect a campesino in debt to do it? The social context of this is difficult, and going against the current is exhausting." (Natalias S., April 26, 2024).

Category	**Details**
Household Information	
Number of Residents	2 – Natalia and Natalia.
Number of Producers	2 – Natalia and Natalia.
Other workers (no resident)	1 – for 2 to 3 days a week
Location	Vereda Carmelo, Santuario
Household Size	2,8 hectares
Selling	Provision of agroforestry services and courses, production for self-consumption.
Cultivated Crops and Plants	
Vegetables	Lettuce, stuffing cucumber, yacón, mortiño beans, soybeans, tomato, eggplant, fava beans, carrots, broccoli, cabbage, kale, corn, arracacha, cassava, potatoes, sweet potato and more depending on the season.
Trees	Aguacate (*Persea americana*), alder (*Alnus spp*.), magnolio (*Magnolia ernandesi*), arbol loco (*Smallanthus pyramidalis*), avocado (*Persea americana*), castor bean (Ricinus communis), cedar (*Cedrus spp*.), ceibas (*Ceiba spp*.), chachafruto (*Erythrina edulis*), cherimoya (*Annona cherimola*), chiripique (*Dalea coerulea*), various citruses (*Citrus spp*.), coffee (*Coffea spp*.), cordoncillo (*Piper bogotense*), Dombeya (*Dombeya wallichii*), dividivi de tierra viva (*Caesalpinia coriaria*), Dumoloco (*Dumetella glabriuscula*), elderberry (*Sambucus spp*.), espaderos (*Cyperaceae*), fique (*Furcraea spp*.), granadilla (*Passiflora spp*.), guaco (*Mikania spp*.), guamo (*Inga edulis*), guava (*Psidium guajava*), jabuticaba (*Plinia cauliflora*), leucaena (*Leucaena leucocephala*), loquat (*Eriobotrya japonica*), lulo (*Solanum quitoense*), *Macanas* spp., madroño (*Arbutus unedo*), *Magnolia ernandesi*, Musaceae (*Musa spp*.), navajuelos (*Anacardium excelsum*), palmicho (*Chamaedorea linearis*), papaya (*Carica papaya*), Patagonian flower, quiebra barrigo (*Trichanthera gigantea*), siete cueros (*Tibouchina lepidota*), siempre viva (*Sedum praealtum*), tágualo (*Phytelephas spp*.), *Tephrosia spp*., wax palm (*Ceroxylon quindiuense*), and yellow oleander (*Thevetia ahouai*). And many more.
Others	King Grass (*Pennisetum purpureum*), fern (*Polypodiopsida*), guadua (*Guadua angustifolia*), botón de oro (*Tithonia diversifolia*), lupine (*Lupinus*), *Tephrosia*, eneas (*Typha domingensis*), papyrus (*Cyperus papyrus*), sage (*Salvia Officinalis*), rosemary (*Rosmarinus Officinalis*), thyme (*Thymus vulgaris*), basil (*Ocimum basilicum*), cape gooseberry (*Physalis peruviana*).
Animals	Hens
Management Practices	
Crop Management	Principles of syntropic agriculture, agroecology, and regenerative agriculture; dense planting; frequent pruning with the "slash and drop" method; constant ground cover with grasses and lignin; intercropping of

	annuals, perennials, and trees of various strata and life cycles; permanent beds.
Pest Management	Diversity, biopreparations (very scarce, as prevention is effective).
Water Management	Bio-reservoirs, rainwater tanks, design in key lines.
Fertilization Practices	"Chop and drop" method, compost, composting toilets, enhancing the natural nutrient cycle.
Socio-environmental challenges	
	Neighbour relations, machismo in rural areas, climate change, systemic problems.

Table 4, Natalia & Natalia summary table.

IV. Don C.: "*Agroecología es un cultivo promisorio, es el futuro*"[9]

Don C. is a 71-year-old *campesino* from Carmen de Viboral, who has worked the land for 50 years. Of these, 20 years were spent using conventional, chemical-intensive farming methods, while the last 30 years have been dedicated to agroecology. He began as an arriero (muleteer) from the age of 18 until 23, transporting goods with horses and mules before roads reached Carmen de Viboral: "*We would start at 4 in the morning and finish at 8 at night, transporting food*" he recalls. With the money he saved, he and his brother purchased the current farm in 1973, where he planted *cargamanto* beans and maìz criollo, which thrived in the region. In the early 1990s, Don C. suffered a severe health crisis due to blood poisoning, from exposure to agricultural chemicals. He was unable to work for five months:

> "*I had migraines, blurred vision, and by 10 in the morning, I couldn't work anymore because the sun was too harsh on my eyes. Even now, I have some vision problems. I didn't use any protection when I sprayed—just shorts. By the time I was 40, I was considered unfit for farm work*" he explains.

His doctor advised him to change his work and avoid using agrochemicals, suggesting there were alternatives. So, in 1993, Don C. began transitioning to agroecology: "*I started doing things differently. At first, the whole hectare was bare, with no weeds—just herbicides every two or three months, as is done in traditional farming. By 1994, I was using zero chemicals. I bought a dairy cow; I needed one to produce milk because our financial situation was tight*.". In 1996, with the support of his doctor and other local farmers, the "Hoja Rasca" store was founded. The doctor would give advice directly in the store and the place became a place where people would come for advice: "*They'd ask, 'What should I do?' and we'd tell them, 'Stop using agrochemicals, make an extract from carrots, chard, cabbage.'*"

[9] All Don C. citations from Don C., April 28, 2024. See Bibliography.

The store now has been bought by Don C., has since expanded into a restaurant and works with stable prices to benefit both farmers and consumers: "*For example, the price of potatoes—any variety—is 4,000 pesos per kilo, and it has been that way since before the pandemic. Whether prices go up or down outside, we maintain that price*". Thanks to the store, Don C. can sustain his farm: "*People say farming isn't profitable, but it's about making it profitable*" he insists. Don C. now offers tours of his farm, produces more profitable items like homemade cream cheese, and even sells lactobacillus culture at the market: "*I pay the rent for the store with everything from the farm, not just what I plant—the tours, the cheese, the Chinese root. I earn more from a group doing a farm tour than from the plants. I use the tour income to pay the rent, while the crops cover the worker's wages and the seeds I buy*.". Don C. frequently reiterates this notion of making farming profitable, particularly because he receives no subsidies or agricultural support, a fact that has led to financial strain in the past. He mentions that he once applied for subsidies for an agroecology project in the municipality, but the funds went to a neighbouring monoculture flower farm instead:

> "*There's no credibility for organic farming. They think it's romantic, that it doesn't produce, that it's pretty but not profitable or secure in the long term. But agroecology is more resilient to climate change—this brutal Verano didn't affect me as much. Agroecology is promising, it is the future. But the lending institutions don't see a future in it—they only support things that can be exported, like flowers, and other large-scale ventures*.".

For Don C., it's crucial to demonstrate that this form of agriculture can be profitable, encouraging others to try it and preserving *campesino* culture in Carmen de Viboral. Reflecting on this culture, Don C. explains: "*Until about ten years ago, it was said that in the Oriente Cercano, what they call the San Nicolas Valley, there were only two municipalities with an agricultural, campesino vocation—San Vicente and Carmen de Viboral. And Carmen has shifted from being campesino-agricultural to campesino-floricultural, agri-business, and ceramists*."

One significant personal challenge for him is the presence of flower farms nearby, where his neighbours work in floriculture. "The flowers degrade the soil, consume a lot of water, and require heavy spraying, which can even contaminate neighbouring plots" he then concludes, "*We are very limited in our thinking about progress and quality of life. How much is quality of life, health, worth? It can't be quantified*."

Category	**Details**
Household Information	
Number of Residents	1 – Don C
Number of Producers	1 (Don C)
Other workers (no resident)	2 (1 working 8 hours per week in the field, 1 for cleaning and cooking tasks), others occasionally.
Location	Vereda la Milagrosa, Carmen del Viboral
Household Size	0.28 hectares (2,800 square meters; 40% pasture, 20% live barriers/wooded areas, 30% cultivated land)
Main Productions	Vegetables
Selling	Sales to the market and own restaurant in town.
Cultivated Crops and Plants	
Vegetables	Beans (Rochela, Lozano), corn (white, native, choclo), potatoes (10 varieties, including colorful and elongated potatoes from Nariño), arracacha, sunflower, artichoke, turmeric, basil, leek, broccoli, cabbage, lettuce, beetroot, soybeans, asparagus, borage, yacón, colorful carrots, Victoria squash, forage peanuts, various chili pepper varieties, purple and white amaranth, buckwheat (attracts beneficial insects), Brussels sprouts.
Trees	Guava (de jugo, de leche and caboba varieties) (*Psidium guajava*), papaya (*Carica papaya*), avocado (*Persea americana*), passion fruit (*Passiflora edulis*), laurel (*Laurus nobilis*), eugenia (*Eugenia stipitata*), pine Trees (*Pinus spp*.), guadua (*Guadua angustifolia*), bamboo, citruses (*Citrus limon, grandis and reticulata*) cherimoya (*Annona cherimola*).
Others	*Lupinus* (nitrogen fixer), prontoalivio (*Plantago major*) (digestive, medicinal, sold a lot during the pandemic as it helps prevent lung congestion, bringing both health and profit), chamomile (*Matricaria chamomilla*), calendula (*Calendula Officinalis*), hibiscus (*Hibiscus sabdariffa*), lemongrass (*Cymbopogon citratus*), belladonna (*Atropa belladonna*), tobacco (*Nicotiana Tabacum*) (allelopathy, insect trap plant), hemlock (*Conium maculatum*), nasturtium (*Tropaeolum majus*) (edible flowers, ground cover).
Animals	Chickens and hens
Management Practices	
Crop Management	Permanent beds and cyclical rotations, intercropping, minimal tillage.
Pest Management	Prevention (through diversity)
Water Management	Rainwater harvesting, manual hose irrigation.
Fertilization Practices	Compost, food scraps, peels, earthworms, cut grass, stable manure, bokashi, liquid fertilizers using cow manure, branches, lupine, water.
Socio-environmental challenges	
	Neighbouring farms using agrochemicals, no subsides.

Table 5, Don C. summary table.

V. Don O.: “*Jardín y monte*”

Don O., now in his seventies, moved to vereda Betania Baja (Carmen del Viboral) 45 years ago. While he worked as a *fontanero*, often as a substitute, his life has always been rooted in the land, drawing from a deep *campesino* culture that extends back to his great-grandparents. Like many in Carmen de Viboral, he initially relied on agrochemicals in his farming practices. However, after suffering from a severe agrochemical poisoning, he sought an alternative path. This marked the beginning of a transformation on his farm, which began when he attended an agroecology workshop 20 years ago. "*I gradually recovered, and so did the land—slowly, with the help of the wild plants. At first, I brought in a lot of organic material like grass and capote sacks and mixed it into the soil*" (Don O., May 3, 2024) he recalls.

Don O. soon realized that agroecological practices were not entirely new to him. They were, in fact, reminiscent of traditional farming methods he had seen and practiced in his youth:

> "*I'm quite old, and I can tell you, it's the same as it used to be. We didn't buy fertilizers, pesticides, or herbicides. Corn was grown year-round. I remember farming without chemicals. For potatoes, they'd use just two baths of ash. Now they use seven different chemicals for potatoes. That all came with the Green Revolution, which was imported from other countries*" (Don O., May 11, 2024).

The agroecological transitions of both Don O. and Don C. can be understood as "*agroecologies of return*" (Giraldo, 2022, p.143), or agroecological transitions that emerge in response to acute crises, such as health deterioration, cancer, poisoning, and other illnesses. These are agroecologies born from deep crises and the abrupt suspension of the prevailing order, resolvable only through a drastic change of course. In the cases of Don O. and Don C., this meant a refusal to abandon their identity as campesinos and a commitment to finding a solution that did not involve agrotoxics: agroecology.

Today, Don O. sells his produce at Hoja Rasca, as well as at larger markets in Medellín and Rio Negro. He manages two plots: a small one (*Jardín*) for a mix of subsistence farming and selling vegetables like cabbage, cilantro, collards, broccoli, lettuce, potatoes, and lemons in Carmen de Viboral, and a larger plot (*Monte*) in the mountains where, 17 years ago, he planted 150 avocado trees. These avocados are distributed among the markets in Carmen, Medellín, and Rio Negro. His agroecological practice now includes pruning, blending some agroforestry practices with agroecology: "*I didn't know you could prune, and now the trees are coming back to life, as if reborn*" Don O. explains, referring to his avocado trees: "*I use the prunings on the ground as barriers to prevent water runoff* *since my land is on a steep slope. The branches decompose and turn into organic matter*" (Don O., May 11, 2024).

The avocado trees have provided significant economic relief for Don O.: "*In the past, I had many debts and was close to losing everything. Now, I don't receive much, but I make it work. The avocados help a lot, and I plant some crops during the summer, harvesting four or five items every eight days. It's scarcer, but it helps*." (Don O., May 3, 2024). The economic landscape in Carmen de Viboral has changed drastically over Don O.'s lifetime. He recounts how, in the past, the region was driven by the ceramics industry and agriculture, especially the cultivation of *cacheton* and *cargamanto* beans. Now, "*It's full of floriculture everywhere. And it's filled with housing developments all around.*" (Don O., May 11, 2024). This shift is also evident in the difficulty of finding labour for the fields:

> "*Finding good workers is extremely difficult now. Everyone who used to work in the fields is now in the flower industry. We, the older ones, are fading away... and the work in floriculture is much harder than in open fields. The greenhouses are very hot, and there are a lot of chemicals. But people choose it for the benefits—pension and insurance. Because the land belongs to a company, they can't have anyone without insurance. In Carmen, there are 20 companies; it's full.*" (Don O., May 11, 2024).

This is a clear example of *descampesinización* (Van der Ploeg, 2009), where both the material and immaterial spaces of campesino life are eroded: land that was once dedicated to beans, corn, and gardens has been overtaken by export-oriented agribusiness. Along with this, the immaterial knowledge is being lost, especially among the younger generations of campesinos, who see few prospects beyond emigrating or working in floriculture.

On the topic of generational succession, Don O. shares that out of his ten children, only two continue to work in agriculture, and among his 37 grandchildren, none seem interested in becoming campesinos: "*I don't see a future in the grandchildren... That's the problem. There's only one boy who likes farming, and another who works a small piece of land, but the rest don't. The younger one farms organically, the other doesn't*." (Don O., May 11, 2024).

Category	**Details**
Household Information	
Number of Residents	4 – Don O., Doña T. and 2 of their children
Number of Producers	1 (Don O.)
Other workers (no resident)	None
Location	Vereda Betania Baja, Carmen del Viboral
Household Size	1,40 hectares (0,20 + 1,20)
Main Productions	Avocados, vegetables.
Selling/ Autoconsumo	Sales to the Rionegro and Medellín markets, and to the HojaRasca store in Carmen del Viboral.
Cultivated Crops and Plants	
Vegetables	Lettuce, chives, arracacha, bulb onion, leek, cargamanto beans, tobacco, pepino potato, air potato, yacón, spinach, parsley, broccoli, sweet potato, kale.
Trees	150 avocado plants (*Persea americana*), coffee (*Coffea arabica*), citruses (*Citrus reticulata, sinensis and aurantium*), loquat (*Eriobotrya japonica*), cherimoya (*Annona cherimola*), plantain (*Musa paradisiaca*), guava (*Psidium guajava*), papaya (*Carica papaya*)
Others	Nasturtium (*Tropaeolum majus*), globitos (*Asclepias Physoca*), lemongrass (*Cymbopogon citratus*), rue (*Ruta graveolens*), pennyroyal (*Mentha pulegium*), mint (*Mentha piperita*), mallow (*Malva sylvestris*), spearmint (*Mentha spicata*), purslane (*Portulaca Oleracea*), acetaminophen plant (medicinal), tarragon (*Artemisia dracunculus*).
Animals	Hens and rabbits.
Management Practices	
Crop Management	Permanent beds, rotations, and soil tillage.
Pest Management	Prevention (through diversity); for slugs: quicklime, ash, saltwater. Potassium soap (self-made), minimal use of sulfates for potatoes.
Water Management	Rainwater harvesting.
Fertilization Practices	Prunings from avocado trees, kitchen scraps, rabbit and chicken waste from the farm, and horse manure donated by neighbors.
Socio-environmental challenges	
	Labor force, generational succession, climate change.

Table 6, Don O. summary table.

VI. Don F.: *“uno montañero no pega a la ciudad”*[10]

Don F., aged 78, has been engaged in organic farming and agroecological practices for 28 years. He recalls, "*At first, I used all chemicals, toxins; I worked in Carmen del Viboral*.". He recounts that when he began working in the 1970s, "*Santuario and Carmen del Viboral were the heart of vegetable production, but with chemicals.*". In search of other employment, he migrated to Medellín, where he worked for 12 years before returning to the countryside: “*You know, a mountain man doesn’t fit in the city, so I*

[10] All Don F. citations from Don F., April 29, 2024. See Bibliography.

returned to farming.". Upon his return, he assisted his brother, who was practicing organic farming, learned agroecology, and never returned to the city or chemicals.

Currently, Don F.'s farm has a section dedicated to fruit trees and a larger area for vegetable cultivation. His agroecological management includes constructing permanent beds (*camas permanentes*) where he rotates a variety of crops every eight days, such as onions, cabbage, zucchini, pumpkin, broccoli, cauliflower, beans and potatoes. In another area without cultivation beds, located in front of his house, he grows 12 to 15 trees, including coffee, bananas, avocados, oranges, and mandarins, primarily for his own consumption.

Don F. produces his own fertilizer at home using rice husks, which he purchases, and organic waste, which is given to him by friends and neighbours since he does not keep any animals. Additionally, he has access to a nearby spring, which has been crucial in helping him cope with the extremely dry summer and climate change.

Despite his age, Don F. manages the farm mostly alone, with sometimes the help of a worker who assists with manual weeding, a task that has become increasingly difficult for him. However, Don F. personally takes his produce to the market in Carmen del Viboral on Sundays and to the *Hoja Rasca* store. He expresses satisfaction with his work, saying, "*I'm doing well; I sell everything. People are becoming increasingly aware that it's true, that you can produce this wa*y.". Regarding his economic situation, he mentions that he lives alone on the farm and has minimal expenses: "*At this age, you don't spend much; you don't buy the latest clothes. A piece of clothing lasts 30 years, so you get by with little*.". However, he notes that farming provides just enough: "*It's enough for me to have soup ('la sopa', to say the essencial), nothing more.*". Fortunately, the market and the store help him significantly, as he had struggled to sell his produce in the past: "*If you're stuck and don't have a place to sell, your morale drops. Some people offered deals to take a certain quantity every eight days, but that amount every week just doesn't work*.". In contrast, at the market and the store, he sells directly, in the quantities he has, without intermediaries, which he says is his true fortune: "*There's no support for campesinos who farm organically. Many people think it's expensive, but it's not. I say this because I manage with little expense since I sell directly to the user, with no intermediaries, and that helps*.".

As an older farmer, Don F. emphasizes one of the most significant problems in the countryside: the lack of generational continuity. Despite having 20 family members, including children and grandchildren, he is alone on the farm; none have chosen the path of farming: "*We are few because I have 20 or 30 relatives who like vegetables—but on their plates. None come to say, 'I'll come to weed for you.' (...) Over time, there will be a shortage of food. People don't value it because there's food here; you don't go hungry.*".

He's a man of few words, but he concludes: "*At this age, I feel in love with life, with the countryside, with the land, and relieved of life's problems*".

Category	**Details**
Household Information	
Number of Residents	1 – Don F.
Number of Producers	1 (Don F.)
Other workers (no resident)	1
Location	Carmen del Viboral
Household Size	0,90 hectares
Main Productions	Vegetables, lemons, avocado
Selling	Sales at the Carmen del Viboral market and to a local store.
Cultivated Crops and Plants	
Vegetables	Green beans, common beans, corn (capio, native, chócolo), onion, cabbage (green and purple), zucchini, squash, purslane, broccoli, cauliflower, potatoes (white pepino, white Dutch, pastusa, red), tomato, carrot.
Trees	12/15 trees: Coffee (*Coffea arabica*), guadua (*Guadua angustifolia*), bananas *(Musa paradisiaca)*, avocado (*Persea americana*), citruses (*Citrus reticulata and aurantium*).
Others	*Lupinus* (nitrogen fixer), black-eyed Susan vine (*Thunbergia alata*), pennyroyal (*Mentha pulegium*).
Animals	/
Management Practices	
Crop Management	Permanent beds and rotations, soil tillage.
Pest Management	Prevention (through diversity), planting more, allowing some crops to be eaten by pests.
Water Management	Rainwater harvesting, irrigation from a spring.
Fertilization Practices	Compost with waste materials.
Socio-environmental challenges	
	Neighbouring farms using agrochemicals, generational succession.

Table 7, Don F. summary table.

VII. Y.: "*Yo como joven veo una necesidad de acelerar la vida*"[11]

Y. is the only relatively young campesino among the case studies from Carmen del Viboral. Born into a campesino family in Vereda La Milagrosa, he is 28 years old. After reaching the 11th grade, he left school due to social and familial pressure to find a job, to do something that would generate income "*beyond the fields*". Consequently, he worked for two years in a metalworking company in Rionegro and then for a year in a call-centre. This experience did not satisfy him, and one day, a friend asked him for help on his farm "*because his food was going to waste*.". When he visited, Y. noticed that his friend had an abundance of crops which were being wasted, fed to birds and donkeys: "*That's when I started thinking—I have the same thing, a little piece of land from my father—and from there, I broke the pattern.*".

Since then, four years have passed. Y. took a small piece of his father's farm (about 800 square meters), constructed a wooden house, and began to cultivate the land, marking the beginning of his journey into agroecology. The decision was not without challenges. As a young person choosing this path, Y. faced scepticism from his family: "*First, you face your family: 'Are you going to live there in a wooden house?' And my siblings, with their nice houses… I had to get serious, be tough.*". Nevertheless, he persisted and, reflecting on the state of the family's land before he took over, Y. recounts, "*That lot was not being cultivated much; there was a tomato greenhouse, and we rented out the small plot over there. Then I started pushing and told my parents that I wanted to plant. It's very difficult because, for them, things are still very structured*.". This transition was not easy, particularly as Y. sought to change long-standing agricultural practices. For example, his father, who traditionally used glyphosate in farming, initially resisted Y.'s new approach. Y. recalls a pivotal moment six months ago when they had "*the definitive fight*" after which his father finally stopped using the chemical: "*My father is 72 years old, very wise, and he has understood the change, the processes. Now, we're cultivating a plot of corn together, and I provide the fertilizer. He has seen the results*.".

Beyond his family, Y. also faced resistance from the broader community. His youth made it difficult for others to take his ideas seriously: "*The ego of adults is very big. I'm in the vereda assembly, and I'm the only young person, and when I start talking, it's as if no*

[11] All Y. citations from Y., May 3, 2024. See Bibliography.

one listens" he says. Similar challenges arose with his neighbours, who rely heavily on agrochemicals in their flower farming operations: "*The issue with chemicals is very serious. We're breathing it every day. I wrote a letter to ICA and Cornare, but they responded that they don't have jurisdiction (...) I tried to approach Fernando (a neighbor, also young) more from the health perspective—his health and his family's*."

Despite these challenges, Y. remains one of the few young campesinos who has chosen this path. He notes, "*I'm the only young campesino. At least here, the young people working in the fields are workers in flower farms or in conventional cultivation*" reflecting a broader cultural trend where young people are increasingly detached from *campesino* life. Y. attributes this to a societal mindset that devalues *campesino* customs, viewing them as relics of poverty. He recalls, "*I remember when I went to town in boots, and people would say, 'Oh, poor kid, with boots,' and as a child, I thought, well, it's normal—I come from the countryside*."

Today, Y. is content with his decision to embrace agroecology:

> "*I've regained a lot of health and time; I've discovered that I have time. I already have my food, so now I'm making a garden at the school, focusing on the family—this is my origin. (...) The good thing about living like this is that I have my time. For example, I take care of the cows in the morning, get them ready with food, and then I have time for pending tasks, free time*".

Y. and his family agroecological transition includes maintaining a garden where much of the produce is for self-consumption, with surplus sold for profit. They also raise cows and chickens, and Y. has begun processing and selling products like cheese and dulce de leche to make the venture more sustainable. Recently, he started making dulce de leche with coffee from his small agroforestry system.

The reforestation process on Y.'s land is anchored in coffee and plantain production for self-consumption, alongside the planting of native species. He relies on intuition in planting these trees, noting that there isn't much information available on agroforestry. However, his practices reflect a deep understanding of agroforestry management. For instance, he creates "*nests*" around trees with lignin and organic biomass material to nourish and protect them and plants trees of different temporal successions alongside annual plants and flowers: "*I planted the trees with intuition. (...) As a young person, I* *see a need to accelerate life. Just as we have accelerated destruction in recent times, now we need the opposite. Look, this ceiba tree is 3 years old, but it's because I've fed it, and it's growing well. I'm reforesting here.*".

Y.'s commitment to agroecological practices extends to a bio-factory he built himself, where he cultivates microorganisms to regenerate the soil. His approach is entirely self-sufficient, with the only inputs purchased being molasses and rice husks. Additionally, Y. is focused on regeneration and biodiversity, implementing techniques such as insect bio-hotels to attract insect biodiversity to his fields. He also envisions future projects, such as one with his sister, who has been working in a flower farm for 21 years but is now tired of it. The plan is for her to quit and start growing flowers without agrochemicals, a first for Carmen del Viboral: "*At first, it will be very difficult because of the pests, but we'll have a biofactory. An organic campesino absolutely needs a biofactory with a lot of good inputs (fertilizers, microorganisms) and natural fumigants. This is what's missing—we need to bring these processes*.". Y. sees this as an opportunity not only to help his sister change her life but also to demonstrate to the community that it is possible to produce in this way:

> "*Others need to see that this is something that produces. (...) But you have to speak to campesinos with results. That's why agroecology hasn't really caught on here in Oriente — because people want to see that you can get a nice car, build a house, all of that. The influence of Medellín on the countryside*.".

Category	**Details**
Household Information	
Number of Residents	7 - Y., his father, his mother, sister, and brothers.
Number of Producers	4
Other workers (no resident)	/
Location	Vereda la Milagrosa, Carmen del Viboral
Household Size	0,53 hectares
Main Productions	Milk, cheese, eggs, dulce de leche.
Selling	Sales through home delivery to neighbours and self-consumption.
Cultivated Crops and Plants	
Vegetables	Corn, beans, lettuce, bulb onion, carrot, broccoli.
Trees	70 trees, with over 20 species including plantain (*Musa paradisiaca*), coffee (*Cofea Arabica*), ceiba (*Ceiba pentandra*), papaya (*Carica Papaya*).
Others	/

Animals	2 cows, purebred and native hens.
Management Practices	
Crop Management	Permanent beds and rotations, Little part of agroforestry
Pest Management	Organic methods, homemade microorganism-based preparations, insect hotels.
Water Management	Water sourced from a stream, shared tank with 5 families, sprinklers used during the summer.
Fertilization Practices	Use of microorganisms, experimentation with solid and tea fermentations for plant application.
Socio-environmental challenges	
	Neighbouring farms using agrochemicals, climate change, generational gaps.

Table 8, Y. summary table.

VIII. Familia B.: "*Cómo habitamos el bosque sin destruirlo*"

The final case study is that of the B. family, composed of Doña A., Don I., and their three daughters. When they married, Doña A. and Don I. were deeply involved in chemical agriculture. "*But life led us to start questioning the system. We didn't want to continue down that path, and when our eldest daughter A. was born, we had the chance to join a civic group in El Carmen, which opened many beautiful opportunities for us to meet people. At one point, we were also warned about the dangers of chemicals*" (Doña A., May 9, 2024) they recount. This led them to abandon chemical agriculture. In 2004, they purchased a farm in Vereda Camargo, a piece of land previously degraded by overgrazing and agrochemicals. The transition was not easy. Don I. recalls: "*My father would say, 'You've gone crazy. Keep a little organic garden for yourself and your family, but stick with chemicals for the rest, or how will you make a living?' But I didn't listen. I worked part-time outside, teaching agriculture in a rural school for 13 years, while also working on the farm.*" (Don I., May 9, 2024).

They began the process of regenerating the land, learning agroecology with the support of knowledgeable friends and the Hoja Rasca process: "*a school for many.*" (Doña A., May 9, 2024). Don I. describes the initial phase of Hoja Rasca as a beautiful process, involving nine continuous years with five other campesino families. Over time, the group began to disintegrate, and Don C. eventually took over the shop. Don I. reflects, "*During Hoja Rasca, I was producing a lot of vegetables, raising many animals—trout, tilapia, chickens, goats. Now, I've slowed down, focusing more on self-consumption. Organic farming produces a lot, but it also involves a lot of soil turnover, and that's something I've had to reconsider.*" (Don I, May 9, 2024). Today, Doña A. and Don I. are centred on self-sufficiency, regenerating their farm, and caring for their family. Doña A. (May 9,

2024) shares, "*We dared to try an experiment with our daughters, and now they all live here on the farm with their husbands. You'll see different little houses, maintaining balance in everything*.". Their daughters have developed various projects on the farm, including an itinerant restaurant using mostly garden produce: "*They evaluate the menu based on what's good in the garden. It's not always open because of that, which limits production, but it's better*" (Don I, May 9, 2024). They also run a small family business delivering pies and bread, and their middle daughter, along with her partner, is building a horse stable and training horses with the goal of educating children in horseback riding.

The agroecological practices on the farm are diverse, forming a complex agroecosystem where the family lives and works. Key practices include replacing all toilets with compost toilets, and transforming waste from humans, animals, and the kitchen into compost at various points on the farm to nourish the soil. The motto guiding their process of soil creation is: "*Compost and cover, always, everywhere*". This involves also continuously pruning biomass species to create soil and a healthy agroecosystem: "*I keep pruning this one (pointing to a pine tree), look at the biomass, look at the soil being built. The soil needs to be covered, and by covering and making soil, trees arrived, like the laurel (Laurus spp.), which came by itself, and I take care of it*" (Don I., May 9, 2024). In addition to composting, maintaining constant soil cover, and integrating agroforestry with gardens and trees, Don I. is passionate about water management. He has created several bio-reservoirs or bio-lakes within the agroecosystem to slow down water flow, filter it with biofilter plants, allow it to infiltrate the soil, and recharge groundwater: "*Here, I create ponds (…) some water infiltrates, and some ends in this torrent below, and it makes me happy because, over time, you see this filling with clean water. But when I got this, it was all mud, not to mention when it was a potato field. Now water frogs, and other animals inhabit it*." (Don I, May 9, 2024).

Don I. mentions that the main challenges in the past were economic, and now he is concerned about land use changes and the shifting agricultural landscape in El Carmen del Viboral. He recalls that things were financially difficult in the past, but they were helped by the Colombian state's tax reduction policies: "*UGAM made a technical visit, and because 70 percent of our land is under conservation and we have forests, we received a substantial tax reduction*." (Don I, May 9, 2024). During financially difficult times, various proposals were made to him: "*People offered me deals, like selling a small piece of land to raise capital. If it were just about money, we would have filled this place* *with hydrangeas for rent, which could bring in 3 million pesos monthly, but that's not the idea.*" (Don I, May 9, 2024).

He also discusses the issues facing campesinos in Colombia, explaining how he as a campesino, had to struggle with his father, who wanted him to continue studying and would say: "*Get an education so you can be somebody*" but Don I. reflects, "*But I'm already somebody. I'm a campesino. (...) My father wanted me to move to the city, and I understand why, because he bought into this concept of development, taking your children out of the countryside so they can 'develop.' Here in Colombia, the Green Revolution came with this idea of development*." (Don I., May 9, 2024). He continues, discussing generational succession and how it stems from *decampenisacion*, along with armed conflict:

> "*There's this whole issue of how they've pressured campesinos to leave the countryside—wars, displacements, the cost of land. Many young people want to stay in the countryside, but it's tough. There's land to work, and there are ways to do it, but the agroindustry has already taken over... You come here, plant corn, and no matter how well it grows, you can't compete with agro-industries. A kilo of mais criollo (native corn) is 5,000 pesos, while Canadian corn here is less than half that price. (...) We need a different economy, saving salaries, investing time in care. We've turned land into a commodity, but it shouldn't be that way*." (Don I., May 9, 2024).

In this case, the agroforestry and agroecological transition is deeply intertwined with campesino identity, creating future natures linked to the past through communities and memories:

> "*To regenerate at that time, I made purely living fences, planted a lot of beans to let the soil rest. And many little trees over time. The living fences and this knowledge came from campesino knowledge, from my father. There was a time when living fences were highly valued, along with planting in key lines. There was a strong concept of key lines; my father did it, but it was forgotten*" (Don I., May 9, 2024).

This type of agroecological regeneration is not disconnected from social and cultural regeneration. Material regeneration comes with immaterial regeneration and the questioning of mainstream values, like the dichotomy between nature and culture: "*This story that 'nature lives without me, I can't live without her,' it's not like that. I am part of nature. As long as we see ourselves as separate, there will be no change. Like weeds have a function, so do I.*" (Don I., May 9, 2024). From this perspective, Don I. and his family have found their role in agroecological regeneration, placing themselves perfectly within the new conservation paradigm based on high-quality matrices (Perfecto & Vandermeer, 2010), in this case made of forest, agroforestry, gardens, and water ponds. They find ways to live and sustain themselves, selling products like honey, alongside the non-human counterparts inhabiting their farm: "*The challenge for me is: how do we inhabit the forest without destroying it? Why do we have to destroy it to inhabit it? Here, we've seen that it's possible to inhabit and not destroy.*" (Don I., May 9, 2024).

Category	**Details**
Household Information	
Number of Residents	8 – Doña A., Don I., three daughters and their partners
Number of Producers	8
Other workers (no resident)	/
Location	Vereda Camargo, Carmen del Viboral
Household Size	1,65 hectares
Main Productions	Fruits, plantains and vegetables (mostly family self-consumption)
Selling/ Autoconsumo	Sale of homemade pies for delivery, bee products (honey, wax), small on-site restaurant.
Cultivated Crops and Plants	
Vegetables	Asparagus, cherry tomatoes, squash, achira, chia, arracacha, lupine, blue lupin, corn, lettuce, sugar cane.
Trees	Coffee (three different varieties) (*Coffea arabica*), avocado (*Persea americana*), citruses (*Citrus limon, reticulata, medica*), chachafruto (*Erythrina edulis*), pomegranate (*Punica granatum*), spearwood (*Ochroma pyramidale*), bamboo, guava (*Psidium guajava*), Plantains (various varieties). bananas (4 varieties), guineo (*Musa spp.*), mamey silvestre (*Clusia rosea*), laurel (Laurus nobilis), loquat (*Eriobotrya japonica*) and at least other 15 native species self-seeded in natural succession.
Others	Calendula (*Calendula Officinalis*), borage (*Borago officinalis*), mafafa (*Xanthosoma sp.*), black-eyed Susan vine (*Thunbergia alata*), *Anthurium*, boton de oro (*Tithonia diversifolia*), *Abutilons* (bailerina), mortiño (*Vaccinum floribundum*), quiebra barrigo (*Trichanthera gigantea*), fique (*Furcraea andina*).
Animals	Chickens, donkey, horses, mules.
Management Practices	
Crop Management	Rotations in permanent beds, composting, and cover for all, "chop and drop" method.
Pest Management	Prevention (through diversity).
Water Management	Bioreservoirs, deep rainwater tanks near the houses (7,000 liters), wooden covers, water pump.
Fertilization Practices	"Chop and drop" method, compost, composting toilets.
Socio-environmental chalenges	
	High parcelization of neighboring lands, concerns over wastewater and degraded soils, economic system of agribusiness.

Table 9, Familia B. summary table.

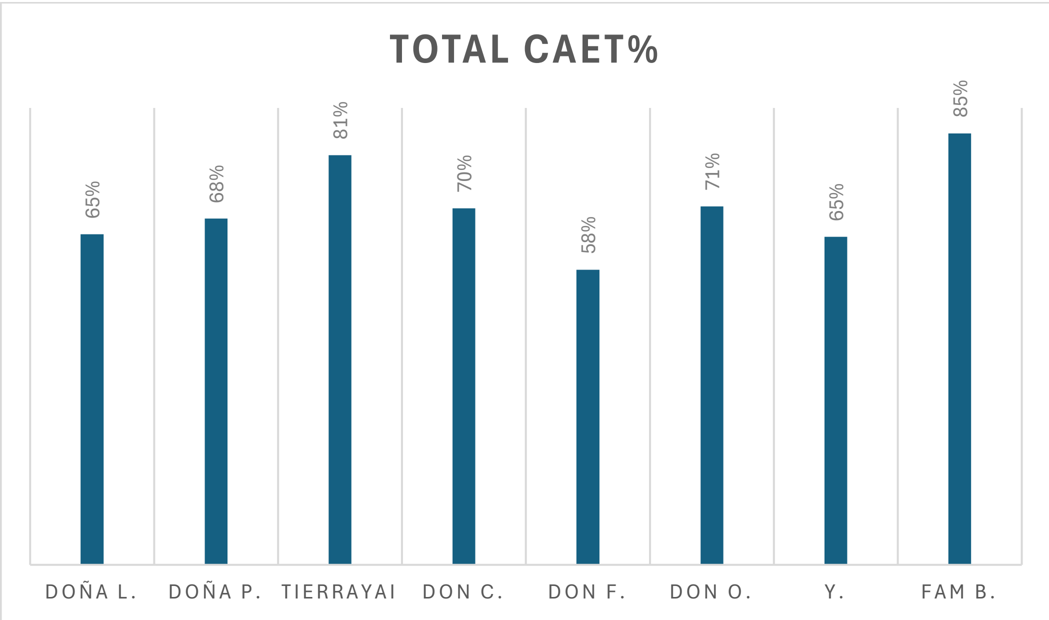
Case Study	Location	Members	Women	Young (<30)	Hectare	Selling	Main Products	Tree Relationship/ Agroforestry
Doña L.	Vereda El Salto, Santuario	3	1	1	0.80	Home delivery at Santuario women's market, local restaurant	Cow's milk, goat's milk, vegetables	Few trees scattered, no integration
Doña P.	Vereda Aldana Abajo, Santuario	3	2	1	0.64	Home delivery to neighbours, Santuario	Eggs, milk, cheese, vegetables	Few trees scattered, no integration
Tierra Yai	Vereda Carmelo, Santuario	2	2	0	2.8	Agroforestry services and courses, no food-production selling	Vegetables, fruits	Regenerative successional agroforestry, complex integration
Don C.	Vereda la Milagrosa, Carmen del Viboral	1	0	0	0.28	Market, own restaurant in Hoja Rasca	Vegetables	Some trees scattered, living fences with multiple trees
Don F.	Carmen del Viboral	1	0	0	0.90	Market, local store Hoja Rasca	Vegetables, lemons, avocado	Some trees scattered, little integration
Don O.	Vereda Betania Baja, Carmen del Viboral	4	1	0	1.40	Rionegro and Medellín markets, HojaRasca store	Avocados, vegetables	Monoculture of avocados, living fence, scattered trees
Y.	Vereda la Milagrosa, Carmen del Viboral	7	2	2	0.53	Home delivery, self-consumption	Milk, cheese, eggs, dulce de leche	Very little agroforestry, living fence, few trees
FamB.	Vereda Camargo, Carmen del Viboral	8	4	2	1.65	Bee products, on-site restaurant	Fruits, plantains, vegetables	Complex regenerative agroforestry, recognized civil natural reserve

Table 10, Summary Table of all the case studies.

b. Quantitative Results - CAET

This section presents the results of the Characterization of Agroecological Transition (CAET) for the eight case studies examined, detailing the average percentage scores obtained for the 10 elements in each production system. According to the agroecological transition classification by Mottet et al. (2020), all case studies are undergoing agroecological transitions, as none scored below 50% to be classified as non-agroecological. However, four case studies (Don C., Don O., Tierra Yai, and Fam B.) can be categorized as advanced in agroecological transition, with Tierra Yai and Fam B.

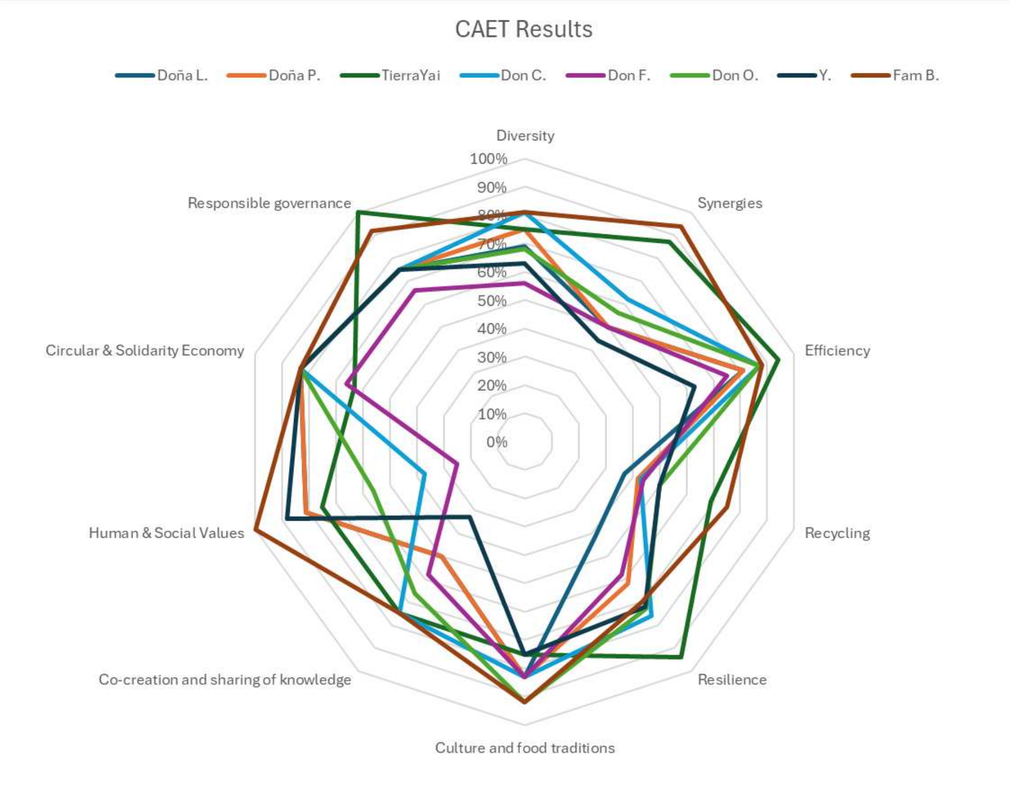
achieving particularly high scores of 81% and 85%, respectively. Three case studies (Doña P., Doña L., and Y.) scored between 60% and 70%, indicating they are "in transition to agroecology" while one case study (Don F.) scored between 50% and 60%, representing an incipient agroecological transition. The elements with the lowest scores were Recycling, Synergies, and Co-creation and Sharing of Knowledge, while the highest were Culture and Food traditions, Efficiency and Responsible Governance.



Graphic 1, Total CAET percentage results for the 8 case studies.

Case studies	Diversity	Synergies	Efficiency	Recycling	Resilience	Culture FT	Co-C&S. knowledge	H&S Values	C&S Economy	R. Governance	Total CAET%
Doña L.	69%	50%	81%	37%	42%	83%	50%	81%	83%	75%	65%
Doña P.	75%	50%	81%	42%	62%	83%	50%	81%	83%	75%	68%
TierraYai	75%	87%	94%	69%	94%	75%	75%	75%	63%	100%	81%
Don C.	81%	62%	87%	43%	76%	83%	75%	37%	83%	75%	70%
Don F.	56%	50%	75%	44%	58%	83%	58%	25%	66%	66%	58%
Don O.	68%	56%	87%	50%	73%	92%	66%	56%	83%	75%	71%
Y.	63%	44%	63%	50%	72%	75%	33%	88%	83%	75%	65%
Fam. B.	81%	94%	88%	75%	70%	92%	75%	100%	83%	92%	85%

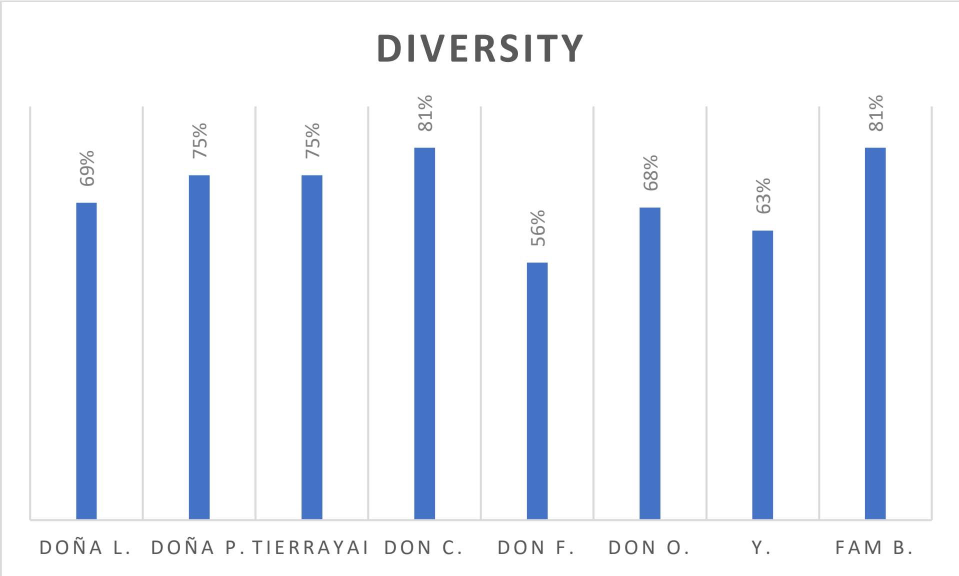
Table 12, Results of the CAET for the 8 case studies.



Graphic 2, AMOEBA Diagram. Visualization of the results of the CAET for the 8 case studies. Elaboration with Excel by author.

I. Diversity

The diversity indicator measures the variety of crops, animals, trees (and other perennials) and of activities, comprehending products and services, within the agroecosystems (see Annex 1). The data shows that Don C. and Fam. B. have the highest diversity scores at 81%, indicating a broad range of species present in their systems. Doña L. and Y. show lower diversity at 69% and 63% respectively. TierraYai and Don O. fall in the mid-range with scores of 75% and 68%. 7 case studies over 8 scored 4 on crop diversity, showing that it is spread to have 3 crops of different varieties in poly or inter-cropping in these agroecology transitions, so the differences of total percentage of diversity are to be found in diversity of trees, animals and activities, where a variety of differences are found between the case studies.



Graphic 3, Percentages for all case studies of the indicator "Diversity"

These scores can be explained by dividing the indicator diversity in its sub-components, animal, trees and activities diversity:

- **Animal Diversity**

Farmers who do not raise animals or who only raise one or two species score poorly in terms of animal diversity, even if their agroecosystem is highly diverse and rich in native biodiversity. For example, Tierra Yai, with its major agroforestry system housing numerous species including migratory birds and insects, received a score of 1 since they only raised hens. The FAO capacity course (FAO, 2024a, p. 18-20) does not elaborate further on "animal diversity," and the term "animals raised" suggests that the diversity of animals raised is the only focus. However, it is crucial to consider the animals inhabiting the regenerated agroecosystem, as this is important for discussing agroecology and agroforestry as complex and sustainable systems (Perfecto & Vandermeer, 2017). Furthermore, the metric does not apply universally, as some participants, such as Don F., scored poorly because he does not raise animals.

Tree Diversity

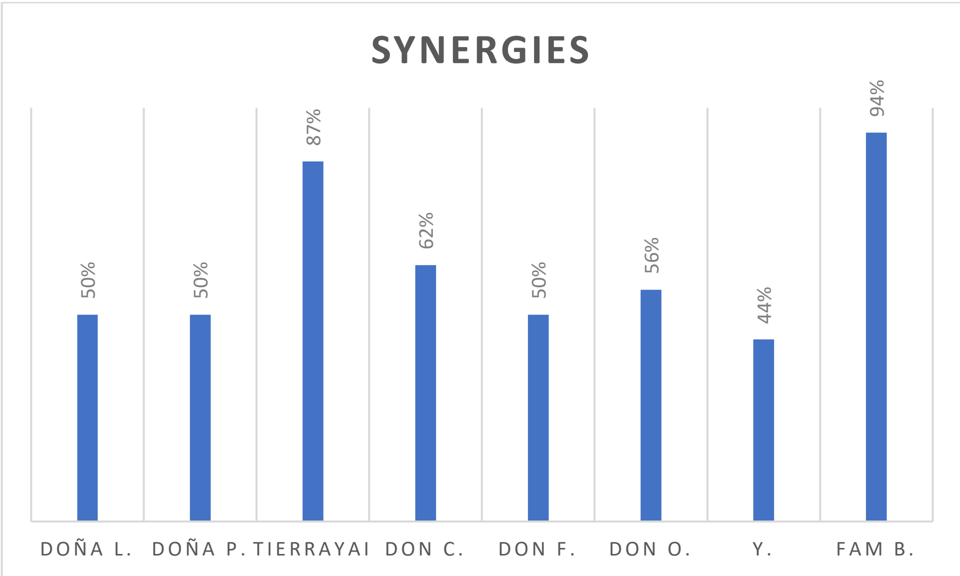
The scoring system for tree diversity is based solely on the number of trees and species, with categories such as "*few trees (1), some trees (2), significant number of trees (3), and high number of trees (4)*" (FAO, 2019, p.61). These categories are qualitative and can vary significantly between different *campesinos* regarding what constitutes a significant number of trees. In this thesis, which includes cases of complex successional agroforestry systems (Tierra Yai, Fam. B.), a new small agroforestry system (Y. case), a monoculture of avocados (Don O.), living fences (Don O.), few scattered trees in the finca (Doña P., Doña L.) the number of trees deemed significant varies greatly. The FAO capacity course notes that "*The presence, roles, and functions of trees vary considerably according to ecoregions or zones. Therefore, it is important for the evaluator to analyse the farm/territory in relation to these particularities. In some cases, other vegetation and perennial plants may be more relevant, as seen in 'grassland' regions or other specific situations to be considered when scoring this diversity index*" (FAO, 2024a, p.19). Consequently, I set the threshold for a significant number of trees as at least 50, to align with the average across the eight cases studied, though this number might not be substantial for Tierra Yai of Fam B., while it could be more than considerable for Doña L. However, the threshold of 50 trees is only based on the mean and should take into account surface of the farm 50 tree on 0,28 ha are different compared to a farm o1,5 ha, that is a limit of the evaluation.

- **Diversity of Activities**

In assessing the diversity of activities, it is essential to note that a score of 4 requires not only productive activities (such as selling crops or animals) but also the provision of services. This aligns with the resilience of economic diversity, reflected by crop diversity. Many of the case studies demonstrated how agroecology not only diversifies production but also income through service diversification: Doña P. sells organic fertilizers, Doña L. transports milk for delivery, Don C. offers farm tours and sells organic fertilizers, Fam. B. markets bread, cakes, and beeswax candles, and Y. is beginning to sell *arequipe* and coffee from their reforestation efforts. As noted by many participants, these activities are driven by economic reasons. Doña P. sells cheese at a sustainable price compared to the very low price of her organic milk. Don C. has shared that he covers his rent through farm tours rather than harvests, and Fam. B., after years of selling vegetables, is finding a new economic equilibrium based on higher-income activities such as running a restaurant and selling cakes, as well as reductions in taxes for conservation and reforestation by the Colombian government. This diversification also reflects the devaluation of agricultural products, making it challenging to compete with market prices and intermediaries. Thus, the creativity that drives the diversity of products and services also serves as a means of resisting socio-economic pressures.

II. Synergies

Synergies refer to the interactions between the various components of the agroecosystem that contribute to overall productivity and sustainability. Here are evaluated crop-livestock integration, soil-plants system management, integration with trees (agroforestry) and connectivity between agroecosystem-landscape. The successional agroforestry case studies have achieved the highest synergy score with Fam B. scoring 94% and Tierra Yai scoring 87%, reflecting strong interactions in the system. Followed by Don C. thanks to his living fence that serves as a tree zone of ecological compensation. The other case studies have moderate synergies score, respectively: Don O. 56%, Doña P., Doña L. and Don F. 50%, and Y. 44%.



Graphic 4, Percentages for all case studies of the indicator "Synergies"

The evaluation of synergies encompasses crop-livestock integration, soil-plant system management, agroforestry integration, and connectivity between the agroecosystem and the landscape. Three of these four elements are particularly relevant to agroforestry practices: intercropping and cover cropping, agroforestry (defined as valuing the integration of trees and other perennial plants into the system) (FAO, 2024a, p. 23), and agroecosystem connectivity (defined as high connectivity where the agroecosystem appears as a diverse mosaic and elements of the production system contribute to connectivity, such as ponds, trees, shrubs, patches of natural vegetation, natural corridors, and natural pastures) (FAO, 2024a, p. 24). As expected, the successional agroforestry case studies achieved the highest synergy scores, with Fam. B. scoring 94% and Tierra Yai scoring 87%, reflecting strong interactions within the system.

The assessment of crop-livestock integration was somewhat confusing. All case studies utilized animal manure to produce fertilizers, except for Don F., who does not keep animals. The criteria for crop-livestock "*High integration*" include animals being mostly "fed with farm-produced feed, crop residues, by-products, and/or grazing, with their manure used as fertilizer *and providing traction"* (FAO, 2019, p.62, cursive mine). "*Complete integration*" requires animals to be exclusively fed with farm-produced feed, crop residues, and by-products, with all manure recycled as fertilizer and providing multiple services (food, products, traction, etc.) (FAO, 2019, p. 62). However, in the studied Andean context, animals typically do not provide traction due to the mountainous terrain and the fact that *microfundios* in the region are often cultivated by hand. Indeed, all eight case studies did not use animals for traction.

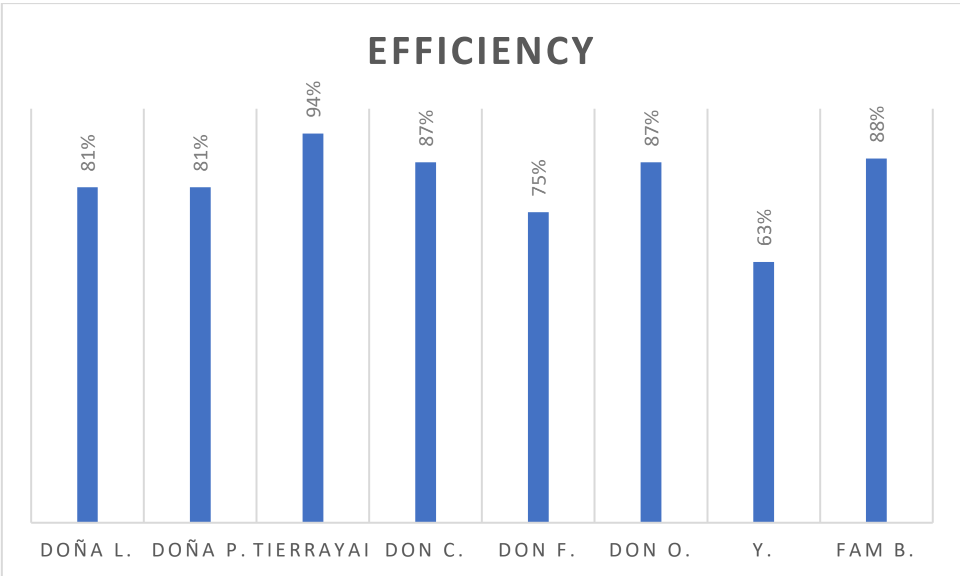
Regarding soil-plant system management, I found that incorporating rotations and intercropping with soil cover was not a functional evaluation in these case studies. All case studies are agroecologically advanced with permanent beds where they practice rotations in their productive plots, such as Don F., Don C., Don O., Doña L., and Doña P., or intercropping as in Tierra Yai, Fam. B., and Y.. However, only two cases (Tierra Yai and Fam. B.) met the criteria where "*all the soil is covered with residues or cover crops*" (FAO 2019, p. 62). Interviews and observations revealed that rotations are far more common than soil cover in this region: "*But as the agronomists teaching organic farming say, we need to use cover crops. But, as someone who has been doing this for a long time, it's hard to adopt, not just for me but also for the workers*!" (Doña L., 2024). Consequently, the FAO's categorization based on coupling such different practices was confusing: "*Score 2: 50% of the soil is covered with residues or cover crops; some crops are rotated or intercropped (or some rotational grazing is carried out); score 3: More than 80% of the soil is covered with residues or cover crops; crops are regularly rotated or intercropped (or rotational grazing is systematic); soil disturbance is minimized.*" (FAO, 2019, p.62). These categorizations do not seem to fit well with the practices in this region.

Similarly, the integration with trees is based on a scale of "small/significant number/many trees," which remains unclear in defining what constitutes a significant number of trees, especially when comparing agroforestry systems with mainly annual intercropping plots.

Finally, regarding connectivity between agroecosystem elements and the landscape, there is a notable emphasis on the presence of agroforests. Even a small agroforest, such as Y.'s on his father's land, serves not only as a productive system but also adds complexity to the landscape and can become a zone for reforestation and ecological compensation, integrating with cropland. Despite this, Y.'s small agroforest resulted in a low score due to its limited size relative to the entire agroecosystem. Conversely, the high scores for Tierra Yai and Fam. B. reflect the complex mosaic and landscape diversity created through active and passive reforestation, productive plots, and agroforests within the same agroecosystem, fostering substantial connectivity and ecological compensation without detracting from production and food sovereignty[12].

III. Efficiency

Efficiency measures evaluate how the production system performs in relation to the use of natural resources, with a strong emphasis on autonomy and minimal reliance on external inputs, particularly chemicals. Higher scores are awarded when inputs are produced on the farm or within the community, and when the household's needs are met through agroecosystem production. No score falls below 63% (as observed in the case of Y.). Don C., the B. family, and Don O. all demonstrate high efficiency, with scores of 87%, 88%, and 87%, respectively, while Tierra Yai achieves the highest score at 94%. Doña L., Doña P., and Don F. also exhibit strong efficiency, each scoring above 75%.



Graphic 5, Percentages for all case studies of the indicator "Efficiency"

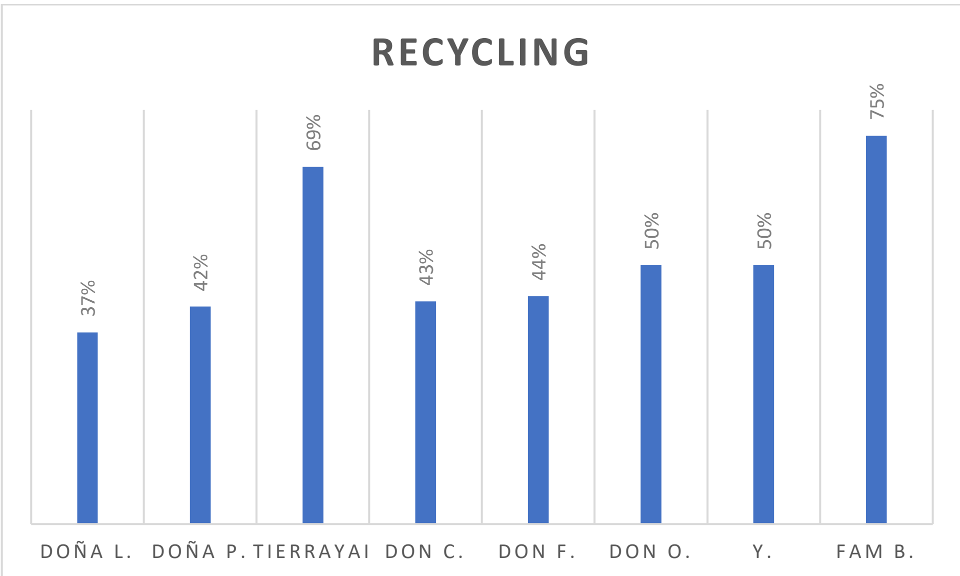
This indicator consistently receives high scores, as all the agroecological transitions assessed no longer rely on chemical inputs and frequently utilize internal inputs, such as

[12] For more in-depth information on Tierra Yai and Fam B. processes of regeneration see Annex 4.

self-made composts, fertilizers, and biological substances for pest management. The only sub-components of the indicator that prevented the case studies from achieving a 100% score are 'Use of External Inputs,' which considers seeds and components for fertilizers. All eight cases still rely on nurseries to purchase some types of plants or seeds, primarily for annual crops and seeds of requested but European varieties (carrots, for example, were a common one). Additionally, for agroforestry, specific tree seeds are difficult to find even in regional *Red de Guardianes de semillas* (Seed guardians' network). Furthermore, some components for fertilizers, such as molasses used in bioactive fertilizers (e.g., Tierra Yai and Y.), are purchased. However, the indicator that most significantly lowered the high scores was 'Productivity and Household Needs.' To score a 4 on this indicator, one must meet the criterion of "*All household needs are met both for food and for cash to buy all essentials and to have regular savings*" (FAO, 2019, p.64). Only two case studies met this criterion, as observed in the ethnographic transition portraits, where economic conditions were found to be challenging

IV. Recycling

Recycling evaluates the extent to which resources are reused within the system, thereby reducing waste and external inputs. This is the overall most deficient element within the studied agroecosystems, with an average score of 51%. The lowest scores are observed for Doña L. and Doña P., with 37% and 42% respectively, followed by Don C. (43%), Don F. (44%), and Don O. and Y., both scoring 50%. The highest score is achieved by the B. family with 75%, followed by Tierra Yai with 69%.

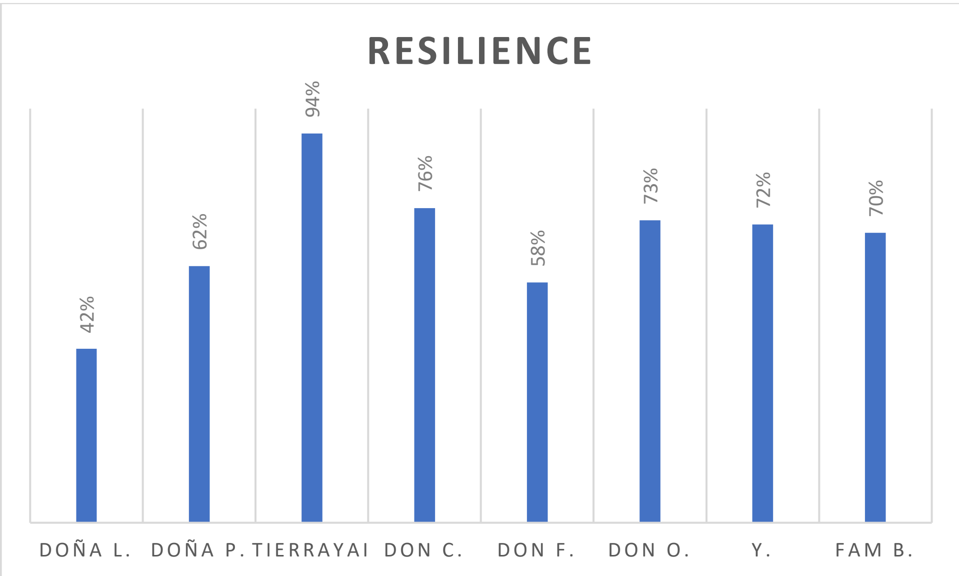


Graphic 6 , Percentages for all case studies of the indicator "Recycling"

In the assessment of this index, it can be observed that the two complex agroforestry systems have scored highly, with a significant gap compared to the other case studies. This could be explained as agroforestry inherently emphasizes the recycling of biomass and nutrients. Moreover, both the agroforestry agroecosystems studied have reservoirs or bio-lakes where water-saving and harvesting practices are actively applied. One of the sub-criteria of recycling and the least scored by all case studies is “renewable energy” and none of the case studies produce renewable energy such as wind or solar power. However, still Fam B. and Y. have scored higher because through agroforestry practices, small amounts of energy for cooking and heating can be generated from wood production. This contributed to a higher recycling score and improved overall recycling practices.

V. Resilience

Resilience indicates the agroecosystem’s ability to absorb perturbations and recover, with a focus on economic resilience, through the evaluation of stability of income, mechanisms to reduce vulnerability and indebtedness. TierraYai again ranks the highest with a resilience score of 94%. Similar results between 70% score and 76% score for Don C, Fam B., Don O and Y.; Doña L. and Doña P. have lower resilience scores, indicating potential vulnerabilities, at 42% and 62%.



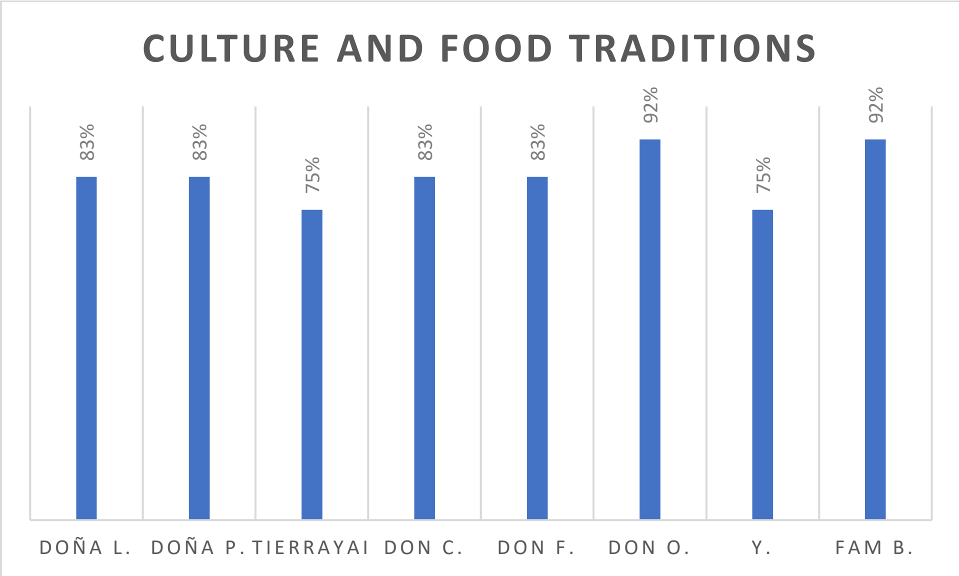
Graphic 7, Percentages for all case studies of the indicator "Resilience"

The substantial disparity between Tierra Yai and the other cases may be attributed to the evaluation criteria for resilience, which include income stability, access to credit, insurance, and indebtedness. Of the eight case studies considered, five do not have insurance or pension systems. This reflects the difficulty in accessing credit without incurring debt for *campesinos* in the region. Additionally, interviews revealed that subsidies are predominantly provided for monocultures or agrochemicals rather than for agroecological practices. While access to credit is more widespread, with seven out of eight cases having it, there are generally negative perceptions surrounding it:

- Doña P.: "*One has to incur debt whether one likes it or not. I don't like getting into debt; I live a bit strained because one takes out a loan and the interest consumes it.*"
- Doña L.: "*Even those who work with agrochemicals often struggle financially, usually having to incur significant debt or seek additional help*."
- Don O.: "*They offer you money, but the challenge is repayment. In the past, I had many debts and came close to losing everything*."
- Don C.: "*No, there are no subsidies or grants, and while I have access to credit, it comes with the highest interest rates on the market*."

VI. Culture and Food Traditions

This indicator reflects the integration of local culture and food traditions within the agroecosystem, evaluating so the social and cultural part of agroecology. This is the indicator that scored higher in all the indicators, based on the elements of appropriate diet, campesinos identity, local varieties and traditional knowledge for food preparation. All case studies score relatively high, with Fam B. and Don O. achieving the highest score of 92%. Don C., Doña L., Doña P., and Don F. all score consistently at 83%, while Y. and Tierra Yai have a slightly lower score of 75%.



Graphic 8, Percentages for all case studies of the indicator "Culture and Food traditions"

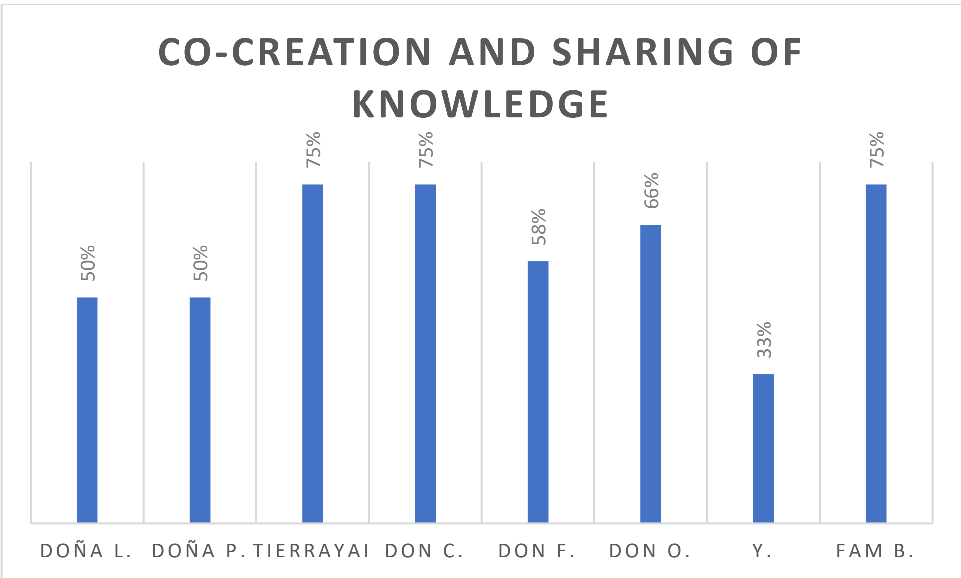
The index is divided in the assessment of Appropriate diet and nutrition awareness, local peasant/indigenous identity and awareness of local varieties and food preparation. All case studies demonstrate a strong sense of dietary appropriateness and nutrition awareness. The sense of identity and traditional food varieties, along with knowledge of food preparation, remain integral to the case studies campesinos lifestyle and practices. Furthermore, interviews frequently highlighted the alignment of traditional *campesino* culture with agroecology, both in terms of practices and the diverse economies it supports. However, there is a pervasive concern about the loss of *campesino* identity:

- Don I. (Fam. B.): "*I believe that campesino culture is fading away. But I do see optimism; people are realizing that organic markets are not a guarantee, and if we truly want to eat well and healthily, we need to reconnect. I think there is a resurgence among those who left for the city, worked, and then realized they were essentially working in a garden. That is hopeful*."
- Don O.: "*Campesino culture? There is a lot of floricolas, only hydrangeas, not even a single cabbage plant*."
- Doña L.: "*Campesinado is being heavily impacted by microenterprises. There will be food shortages in the future if campesino culture disappears. Awareness has shifted*."

This aspect of the TAPE methodology is highly relevant for indigenous and peasant identities, which are explicitly mentioned and align well with the frameworks of "*agroecologias del retorno*" and "*agroecologías históricas*" (Giraldo, 2022). However, the integration of such identity considerations into emerging agroecologies—where there is a significant presence of urban and neo-rural identities—poses a challenge. The concept of identity is complex, and the TAPE ranking of 0, which indicates "*no local or traditional (peasant/indigenous) identity felt*" (FAO, 2019, p.67) is specifically for peasant, indigenous, or Afro-descendant identities (though Afro-descendant identities are not explicitly mentioned, they are very present in Latin America). It is unclear whether this ranking applies to other types of identity or if it should recognize diverse identities within rural contexts. Applying TAPE to urban agroecologies or neo-rural transitions should address and detail these questions. In my case, during the questionnaire with the Natalias of Tierra Yai, we discussed this issue and decided to apply the question to their identity as rural inhabitants. They self-rated a 3, indicating a good awareness of local and traditional identity but without a strongly felt identity (score 4).

VII. Co-creation and Sharing of Knowledge

This indicator evaluates the collaborative practices for transfer, creation, access to agroecological knowledge. The scores here vary significantly, with Fam B., Don C. and Tierra Yai leading at 75%. Doña L., Doña P., and Don F. have moderate scores around 50%, indicating some level of knowledge sharing around agroecology. Y. shows the lowest score at 33%.



Graphic 9, Percentages for all case studies of the indicator "Co-creation and sharing of knowledge"

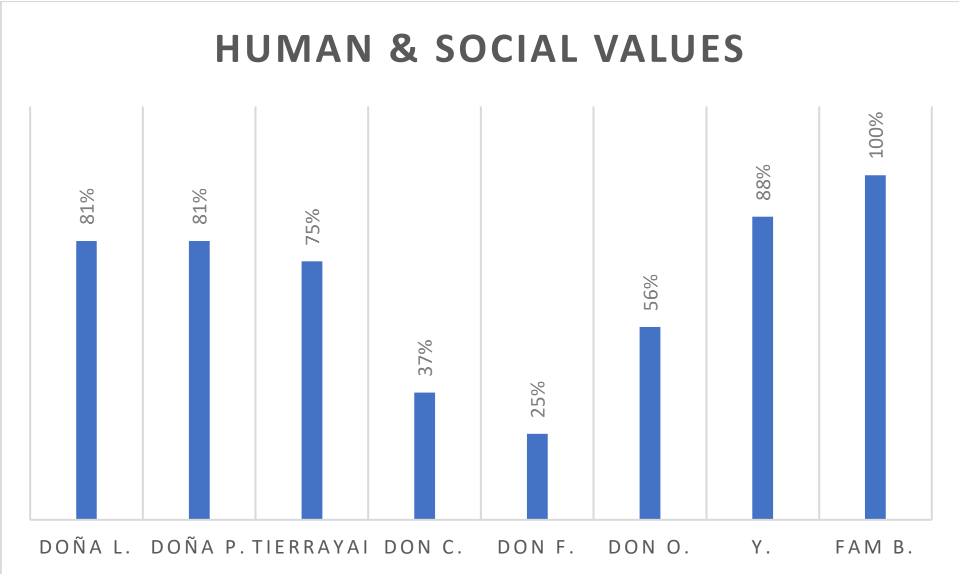
The indicator for co-creation and sharing of knowledge assesses the presence and effectiveness of platforms for the horizontal creation and transfer of agroecological knowledge. None of the case studies achieved the highest score of 4, which represents "*Several well-established and functioning platforms for the co-creation and transfer of knowledge are available and widespread within the community, including women*." (FAO, 2019, p.68). This outcome is due in part to the need to consider factors such as "*the actual level of participation, social recognition, openness, and other relevant local factors*" (FAO, 2024a, p. 41). Conversations with the campesinos explain the differences in scores: in general, even individuals well-connected to agroecological networks, such as Don C. and Tierra Yai, could not report the existence of several well-established and functioning platforms for knowledge co-creation in their territories.

In the Santuario region, a network is being developed through a *campesino* association with regular meetings, but horizontal transfer and co-creation of knowledge have not yet been fully realized. In Carmen del Viboral, there are more processes underway, but none are widespread. For example, *Hoja Rasca* has served as a school for many, as noted by Don I., and continues to transfer knowledge. However, its participatory processes are now more focused on tours with schools and university students rather than directly engaging local campesinos. What is notably lacking in the region is a robust campesino-to-campesino network. Interviews revealed a general sentiment of isolation among campesinos, particularly Y., Doña P., and Doña L., who also received lower scores for this indicator. This led me to consider that this feeling of isolation may be associated with the lack of a robust local network.

This issue is also reflected in the evaluation of the “participation of producers in networks and grassroots organizations”, where no participants rated the score as 4. This score represents "*Producers (with equal participation of men and women) who are highly interconnected and supportive and show very high engagement and participation in all events of their local community and grassroots organizations*". The limited participation observed in the territory is compounded by gender issues, which are challenging to assess when male interviewees are the primary respondents.

VIII. Human and Social Values

This index assesses the contribution of the agroecosystem to the well-being and social equity of the agroecological transitions, evaluating 4 elements: women empowerment, labour conditions, youth empowerment and animal welfare. Don I. scores the highest in this category with 100%. Y. scores high with 88%, near Doña P. and Doña L. who scored both 81%. Don O., Don C. and Don F. have lower scores of 56%, 37% and 25% respectively.



Graphic 10, Percentages for all case studies of the indicator "Human & Social Values"

The indicator for Human and Social Values exhibits the highest standard deviation, with scores ranging from 25% to 100%. The significant variation in scores is primarily due to differences in youth empowerment and women's empowerment, which received markedly different ratings.

Regarding women's empowerment, high scores were observed for Doña P., Doña L., and the Natalias of Tierra Yai. These women, as *campesinas* and *sembradoras*, embody many of the qualities defined by the FAO for women's empowerment, including decision-making at the household, production, and marketing levels, access to household resources and goods, and the presence of women's organizations or gender-focused organizational spaces. Doña P., Doña L., and the Natalias are all women who do not live with men and have full ownership of their assets and decision-making power over their finca's production resources. As reflected in their personal narratives, this empowerment presents challenges such as difficulty in finding workers and being taken seriously in the work field. These challenges are structural issues stemming from a patriarchal society, which all four women are aware of and openly discuss within their associative groups.

The Family B. also received relatively high scores for women’s empowerment, as the family consists of four women who have their own enterprises, registered under Doña A. and her daughters, and possess decision-making power over the finca. However, there are no functional and operational women’s organizations within this context.

Conversely, Don F. and Don C. received very low scores in women’s empowerment. Since both individuals are single men, therefore there are no women with decision-making power in their households. This undoubtedly contributed to their low scores in this indicator.

In terms of youth empowerment, only Y. and Family B. achieved high scores, which were reflected in the final index assessment. These are the only cases with young individuals within the agroecosystem who “*see their future in agriculture and are eager to continue and improve their parents’ activities*” (FAO, 2019, p. 70). The stories of Y. and the daughters of Family B. are inspiring and optimistic for a rural area that is increasingly depopulated and aging, as highlighted in their personal narratives.

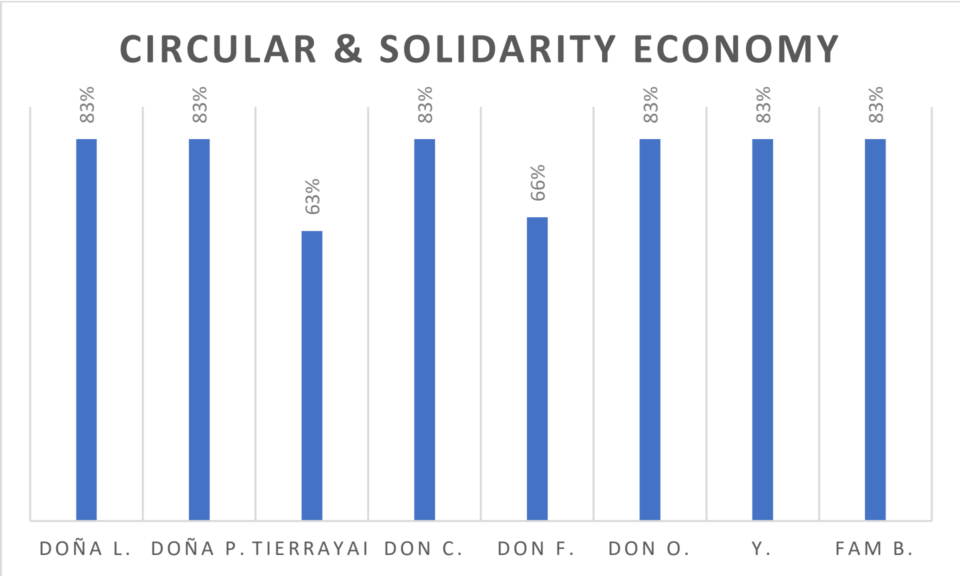
The indicator for Human and Social Values includes "Animal Welfare" as a final subdivision of evaluation, where the general welfare of animals and practices related to slaughter are assessed, when applicable. To my positive surprise, slaughter was not always a relevant or present factor to evaluate. Observations and interviews revealed that the relationship between campesinos and their breeding animals often extends beyond mere production or consumption. For example, three case studies illustrate that these farmers do not slaughter their animals for meat:

- Doña L.: "*I don't use goats for meat; I don’t like killing animals, it feels like a sin. I only deliver milk at home*."
- Doña P.: "*When they are old, I sell them alive because I don’t like to kill the little animals.*"
- Don O.: "*I have rabbits that were given to me; I couldn't bring myself to kill them; they are such beautiful animals*."

In most of the case studies, animals are an integral part of the agroecosystem, contributing to its synergies by producing manure that is recycled back into the system, and by providing other products. However, the value these farmers place on the lives of their animals, along with their moral decisions to refrain from killing them, challenges the notion that animals exist solely for utility. These perspectives offer new insights into the concept of animal welfare, prompting to reconsider and expand the understanding of it.

IX. Circular and Solidarity Economy

The circular and solidarity economy indicator assesses the extent to which the agroecological transition contributes to a circular and solidarity-based economy, prioritizing local markets and supporting local economic development by creating virtuous cycles. This indicator consistently receives high average scores, with generally similar and elevated results across cases. The B. family, Doña L., Doña P., Don C., Don O., and Y. all scored similarly at 83%, indicating comparable levels of engagement and economic strategies. Don F. and Tierra Yai have the lowest scores in this category, with scores of 66% and 63%, respectively.



Graphic 11, Percentages for all case studies of the indicator "Circular & Solidarity economy"

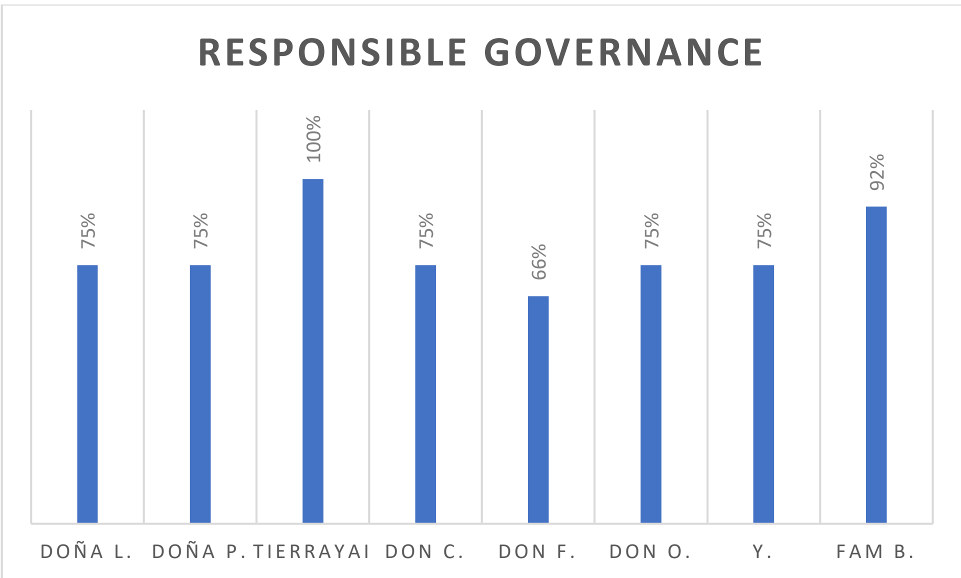
The Circular and Solidarity Economy indicator achieved a high average score with the lowest standard deviation among the indicators. Six case studies recorded a consistent high result of 83%. This can be attributed to the similarity in market networks utilized by the campesinas and campesinos, which are predominantly campesino markets, such as those in the Santuario and Carmen municipalities, operating without intermediaries and locally. Hoja Rasca, although there is an intermediary involved, helps stabilize prices to prevent significant inflation and market fluctuations, thereby maintaining a presence of local and solidarity economy principles. Regarding the network of producers, despite the similarities between the campesino markets in the two municipalities, there are some fundamental differences:

- The Santuario market is predominantly a women's market, fully establishing the gender perspective required by the FAO.
- Conversely, the market in Carmen del Viboral is better supported and operational due to municipal policies, which contributed to similar overall scores.

As the other indexes, gender assessment made Don F., as a only man to asses poorly, while Tierra Yai scores lower than the others because there is no food commercialization therefore no food markets, so it was assessed the market of the courses and services that extends not just locally but also on all national territory.

X. Responsible Governance

Responsible governance assesses how well governance structures and policies support the agroecosystem's sustainability and equity. Don I. leads with a score of 92%, indicating strong governance practices. TierraYai and Don O. also show high governance scores at 81% and 75%. Doña P. and Y. have governance scores of 68% and 65%, indicating areas for potential enhancement.



Graphic 12, Percentages for all case studies of the indicator "Responsible Governance"

The Responsible Governance indicator requires a multi-level analysis. It includes elements at the finca level, such as the participation of producers in land governance, and broader elements like producer empowerment and producers' organizations and associations. Producer empowerment assesses the acquisition of rights by farmers, including the effectiveness and opportunities for their practical exercise, considering gender perspectives and ethnic groups, and evaluates their means and capabilities to mobilize their interests, such as negotiation capacity and influence.

In this case, scores were relatively consistent across the case studies due to shared regional issues. *Campesinos* have access to markets and possess negotiation capacity and influence, though Colombia and Oriente still face significant challenges related to agribusiness and rural inequality. However, as observed within the Colombian framework, there are gradual changes occurring, influenced by national laws, policies, and programs that reward agricultural management models improving campesino governance, such as the recognition of campesinos as constitutional rights holders and the agroecological law. Regarding producers' organizations and associations, Don C., Family B., and Tierra Yai noted their participation in Semillas Libres de Antioquia, a regional network connected to a national network, which provides substantial support to farmers beyond traditional market and input access services.

8. Discussion

The findings of this research highlight the significant potential of agroecology and agroforestry as transformative practices that address both the ecological and social dimensions of agriculture. The case studies from the Oriente region of Antioquia, Colombia, demonstrate how these practices can enhance resilience, biodiversity, and food sovereignty in communities traditionally marginalized by industrial agricultural systems. In this discussion, I will revisit the research questions to analyse and synthesize the results obtained.

I. What are the primary barriers to implementing agroecological practices in the Oriente region, particularly concerning agroforestry practices?

As stated in the research objective, understanding these barriers is crucial for developing strategies to promote the widespread adoption of sustainable practices. The challenges related to agroecological transitions that emerged from interviews with *campesinos* and *campesinas* share many commonalities. Specifically, the most frequently mentioned and pressing issues, in order of occurrence in the interviews, are neighbouring farms' agrochemical use, economic pressures, lack of generational renewal, climate change, *machismo*, and degraded soils. Each of these will be discussed in detail.

Agrochemical Use by Neighbouring Farms

This issue, while external to the agroecological transition itself, was the most frequently lamented by the *campesinos* and *campesinas* interviewed. Only Don O. maintained good relations with his neighbours, who own pastureland and do not use agrotoxics. This problem reflects the condition where agroecology is confined to the farm level rather than being integrated at the landscape level, where these agroecological farms serve as bastions of resistance against an agribusiness system that has already colonized the broader landscape (Bartra, 2014). This situation poses contamination risks to agroecological farms, as evidenced by the experiences of Y.'s neighbours, Don C., and Fam B., who are surrounded by floriculture agribusinesses with high agrotoxics use, and Doña P., whose neighbours engage in conventional practices that involve fumigating their monocultures. As an example, Doña P. recounted that she once had fish in her reservoir, but they all died from water contamination because of neighbours' practices. Following the nature's matrix paradigm (Perfecto et al., 2019), animals, including soil microfauna and insects, migrate to and thrive in these pesticide-free agroecosystems, creating significant biodiversity, as seen in Tierra Yai, where a worker who often collaborated with me observed birds, fungi, and insects that she had never seen before or had not seen in many years. However, this situation can also create initial challenges, including economic ones. For instance, as Doña L. shared, her farm, being a little heaven for insects in a sea of pesticides, faced significant pest issues for a few years until a period of stabilization was reached. This situation also has health implications for *campesinos*, as evidenced by Don O. and Don C., who narrowly escaped poisoning after working with agrotoxics for many years.

Economic Pressure

Transitioning to agroecology often involves moving away from conventional markets, which, while positive in terms of eliminating intermediaries, presents challenges. As Doña P. explained, her organic raw milk is priced at the lowest level in the market—half the price of that in supermarkets. This situation underscores the need to value *campesinos*' labour and ensure fair prices in the market, a challenge that *Hoja Rasca* has been addressing in recent years by establishing fixed prices for both producers and buyers. This initiative has helped elevate the agroecological transition to Glissman's (2016) fourth level of transition, connecting campesinos with buyers and bridging the gap between rural areas and urban centres. Nevertheless, economic pressure remains a systemic issue, highlighting the political ecology of the food system, where there is a significant power disparity between *campesinos* and agribusiness, with their capacity to acquire land, access cheap labour, and offer competitive market prices at the cost of ecological devastation and loss of *campesino* food sovereignty, leading to de-peasantization (Van der Ploeg, 2009). It is evident that these agroecological transitions represent resistance, but although local initiatives, such as markets for agroecological products, provide some support, the overall infrastructure and institutional backing are often lacking or insufficient, making the transition more difficult. For example, subsidies were a frequently discussed topic in the interviews: none of the eight case studies receive subsidies for their agroecological production. The B. family managed to obtain a tax reduction by having their regenerative agroforestry efforts recognized as a civil natural park, but no one benefits from the state subsidies given to conventional producers. As a result, agroecological farmers are left to support themselves, competing in a market that is often unfair. Although there has been some legislative progress in terms of protecting *campesinos*, recognizing family agriculture, and redistributing land, conventional mechanisms still have a stronger hold on the population, making agroecological transitions in the Santuario and Carmen del Viboral areas still limited. This, coupled with years of armed conflict, has led to significant de-peasantization, which brings us to the next issue.

Lack of generational renewal.

The rural population is aging, and young campesinos are increasingly migrating to cities. If they remain, as reported by Y. and Don I. from the B. family, they tend to work in conventional agriculture or floriculture. This shift is not because the work is enjoyable, but because private companies typically provide a fixed salary with social security and a pension—benefits that campesinos often lack, as seen in the CAET results. This dynamic once again highlights the power disparity between floriculture companies and campesinos seeking to undertake an agroecological transition. Without effective subsidies or incentives for this transition, the struggle for ecological and social resistance for socially and ecologically just food sovereignty will fall on the shoulders of campesinos.

Systemic Gender Issues

For *campesinas* and *sembradoras*, this systemic economic oppression is exacerbated by the patriarchal oppression observed in the ethnographic portraits of transitions. All the women interviewed stated that one of the difficulties of the agroecological transition was being taken seriously and recognized by other men in rural areas. For instance, Doña L. and Doña P. faced exclusion because they could not find male workers willing to work for them, as the men did not want to be commanded by women, adding an extra layer of difficulty to their farming activities. Additionally, this is not only an issue of external labour but also of internal farm work that remains invisible and unpaid, as *campesinas* and *sembradoras* must carry out daily care work. The demands of unpaid care work disproportionately fall on women, as illustrated by Natalia from Tierra Yai and Doña L.'s experiences of caring for sick relatives, or Doña P. caring for her niece, which affects the ability to manage their farm effectively and reduced the time that could be dedicated to farming and agroforestry.

Climate change

Finally, a brief note on this topic, which was frequently mentioned in the interviews and acknowledged by all case studies. They recounted how the region used to be a "*reloj*" ("clock") (Doña L., Don C., Don O.), but in recent years, seasons no longer arrive when expected, with unpredictable weather patterns making it difficult to determine planting times. Additionally, there was considerable discussion about the recent *Verano* season, the warmer and drier season experienced in the Andean region under study. The last *Verano* (January-May 2024) was particularly harsh in terms of water scarcity and dry soil, indicating that not only is the weather unpredictable, but the externalities of climate change are making the conditions of *Verano* generally harsher. Doña P. recounted how the *Verano* destroyed the potato seedlings she had carefully managed for years, while Don F. reported losing his carrot and onion seeds due to the drought and sun. However, the agroecological transition has demonstrated good resilience to this phenomenon, particularly the agroforests of Tierra Yai and the B. family, which survived without water thanks to the coverage and succession that create shade and retain moisture.

And what about agroforestry practices?

In discussing the specific challenges associated with agroforestry systems in transition, it is important to consider that the two main case studies, Tierra Yai and Fam. B., are the only successional and regenerative agroforestry cases in the two municipalities, and they are quite unique. Both, over the past few years, have opted to stop selling their products at the market and instead generate income through alternative activities. In the case of Tierra Yai, the focus has shifted towards outreach and education. They offer courses on syntropic agroforestry design and provide agroforestry design and planting services for private clients. Additionally, they engage in specific projects with various institutions or social groups, such as the *Vamos Mujer* organization and *Parque Arvì*, aimed at training and designing agroforestry systems for *campesinos* and *campesinas*. A portion of their income also comes from remote work. For Fam. B., while the finca primarily supports self-sufficiency, they also provide other services. They run a seasonal restaurant that offers a menu based on the finca's seasonal harvest, overseen by the youngest daughter, who also manages the restaurant's operations. Additionally, they offer home delivery of cakes. Furthermore, Don I. occasionally works as a bio-constructor outside the finca. Thus, these are two cases of productive agroforestry systems primarily aimed at family self-sufficiency. Y.'s agroforestry process represents another form of regeneration, though it is still at an early stage and does not yet have an economic focus.

Often, economic studies on agroforestry emphasize the production, sales, and capital generated by such systems. However, in these cases, we can focus on other insights provided by the case studies. For example, the local markets of Santuario and Carmen del Viboral primarily revolve around annual crops, such as cabbage, lettuce, and carrots. Producing these short-cycle annuals intensively requires frequent planting and rotation, as highlighted by some interviewees, including Don I. from Fam. B.. However, for those focused on successional agroforestry with permanent beds, such practices are not the primary focus. As Don I. stated, "*When Hoja Rasca was focused on producing a lot of vegetables, many animals, trout, tilapia, chickens, goats, I found myself gradually shifting towards those. In organic farming, there is a lot of harvest, and with that, a lot of soil turnover, but you have to put a stop to so much tilling*." (Don I., May 9, 2024).

Furthermore, fruit sales in Santuario and Carmen are generally dominated by conventional large-scale monoculture farmers, as this is how the distribution system has operated since the Green Revolution. This poses a challenge for agroforestry or agroecological systems that aim to produce equal quantities but with increased diversity. This contrast is evident when comparing a highly diversified and productive agroforestry system like Tierra Yai, which regenerated land degraded by agrochemicals through successional agroforestry, with the monoculture of avocados cultivated by Don O. He sells his organic avocados to Hoja Rasca and at the Rionegro and Medellin markets, managing 150 trees to produce avocados suitable for large-scale distribution. These findings align with the challenges identified in the literature on transitioning to agroforestry. Market access often conflicts with prevailing market norms, which prioritize short-term economic gains and large-scale monoculture production (Hastings et al., 2021). Santoro et al. (2022) suggest that to support the adoption of agroforestry systems, it is necessary to develop policies that recognize the full range of ecosystem services provided by these systems, beyond the mere economic value of agricultural products. However, such measures are still largely lacking in Colombia and the region, leaving agroforestry systems to fall through the gaps within organizations that traditionally separate agriculture from conservation. Interestingly, the case of Fam. B. highlights how the Colombian government's Decree 2372 of 2010, Art. 17, allowed them to include their agroforestry regeneration process within the Civil Society Natural Reserves, granting them significant tax reductions. As Fam. B. explained, they were in debt, and this decree helped them substantially, especially in the current political and economic climate, where financial incentives, rural credit, and supply chain opportunities tailored to agroforestry systems are scarce.

Contrary to the literature, the agroforestry cases studied did not face issues related to the lack of secure and long-term land tenure, which often limits the willingness and ability to invest in perennials and trees (Lawin & Tamini, 2019). This is attributable to the specific structural conditions in Santuario and Carmen del Viboral, as presented in the geographical context. Although Antioquia has the highest Gini index among Colombian regions, indicating significant inequality in land distribution, it also has the highest number of *micro-fundios* owned by campesinos (IGAC, 2023). All eight case studies involved land areas generally smaller than two hectares but owned by the campesinos themselves.

Returning to the literature review question, "Who gets the privilege to adopt agroforestry?" (Hastings et al., 2021), in these case studies, those who have the power to diversify their income through various activities both within and outside the agroforestry system are more likely to adopt it. Another privilege is access to knowledge, as highlighted in the challenges of agroforestry (Hastings et al., 2021), with the major challenge to access to relevant information and comprehensive resources necessary for successful implementation (Simelton et al., 2015). This disparity is evident in the two successional agroforestry processes in these case studies. The regeneration process of Fam. B. has been ongoing for 20 years, involving the planting of trees (see Annex 4). Meanwhile, Tierra Yai's process began in 2012, with their first agroforestry system planted in 2020 (see Annex 2 and 4). Despite being more recent, their system is more complex, regenerative, and biodiverse, thanks to the syntropic, permaculture, and regenerative techniques they have implemented. This progress is partly due to their access to international agroforestry experiences in Brazil and the ability to read and utilize agroforestry information, typically available in Portuguese or English, usually online. This requires the skills to locate and understand these documents, even in non-native languages, which Don I. and Doña A. lack, making such knowledge a form of cultural capital (Bourdieu, 1986). Despite these differences, it is interesting to observe how Tierra Yai and Fam. B. share similar successional agroforestry practices, with guiding principles like soil coverage, respecting natural succession, constant pruning, and using the woody cover from pruning as mulch (see Annex 4).

II. Do agroecological transitions that incorporate agroforestry practices achieve better outcomes, as measured by TAPE, compared to other types of agroecological transitions?

The TAPE methodology does not solely evaluate the biological or diversity components of the agroecosystem but also considers the social and political externalities, focusing on aspects such as gender equality, the presence of campesino associations, and sales economy. The final scores indeed showed better achievements for Fam. B. and Tierra Yai, with scores of 85% and 81%, respectively.

Specifically, as illustrated by the AMOEBA diagram (see Graphic 1), the two successional agroforestry systems significantly outperformed others in the areas of synergies and recycling. This outcome, as explained in the results, is due to the high level of interaction within the system and the strong synergies inherent in successional agroforestry, particularly in the presence of trees, landscape diversity, and soil-plant interactions. Tierra Yai and Fam. B. demonstrate the benefits of creating a complex mosaic and diverse landscape through active and passive reforestation, productive plots, and agroforests within the same agroecosystem. This approach enhances substantial connectivity and ecological compensation without compromising production and food sovereignty. Soil-plant interactions are further encouraged through practices such as pruning, cover cropping, and the chop-and-drop method. It is also evident that the presence of living fences by Don C., Y.'s small agroforestry system, and Don O.'s tree polyculture contributed positively to synergies. In terms of recycling, Tierra Yai and Fam. B. scored higher due to their ability, as discussed in the results, to produce firewood on-site, which enhances the finca's resilience, even though they do not produce other forms of renewable energy.

Regarding diversity, where I had expected a significant advantage for regenerative agroforestry systems, the performance was good but average compared to other agroecosystems. This is partly because diversity scores were lowered, particularly in animal diversity. For example, Tierra Yai, despite its major agroforestry system supporting numerous species, including migratory birds and insects, received a lower score because they only raised hens. While in other indexes the agroforestry systems evaluated also scored well, it is uncertain how much of this can be attributed directly to agroforestry. Clearly, there is a significant academic gap, and more studies should be conducted on agroforestry systems, with TAPE applied to a larger number of case studies.

A final and crucial observation is that the three farms that scored the highest (Fam B., Tierra Yai, Don O.) did so likely because of their agroforestry systems, diversity, and the presence of trees. However, it is also worth noting that these farms have the largest land size, even though we are still talking about micro-farms, all under 3 hectares, and in most cases, less than 2 hectares (see Annex 5). This could suggest that the other farms, with less land, might need to produce the same amount with more intensive rotations due to market demands. This observation also ties back to the comprehensive *Reforma Rural Integral* in Colombia and the fact that small farmers in Colombia generally have access to very little secure land (IGAC, 2023). The redistribution of even a small amount of land could be key to fostering a robust and resilient agroecological family farming system if, as suggested by these findings, improved performance is indeed correlated with a slight increase in land size.

III. What are the challenges and specificities of applying TAPE in this territorial context, particularly in relation to agroforestry transitions?

This section discusses the final research question, which explores the practical and methodological challenges of using TAPE within the specific socio-economic and environmental context of the Oriente region, with a focus on how effectively TAPE can be adapted to measure the outcomes of agroforestry transitions.

Overall, I believe that using TAPE's CAET is helpful for identifying strengths and weaknesses in the various agroecological transitions assessed. It serves as a valuable initial evaluation tool for identifying areas that require recommendations for project design and for assisting vulnerable populations in beginning or accelerating their transition to agroecology. The CAET evaluates these aspects using a simple 0–4 Likert scale, which can lack depth, as many of the scales cover multiple aspects. Therefore, while CAET is a good tool for obtaining an overview of agroecological transitions and identifying well-developed areas, it would be beneficial to complement it with more in-depth studies, such as detailed interviews, whenever possible.

Limitations of the CAET Method in the Geographic Context

The generic indicators and scores of CAET require grounding in local realities before they can be effectively used in assessments (Mottet et al., 2020). Namirembe et al. (2022) provide an example of the differing perceptions between what the FAO considers good nutrition and what farmers in Soroti consider good nutrition: "*farmers in Soroti* *considered some 'new' foods as good for diets and nutrition (such as the recently introduced fruit trees like jackfruit, avocado, and banana), yet the FAO tool seems to imply that only 'traditional food' is 'good'*" (Namirembe et al., 2022, p.7). This discrepancy complicates the assessment of the "culture and food tradition" index, which needs to be contextualized and possibly modified to reflect local realities. Here are some of the issues that may limit or need to be contextualized when applying TAPE in the Oriente Andean area:

- In the studied Andean context, animals are typically not used for traction due to the mountainous terrain, and the *microfundios* in the region are often cultivated by hand. Indeed, all eight case studies did not use animals for traction and this confused the assessment of the crop-livestock-aquaculture integration of synergies index where the 3 score "their manure is used as fertilizer *and* they provide traction" (italics mine) while the 4 score "all their manure is recycled as fertilizer and they provide more than one service (food, products, traction, etc.)." contemplates more than just the traction service (FAO, 2019, p.62).

- Incorporating rotations and intercropping with soil cover was not prevalent in this region. Only two cases (Tierra Yai and Fam. B.) met the criteria where "*all the soil is covered with residues or cover crops*" (FAO 2019, p. 62). Interviews and observations revealed that rotations are far more common than soil cover in this region, leading to a "*double-barreled*" index where responses encompass more than one option, making it difficult to assign an appropriate score when only partially fulfilling the criteria.

- As highlighted in the results, the index culture and food traditions evaluates the concept of "*local or traditional (peasant/indigenous) identity felt*" (FAO, 2019 p. 67). However identity is a complex concept and just specifically refers to peasants and indigenous identities, and it is unclear whether this ranking applies to other types of identity or if it should recognize diverse identities within rural contexts. This could be particularly challenging for applying TAPE to urban agroecologies or neo-rural transitions, with the question if it should be applied or not to recent identities, like neo-rurals.

- As highlighted in the literature by López-Rojas et al. (2024), the tool does not include alternatives for evaluating agroecological transitions in cases where certain elements are missing. For example, in cases where there are no young people because the couple had no children, or where there are no women because the household consists of single men, such as with Don C. and Don F. These two cases reached very low gender scores, negatively affecting the overall evaluation.

- Finally, one of the limitations I encountered was the time required for the interview. According to the FAO (2021), interviews comprising phases 1 and 2 should take approximately two hours. However, in the field, I found that just covering phase 1 took an average of two hours and forty minutes, sometimes more, with follow-up visits needed, as with Don C. and Don O., to clarify and grasp more information. I also added an ethnographic component to TAPE, which contributed to the time required. Nonetheless, I believe it would have taken longer regardless because building trust with campesinos to obtain truthful responses, especially on sensitive topics such as debt and the economy, is not something that can be done quickly. Additionally, an ethical consideration arises from the time I spent with the *campesinos*: interviews and hours spent talking mean lost working hours for the producers. Although all the *campesinos* and *campesinas* involved in the case studies were very kind to me, I still perceived this struggle, especially with the women interviewed, who typically have less time due to their caring roles.

Limitations of the CAET Method in the Agroforestry Context

- Highly diverse and rich in native biodiversity, successional agroforestry systems without breed animals score poorly, even if they serve as biodiversity hubs. The sub-component of the categorization "*animal diversity*" should be extended to include animals not bred by humans, to acknowledge a less anthropocentric view of non-human animals.
- For evaluating tree diversity, the categorization currently uses only qualitative indicators. It would be appropriate to jointly discuss with the farmers what constitutes "a significant number of trees," establish an average, and evaluate the agroforestry systems accordingly. Similarly, the integration with trees in synergies index is based on a scale of "small/significant number/many trees," which remains unclear in defining what constitutes a significant number of trees,

especially when comparing agroforestry systems with primarily annual intercropping plots.

9. Conclusions

Citing the latest IPCC report: "*Climate change is a threat to human well-being and planetary health (very high confidence). There is a rapidly closing window of opportunity to secure a liveable and sustainable future for all (very high confidence). (…) The choices and actions implemented in this decade will have impacts now and for thousands of years (high confidence)*" (IPCC, 2023, p.24). This stark reality, combined with the data presented in the introduction concerning the massive greenhouse gas emissions from agriculture and its contribution to climate change (Crippa et al., 2021; FAO, 2023a, 2024b; IPCC, 2022), alongside unprecedented levels of inequality (Khalfan et al., 2023; Riddell et al., 2024), mass extinction events (Ceballos et al., 2015; Cowie et al., 2022), tipping points (Armstrong McKay et al., 2022), and the risk of irreversible climate feedback loops leading to a "Hothouse Earth" scenario (Steffen et al., 2018), are all pressing challenges we face in the current epoch of climate crisis.

As a sociologist researcher studying climate change, the emotional burden is considerable, mostly because I always focused on critical research and studies, yet often struggle to identify practical, feasible solutions to truly address this polycrisis - or at least manage to find a space in the *art of living on a damaged planet*, as Tsing et al. (2017) and Hawaray (2019) describe it. Discovering agroecology as an alternative for creating a more equitable and climate-adaptive system has been one of the most significant insights over the past two years. I essentially recognized that a *pluriverse* of solutions already exists (Kothari et al., 2019), including the diverse agroecological *multitudes* (Giraldo, 2022). Agroecology emerges for me as the crucial nexus between the biological and social challenges of our time, all of which are deeply intertwined within the climate crisis. The rediscovery of traditional, familiar, agroecological agroforestry systems and biomimicry represents an ontological shift, offering solutions that integrate both the causes and remedies of the crisis into a cohesive socio-biological framework.

As outlined in the objectives of this study, this thesis aims to be pivotal in the understanding of the complex processes involved in agroecological transitions, experimenting with a blend of ethnography and the FAO methodology. It seeks to address gaps in the literature, particularly the significant lack of social science research in the study of agroforestry and, more specifically, in the examination of agroecological agroforestry transitions. This study aspires to be a starting point for understanding these dynamics, with the hope that future research will engage in long-term studies to fully comprehend these dynamics, prioritizing taking more time to study these transitions. In agroecological and especially agroforestry systems, which operate on the time scales of nature, it is crucial not to seek quick answers.

Regarding TAPE, future research should adopt the full TAPE methodology, including steps 0, 1, 2, and 3, and implement it across all farms in the region or municipalities. This would provide a comprehensive understanding of the current state of agroecological transition within the territory and the landscape, allowing for targeted evaluations to identify where support and incentives are most needed in the transition process. However, as suggested in the discussion, TAPE should be adapted to local contexts: for instance, the assessment of cultural and food traditions could be tailored to reflect local dietary practices, nutritional perceptions, and the diversity of identities within rural populations. Such adaptations would enhance the tool's relevance and accuracy in measuring the true impact of agroecological practices in different settings.
While for the application of TAPE to agroforestry systems, with a few adjustments to address its limitations - such as clarifying what constitutes a significant number of trees - it could serve as an effective method for bridging the gap between agroforestry and agroecology and for monitoring the socio-cultural dynamics of transitions towards agroforestry systems. Furthermore, it would be beneficial to supplement the tool with qualitative methods: in-depth interviews, as used in this thesis, could accompany the CAET to capture the nuances of agroecological transitions that may be overlooked by the tool’s standardized questions. For example, understanding the reasons behind the absence of certain particularly low scores, could provide a richer context for interpreting results.

A theoretical contribution of this thesis is the exploration of the connections between agroecology and agroforestry, highlighting how they can be integrated, where they diverge in practice, and the broader socio-political context in which they coexist. It is crucial to acknowledge that not all agroforestry systems align with agroecological principles, and this distinction should be considered when analysing agroforestry transitions within the global food system framework. This approach reveals the power dynamics at play and helps identify which transitions genuinely advance ecological and social justice. Moreover, I find it essential to avoid academic, political and militant divisions between agroforestry, agroecology, permaculture, and other agro-transformative approaches. By understanding and integrating the principles of both agroecology and agroforestry, while remaining vigilant to the risks of co-optation, we can work towards creating agricultural landscapes that are ecologically balanced, socially just, and economically sustainable, while regenerating biodiversity, soil fertility, and food sovereignty.

In conclusion, this thesis blends the personal experiences of *campesinos*, *campesinas*, and *sembradoras* with the evaluation of practices, all in the pursuit of closely examining local realities to better understand global processes. At the end of this journey, I am increasingly convinced that agroecology and agroforestry have the potential not only to transform agricultural systems but also to offer a critical opportunity to rethink the relationship between agriculture, society, and the environment, as well as the dichotomy between nature and culture. Finally, it offers us a practice, on this wounded planet: "*Transformar y alimentar de forma activa los ecosistemas para que la reproducción de la vida se dinamice. Crear y recrear saberes ambientales localizados capaces de trabajar con las fuerzas vitales, en un bucle poietico de vida que cree más vida*"[13] (Giraldo, 2022, p.201).

[13] "Actively transforming and nourishing ecosystems so that the reproduction of life is invigorated. Creating and recreating localized environmental knowledge capable of working with vital forces in a poietic loop of life that generates more life". Translation by author.

IX. Glossary

- TAPE - Tool for Agroecology Performance Evaluation
- CAET - Characterization of Agroecological Transition
- AFS - Agroforestry Systems
- ICRAF - International Centre for Research in Agroforestry
- TAS - Traditional Agroforestry Systems
- PNA - Plano Nacional Agroecológico
- RRI - Reforma Rural Integral
- ACFC - Agricultura Campesina Familiar Comunitaria
- FARC-EP - Fuerzas Armadas Revolucionarias de Colombia – Ejército del Pueblo
- ELN - Ejército de Liberación Nacional
- GAO - Grupos Armados Organizados
- GAOR - Grupos Armados Organizados Residuales

X. Bibliography

a. Interviews

Name	Date	Topic	Time	Place
Sanin Natalia and Valencia Natalia	March 15, 2024	Internship conversation	2h	Tierra Yai, Vereda el Carmelo, Santuario.
Sanin Natalia and Valencia Natalia	April 26, 2024	Cartographic participatory lab	2h	Tierra Yai, Vereda el Carmelo, Santuario.
Sanin Natalia and Valencia Natalia	May 5, 2024	Tierra Yai tour and Conversation with Red Semillas Libres de Antioquia	1h 30 min	Tierra Yai, Vereda el Carmelo, Santuario.
Sanin Natalia and Valencia Natalia	May 15, 2024	CAET	1h	Tierra Yai, Vereda el Carmelo, Santuario.
Fam B. (Doña A. and Don I.)	May 9, 2024	Walking Interview + CAET	3h 30 min	Finca B., Vereda Camargo, Carmen del Viboral.
Doña L.	April 23, 2024	Walking Interview + CAET	3h 33 min	Vereda el Salto, Santuario.
Doña P.	April 24, 2024	Walking Interview + CAET	4h 45 min	Vereda Aldana Abajo, Santuario, Antioquia.
Don C.	April 28, 2024	Walking Interview	2h 10 min	Vereda La Milagrosa, Carmen del Viboral.
Don C.	April 28, 2024	CAET	1h	Hoja Rasca, Carmen del Viboral

Don F.	April 29, 2024	Walking Interview + CAET	2h	Finca P., Carmen del Viboral.
Don O.	May 3, 2024	CAET	45min	Hoja Rasca, Carmen del Viboral
Don O.	May 11, 2024	Walking Interview	2h 30min	Vereda Betania Baja, Carmen del Viboral.
Y.	May 3, 2024	Walking Interview + CAET	2h 30 min	Vereda la Milagrosa, Carmen del Viboral.

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XII. Annexes

a. Appendix 1: Questionnaire administered to case studies in Phase 0 and Phase 1 (CAET) in Spanish, including additional questions on challenges and trees.

PASO 0 - DESCRIPCIÓN DE SISTEMAS Y CONTEXTO

1. ¿Cuántas personas viven en el hogar? ¿Cuántas mujeres, jóvenes y niños?
2. ¿Cuántos de estos trabajan en el sistema de producción agrícola evaluado?
3. Superficie total en producción (ha)
4. ¿Cuáles son los productos agrícolas productivos?
5. ¿Cuál es el principal destino previsto de la producción agrícola?

PASO 1 – CAET

1. **Diversidad**

1.1. **Cultivos**

0 - Monocultivo (o sin cultivos).
1 - Un cultivo que cubre más del 80 por ciento del área cultivada.
2 - Dos o tres cultivos con una superficie cultivada importante.
3 - Más de 3 cultivos con una superficie cultivada significativa adaptada a las condiciones climáticas locales y cambiantes.
4 - Más de 3 cultivos de diferentes variedades adaptados a las condiciones locales y finca espacialmente diversificada con cultivos múltiples, policultivos o intercalados.

1.2. **Animales**

0 - No se crían animales.
1 - Solo una especie.
2 - Dos o tres especies, con pocos animales.
3 - Más de tres especies con un número significativo de animales.
4 - Más de tres especies con diferentes razas bien adaptadas a las condiciones locales.

1.3. **Árboles**

0 - Sin árboles (ni otras plantas perennes).
1 - Pocos árboles (y/u otras plantas perennes) de una sola especie.
2 - Algunos árboles (y/u otras plantas perennes) de más de una especie.
3 - Número significativo de árboles (y/u otras plantas perennes) de diferentes especies.
4 - Gran cantidad de árboles (y/u otras plantas perennes) de diferentes especies integrados en la tierra de cultivo.

1.4. **Diversidad de actividades, productos y servicios**

0 - Una sola actividad productiva (por ejemplo, vender una sola cosecha).
1 - Dos o tres actividades productivas (por ejemplo, venta de 2 cultivos, o un cultivo y un tipo de animales).
2 - Más de 3 actividades productivas.
3 - Más de 3 actividades productivas y un servicio (por ejemplo, procesamiento de productos en la finca, ecoturismo, transporte de bienes agrícolas, capacitación, etc.).
4 - Más de 3 actividades productivas y varios servicios.

2. **Sinergias**

2.1. Integración cultivo-ganado-acuicultura

0 - Sin integración: los animales, incluidos los peces, se alimentan con piensos comprados y su estiércol no se utiliza para la fertilidad del suelo; o ningún animal en el agroecosistema.
1 - Baja integración: los animales se alimentan principalmente con piensos comprados, su estiércol se utiliza como fertilizante.
2 - Integración media: los animales se alimentan mayoritariamente con piensos producidos en la explotación y/o pastoreo, su estiércol se utiliza como fertilizante.
3 - Alta integración: los animales se alimentan mayoritariamente con piensos producidos en la explotación, residuos y subproductos de cultivos y/o pastoreo, su estiércol se utiliza como fertilizante y les proporciona tracción.
4 - Integración completa: los animales se alimentan exclusivamente con piensos producidos en la granja, residuos y subproductos de cultivos y/o pastoreo, todo su estiércol se recicla como fertilizante y brindan más de un servicio (alimento, productos, tracción, etc.).

2.2. **Gestión del sistema de plantas de suelo**

0 - El suelo está descubierto después de la cosecha. Sin cultivos intercalados. Sin rotaciones de cultivos (o sistemas de pastoreo rotacionales). Fuerte alteración del suelo (biológica, química o mecánica).
1 - Menos del 20 por ciento de la tierra cultivable está cubierta con residuos o cultivos de cobertura. Más del 80 por ciento de los cultivos se producen en monocultivo y cultivo continuo (o sin pastoreo rotativo).
2 - 50 por ciento del suelo está cubierto de residuos o cultivos de cobertura. Algunos cultivos se rotan o intercalan (o se realiza algún pastoreo rotativo).
3 - Más del 80 por ciento del suelo está cubierto de residuos o cultivos de cobertura. Los cultivos se rotan con regularidad o se intercalan (o el pastoreo rotativo es sistemático). Se minimiza la alteración del suelo.
4 - Todo el suelo está cubierto de residuos o cultivos de cobertura. Los cultivos se rotan regularmente y el cultivo intercalado es común (o el pastoreo rotativo es sistemático). Poca o ninguna alteración del suelo.

2.3. **Integración con árboles (agroforestería, silvopastoralismo, agrosilvopastoralismo)**

0 - Sin integración: los árboles (y otras plantas perennes) no tienen un papel para los humanos, ni en la producción de cultivos o animales.

1 - Baja integración: una pequeña cantidad de árboles (y otras plantas perennes) solo proporcionan un producto (por ejemplo, frutas, madera, forraje, sustancias medicinales o bioplaguicidas ...) o servicio (por ejemplo, sombra para los animales, mayor fertilidad del suelo, retención de agua, barrera para erosión del suelo ...) para humanos, cultivos y/o animales.
2 - Integración media: un número significativo de árboles (y otras plantas perennes) proporcionan al menos un producto o servicio.
3 - Alta integración: un número significativo de árboles (y otras plantas perennes) proporcionan varios productos y servicios.
4 - Integración completa: muchos árboles (y otras plantas perennes) proporcionan varios productos y servicios.

2.4. **Conectividad entre elementos del agroecosistema y el paisaje**

0 - Sin conectividad: alta uniformidad dentro y fuera del agroecosistema, sin ambientes seminaturales, sin zonas de compensación ecológica.
1 - Baja conectividad: se pueden encontrar algunos elementos aislados en el agroecosistema, como árboles, arbustos, cercas naturales, un estanque o una pequeña zona de compensación ecológica.
2 - Conectividad media: varios elementos son adyacentes a cultivos y/o pastos o una gran zona de compensación ecológica.
3 - Conectividad significativa: se pueden encontrar varios elementos entre parcelas de cultivo y/o pastos o varias zonas de compensación ecológica (árboles, arbustos, vegetación natural, pastos, setos, canales, etc.).
4 - Alta conectividad: el agroecosistema presenta un mosaico y paisaje diversificado, muchos elementos como árboles, arbustos, vallas o estanques se pueden encontrar entre cada parcela de cultivo o pasto, o varias zonas de compensación ecológica.

3. **Eficiencia**

3.1. **Uso de entradas externas**

0 - Todos los insumos se compran en el mercado.
1 - La mayoría de los insumos se compran en el mercado.
2 - Algunos insumos se producen en la finca/dentro del agroecosistema o se intercambian con otros miembros de la comunidad.
3 - La mayoría de los insumos se producen en la finca/dentro del agroecosistema o se intercambian con otros miembros de la comunidad.
4 - Todos los insumos se producen en la finca/dentro del agroecosistema o se intercambian con otros miembros de la comunidad.

3.2. **Gestión de la fertilidad del suelo**

0 - Los fertilizantes sintéticos se utilizan regularmente en todos los cultivos y/o pastizales (o no se utilizan fertilizantes por falta de acceso, pero no se utiliza ningún otro sistema de gestión).
1 - Los fertilizantes sintéticos se usan regularmente en la mayoría de los cultivos y algunas prácticas orgánicas (por ejemplo, estiércol o compost) se aplican a algunos cultivos y/o pastizales.
2 - Los fertilizantes sintéticos se utilizan solo en unos pocos cultivos

específicos. Las prácticas orgánicas se aplican a los demás cultivos y/o pastizales.
3 - Los fertilizantes sintéticos solo se utilizan excepcionalmente. Una variedad de prácticas orgánicas son la norma.
4 - No se utilizan fertilizantes sintéticos, la fertilidad del suelo se maneja solo a través de una variedad de prácticas orgánicas.

3.3. **Manejo de plagas y enfermedades**

0 - Los pesticidas y medicamentos químicos se utilizan regularmente para el manejo de plagas y enfermedades. No se utiliza ninguna otra gestión.
1 - Los pesticidas y medicamentos químicos se utilizan únicamente para un cultivo/animal específico. Algunas sustancias biológicas y prácticas orgánicas se aplican esporádicamente.
2 - Las plagas y enfermedades se manejan mediante prácticas orgánicas, pero los pesticidas químicos se utilizan solo en casos específicos y muy limitados.
3 - No se utilizan pesticidas ni medicamentos químicos. Las sustancias biológicas son la norma.
4 - No se utilizan pesticidas ni medicamentos químicos. Las plagas y enfermedades se gestionan mediante una variedad de sustancias biológicas y medidas de prevención.

3.4. **Productividad y necesidades del hogar**

0 - No se satisfacen las necesidades de alimentos ni de otros elementos esenciales del hogar.
1 - La producción cubre solo las necesidades alimentarias del hogar. Sin excedente para generar ingresos.
2 - La producción cubre las necesidades de alimentos de los hogares y los excedentes generan dinero en efectivo para comprar lo esencial, pero no permiten ahorrar.
3 - La producción cubre las necesidades de alimentos de los hogares y el excedente genera efectivo para comprar lo esencial y tener ahorros esporádicos.
4 - Todas las necesidades del hogar se satisfacen, tanto en comida como en efectivo para comprar todos los artículos básicos necesarios y tener ahorros regulares.

4. Reciclaje

4.1. Reciclaje de biomasa y nutrientes

0 - Los residuos y subproductos no se reciclan (por ejemplo, se dejan para descomponer o quemar). Se descargan o se queman grandes cantidades de desechos.
1 - Una pequeña parte de los residuos y subproductos se recicla (por ejemplo, residuos de cultivos como alimento para animales, uso de estiércol como fertilizante, producción de compost a partir de estiércol y desechos domésticos, abono verde). Los desechos se descargan o se queman.
2 - Se recicla más de la mitad de los residuos y subproductos. Algunos residuos se descargan o se queman.
3 - La mayoría de los residuos y subproductos se reciclan. Solo se descarga o quema una pequeña cantidad de desechos.

4 - Se reciclan todos los residuos y subproductos. No se descarga ni se quema ningún residuo.

4.2. **Ahorro de agua**

0 - Sin equipos ni técnicas para la recolección o el ahorro de agua.
1 - Un tipo de equipo para la recolección o el ahorro de agua (por ejemplo, riego por goteo, tanque).
2 - Un tipo de equipo para la recolección o el ahorro de agua y el uso de una práctica para limitar el uso del agua (por ejemplo, riego temporal, cultivos de cobertura).
3 - Un tipo de equipo para la recolección o ahorro de agua y diversas prácticas para limitar el uso de agua.
4 - Varios tipos de equipos para la recolección o ahorro de agua y diversas prácticas para limitar el uso de agua.

4.3. Manejo de semillas y razas

0 - Todas las semillas y/o recursos genéticos animales (por ejemplo, pollitos, animales jóvenes, semen) se compran en el mercado.
1 - Más del 80 por ciento de las semillas/recursos zoogenéticos se compran en el mercado.
2 - Aproximadamente la mitad de las semillas son de producción propia o de intercambio, la otra mitad se compra en el mercado. Aproximadamente la mitad de la cría se realiza con granjas vecinas.
3 - La mayoría de las semillas/recursos zoogenéticos son de producción propia o de intercambio. Algunas semillas específicas se compran en el mercado.
4 - Todas las semillas/recursos zoogenéticos se producen por sí mismos, se intercambian con otros agricultores o se gestionan colectivamente, lo que garantiza una renovación y diversidad suficientes.

4.4. Uso y producción de energías renovables

0 - No se utiliza ni se produce energía renovable.
1 - La mayor parte de la energía se compra en el mercado. Una pequeña cantidad es de producción propia (tracción animal, viento, turbina, hidráulica, biogás, madera…).
2 - La mitad de la energía utilizada es de producción propia, la otra mitad se compra.
3 - Producción significativa de energía renovable, uso insignificante de combustible y otras fuentes no renovables.
4 - Toda la energía utilizada es renovable y/o autoproducida. El hogar es autosuficiente para el suministro energético, que está garantizado en todo momento. El uso de combustibles fósiles es insignificante.

5. Resiliencia

5.1. Estabilidad de ingresos/producción y capacidad para recuperarse de las perturbaciones

0 - Los ingresos están disminuyendo año tras año, la producción es muy variable a pesar del nivel constante de insumos y no hay capacidad de recuperación después de choques/perturbaciones.
1 - La renta está en tendencia decreciente, la producción es variable de año a año (con insumos constantes) y hay poca capacidad de recuperación después de

choques/perturbaciones.
2 - La renta es estable en general, pero la producción es variable de un año a otro (con insumos constantes). La renta y la producción se recuperan principalmente después de los choques/perturbaciones.
3 - La renta es estable y la producción varía poco de un año a otro (con insumos constantes). La renta y la producción se recuperan principalmente después de los choques/perturbaciones.
4 - Los ingresos y la producción se mantienen estables y aumentan con el tiempo. Se recuperan completa y rápidamente después de choques/perturbaciones.

5.2. Mecanismos para reducir la vulnerabilidad

0 - Sin acceso a crédito, sin seguro, sin mecanismos de apoyo comunitario.
1 - La comunidad no brinda mucho apoyo y su capacidad de ayudar después de las crisis es muy limitada. Y/o el acceso al crédito y al seguro es limitado.
2 - La comunidad es solidaria pero su capacidad de ayudar después de las crisis es limitada. Y/o el acceso al crédito está disponible, pero es difícil de obtener en la práctica. El seguro es poco común y no permite una cobertura completa de los riesgos.
3 - La comunidad brinda mucho apoyo tanto a hombres como a mujeres, pero su capacidad de ayudar después de las crisis es limitada. Y/o acceso a crédito está disponible y el seguro cubre solo productos/riesgos específicos.
4 - La comunidad es un gran apoyo tanto para hombres como para mujeres y puede ayudar significativamente después de las crisis. Y/o el acceso al crédito es casi sistemático y el seguro cubre la mayor parte de la producción.

5.3. Endeudamiento

0 - la deuda es mayor que los ingresos.
1 - La deuda es más de la mitad de los ingresos. La capacidad de reembolso es limitada.
2 - La deuda es aproximadamente la mitad de los ingresos
3 - La deuda es limitada y la capacidad de reembolso es total.
4 - Sin deuda.

6. **Cultura y tradición alimentaria**

6.1. Alimentación apropiada y conocimiento nutricional

0 - Insuficiencia alimentaria sistemática para satisfacer las necesidades nutricionales y desconocimiento de las buenas prácticas nutricionales.
1 - La comida periódica es insuficiente para satisfacer las necesidades nutricionales y/o la dieta se basa en un número limitado de grupos de alimentos. Falta de conocimiento de buenas prácticas nutricionales.
2 - Seguridad alimentaria general a lo largo del tiempo, pero diversidad insuficiente en los grupos de alimentos. Las buenas prácticas nutricionales son conocidas, pero no siempre se aplican.
3 - La comida es suficiente y diversa. Las buenas prácticas nutricionales son conocidas, pero no siempre se aplican.
4 – Alimentación sana, nutritiva y diversificada. Las buenas prácticas nutricionales son bien conocidas y se aplican.

6.2. Identidad y conocimiento local o tradicional (campesino/indígena)

0 - No se siente identidad local o tradicional (campesina/indígena).
1 - Poca conciencia de la identidad local o tradicional.
2 - Se percibe parcialmente la identidad local o tradicional, o concierne solo a una parte del hogar.
3 - Buen conocimiento de la identidad local o tradicional y respeto de las tradiciones o rituales en general.
4 - Identidad local o tradicional fuertemente percibida y protegida, alto respeto por las tradiciones y/o rituales.

6.3. Uso de variedades/razas locales y conocimientos tradicionales (campesinos e indígenas) para la preparación de alimentos

0 - No se utilizan variedades/razas locales ni conocimientos tradicionales para la preparación de alimentos.
1 - Se consume la mayoría de las variedades/razas exóticas/introducidas, o se utilizan poco los conocimientos y prácticas tradicionales para la preparación de alimentos.
2 - Se producen y consumen variedades/razas locales y exóticas/introducidas. Se identifican los conocimientos y prácticas locales o tradicionales para la preparación de alimentos, pero no siempre se aplican.
3 - La mayoría de los alimentos consumidos proviene de variedades/razas locales y se implementan los conocimientos y prácticas tradicionales para la preparación de alimentos
4 - Se producen y consumen varias variedades/razas locales. Los conocimientos y prácticas tradicionales para la preparación de alimentos se identifican, aplican y reconocen en marcos oficiales y/o eventos específicos.

7. Co-creación e intercambio de conocimientos

7.1. **Plataformas para la creación y transferencia horizontal de conocimientos y buenas prácticas**.

0 - Los productores no disponen de plataformas de co-creación y transferencia de conocimiento.
1 - Existe al menos una plataforma para la co-creación y transferencia de conocimiento, pero no funciona bien y/o no se utiliza en las prácticas.
2 - Existe y está funcionando al menos una plataforma para la co-creación y transferencia de conocimientos, pero no se utiliza para compartir conocimientos sobre agroecología específicamente.
3 - Existen una o varias plataformas para la co-creación y transferencia de conocimiento, están funcionando y se utilizan para compartir conocimientos sobre agroecología, incluidas las mujeres.
4 - Varias plataformas bien establecidas y en funcionamiento para la co-creación y transferencia de conocimiento están disponibles y generalizadas dentro de la comunidad, incluidas las mujeres.

7.2. Acceso al conocimiento agroecologica e interés de los productores en agroecología

0 - Falta de acceso al conocimiento agroecológico: los productores desconocen los principios de la agroecología.
1 - Los principios de la agroecología son en su mayoría desconocidos para los productores y/o hay poca confianza en ellos.
2 - Los productores conocen algunos principios agroecológicos y existe interés

en difundir la innovación, facilitando el intercambio de conocimientos dentro y entre las comunidades e involucrando a las generaciones más jóvenes.
3 - La agroecología es bien conocida y los productores están dispuestos a implementar innovaciones, facilitando el intercambio de conocimientos dentro y entre las comunidades e involucrando a las generaciones más jóvenes. Incluidas las mujeres y las generaciones más jóvenes.
4 - Acceso generalizado al conocimiento agroecológico tanto de hombres como de mujeres: los productores conocen bien los principios de la agroecología y están ansiosos por aplicarlos, facilitando el intercambio de conocimientos dentro y entre las comunidades e involucrando a las generaciones más jóvenes.

7.3. Participación de productores en redes y organizaciones base

0 - Los productores están aislados, casi no tienen relación con su comunidad local y no participan en reuniones y organizaciones de base.
1 - Los productores tienen relaciones esporádicas con su comunidad local y rara vez participan en reuniones y organizaciones de base.
2 - Los productores mantienen relaciones regulares con su comunidad local y algunas veces participan en los eventos de sus organizaciones de base, pero no tanto para las mujeres.
3 - Los productores están bien interconectados con su comunidad local y a menudo participan en los eventos de sus organizaciones de base, incluidas las mujeres.
4 - Los productores (con participación equitativa de hombres y mujeres) están altamente interconectados y brindan apoyo y muestran un compromiso y participación muy altos en todos los eventos de su comunidad local y organizaciones de base.

8. Valores humanos y sociales

8.1. Empoderamiento de las mujeres

0 - Las mujeres normalmente no tienen voz en la toma de decisiones, ni en el hogar ni en la comunidad. No existe ninguna organización para el empoderamiento de la mujer.
1 - Las mujeres pueden tener voz en su hogar, pero no en la comunidad. Y/o existe una forma de asociación de mujeres, pero no es completamente funcional.
2 - Las mujeres pueden influir en la toma de decisiones, tanto a nivel doméstico como comunitario, pero no toman decisiones. No tienen acceso a los recursos. Y/o existen algunas formas de asociaciones de mujeres, pero no son completamente funcionales.
3 - Las mujeres participan plenamente en los procesos de toma de decisiones, pero aún no tienen acceso total a los recursos. Y/o existen organizaciones de mujeres y se utilizan.
4 - Las mujeres están completamente empoderadas en términos de toma de decisiones y acceso a recursos. Y/o existen organizaciones de mujeres, son funcionales y operativas.

8.2. Trabajo (condiciones productivas, desigualdades sociales)

0 - Las cadenas de suministro agrícola están integradas y administradas por la agroindustria. Distancia social y económica entre terratenientes y trabajadores. Y/o los trabajadores no tienen condiciones de trabajo decentes, ganan salarios

bajos y están muy expuestos a riesgos.
1 - Las condiciones laborales son duras, los trabajadores tienen salarios medios para el contexto local y pueden estar expuestos a riesgos.
2 - La agricultura se basa principalmente en la agricultura familiar, pero los productores tienen un acceso limitado al capital y a los procesos de toma de decisiones. Los trabajadores tienen las condiciones laborales mínimas decentes.
3 - La agricultura se basa principalmente en la agricultura familiar y los productores (tanto hombres como mujeres) tienen acceso al capital y a los procesos de toma de decisiones. Los trabajadores tienen condiciones laborales dignas.
4 - La agricultura se basa en agricultores familiares que tienen pleno acceso a capital y procesos de toma de decisiones en equidad de género. Proximidad social y económica entre agricultores y empleados.

8.3. Empoderamiento y emigración de los jóvenes

0 - Los jóvenes no ven futuro en la agricultura y están ansiosos por emigrar.
1 - La mayoría de los jóvenes piensa que la agricultura es demasiado dura y muchos desean emigrar.
2 - La mayoría de los jóvenes no quieren emigrar, a pesar de las duras condiciones laborales, y desean mejorar sus medios de vida y sus condiciones de vida dentro de su comunidad.
3 - La mayoría de los jóvenes (hombres y mujeres) están satisfechos con las condiciones laborales y no quieren emigrar.
4 - Los jóvenes (hombres y mujeres) ven su futuro en la agricultura y están ansiosos por continuar y mejorar la actividad de sus padres.

8.4. Bienestar animal [Si aplica]

0 - Los animales sufren de hambre y sed, estrés y enfermedades durante todo el año, y son sacrificados sin evitar dolores innecesarios.
1 - Los animales sufren periódicamente/estacionalmente de hambre y sed, estrés o enfermedades, y son sacrificados sin evitar dolores innecesarios.
2 - Los animales no padecen hambre ni sed, pero sufren estrés, pueden ser propensos a enfermedades y pueden sufrir dolor en el momento del sacrificio.
3 - Los animales no padecen hambre, sed o enfermedades, pero pueden sufrir estrés, especialmente en el momento del sacrificio.
4 - Los animales no sufren estrés, hambre, sed, dolor o enfermedades, y son sacrificados de manera que se eviten dolores innecesarios.

9. **Economía circular y solidaridad**

9.1. Productos y servicios comercializados localmente

0 - Ningún producto/servicio se comercializa localmente (o no se produce suficiente excedente), o no existe un mercado local.
1 - Existen mercados locales, pero casi ninguno de los productos/servicios se comercializa localmente.
2 - Existen mercados locales. Algunos productos/servicios se comercializan localmente.
3 - La mayoría de los productos/servicios se comercializan localmente.
4 - Todos los productos y servicios se comercializan localmente.

9.2. Redes de productores, relación con consumidores y presencia de intermediarios

0 - No existen redes de productores para comercializar la producción agrícola. Sin relación con los consumidores. Los intermediarios gestionan todo el proceso de mercadeo.
1 - Las redes existen, pero no funcionan correctamente. Poca relación con los consumidores. Los intermediarios gestionan la mayor parte del proceso de mercadeo.
2 - Las redes existen y están operativas, pero no incluyen mujeres. Existe una relación directa con los consumidores. Los intermediarios gestionan parte del proceso de mercadeo.
3 - Las redes existen y están operativas, incluidas las mujeres. Existe una relación directa con los consumidores. Los intermediarios gestionan parte del proceso de mercadeo.
4 - Existen redes operativas y bien establecidas con participación igualitaria de mujeres. Relación sólida y estable con los consumidores. Sin intermediarios.

9.3. Sistema alimentario local

0 - La comunidad depende totalmente del exterior para comprar alimentos e insumos agrícolas y para la comercialización y procesamiento de productos.
1 - La mayoría del suministro de alimentos e insumos agrícolas se compran en el exterior y los productos se procesan y comercializan fuera de la comunidad local. Muy pocos bienes y servicios se intercambian/venden entre productores locales.
2 - El suministro de alimentos y los insumos se compran fuera de la comunidad y/o los productos se procesan localmente. Algunos bienes y servicios se intercambian / venden entre productores locales.
3 - Las partes iguales del suministro de alimentos e insumos están disponibles localmente y se compran fuera de la comunidad y los productos se procesan localmente. Los intercambios/intercambios entre productores son regulares.
4 - La comunidad es casi completamente autosuficiente para la producción agrícola y alimentaria. Alto nivel de intercambio/comercio de productos y servicios entre productores.

10. Gobernanza responsable

10.1. Empoderamiento de los productores

0 - No se respetan los derechos de los productores. No tienen poder de negociación y carecen de los medios para mejorar sus medios de vida y desarrollar sus habilidades.
1 - Se reconocen los derechos de los productores, pero no siempre se respetan. Tienen poco poder de negociación y pocos medios para mejorar sus medios de vida y/o desarrollar sus habilidades.
2 - Los derechos de los productores son reconocidos y respetados tanto para hombres como para mujeres. Tienen poco poder de negociación, pero no se les estimula para mejorar sus medios de vida y/o desarrollar sus habilidades.
3 - Los derechos de los productores son reconocidos y respetados tanto para hombres como para mujeres. Tienen la capacidad y los medios para mejorar sus medios de vida y, a veces, se les estimula a desarrollar sus habilidades.
4 - Los derechos de los productores son reconocidos y respetados tanto para

hombres como para mujeres. Tienen la capacidad y los medios para mejorar sus medios de vida y desarrollar sus habilidades

10.2. Organizaciones y asociaciones de productores

0 - La cooperación entre productores es poco transparente, corrupta o inexistente. No existe ninguna organización, o no distribuyen las ganancias de manera transparente y/o equitativa ni apoyan a los productores.
1 - Existe una organización de productores, pero su función es marginal y el apoyo a los productores se limita al acceso al mercado.
2 - Existe una organización de productores que brinda apoyo a los productores para el acceso al mercado y otros servicios (por ejemplo, información, desarrollo de capacidades, incentivos...), pero las mujeres no tienen acceso.
3 - Existe una organización de productores que brinda apoyo a los productores para el acceso al mercado y otros servicios con igualdad de acceso para hombres y mujeres.
4 - Existe más de una organización. Proporcionan acceso al mercado y otros servicios, con igualdad de acceso para hombres y mujeres.

10.3. Participación de productores en la gobernanza de la tierra y los recursos naturales

0 - Los productores están completamente excluidos de la gobernanza de la tierra y los recursos naturales. No existe equidad de género en la gobernanza de la tierra y los recursos naturales.
1 - Los productores participan en la gobernanza de la tierra y los recursos naturales, pero su influencia en las decisiones es limitada. No siempre se respeta la equidad de género.
2 - Existen mecanismos que permiten a los productores participar en la gobernanza de la tierra y los recursos naturales, pero no son plenamente operativos. Su influencia en las decisiones es limitada. No siempre se respeta la equidad de género.
3 - Existen y están en pleno funcionamiento mecanismos que permitan a los productores participar en la gobernanza de la tierra y los recursos naturales. Pueden influir en las decisiones. No siempre se respeta la equidad de género.
4 - Existen y están en pleno funcionamiento mecanismos que permitan a los productores participar en la gobernanza de la tierra y los recursos naturales. Tanto mujeres como hombres pueden influir en las decisiones.

11. **¿Cuáles son los desafíos ambientales más impactantes en su finca?**
12. **¿Como, cuando y porque ha decidido de hacer la transición hacia la agroecología?**
13. **Arboles:**
    13.1. ¿Cuántos árboles hay en la finca?
    13.2. ¿De cuantas especies?
    13.3. ¿Habría interés a incorporar más árboles en el futuro?

b. Annex 2: Specific on Tierra Yai Major and Minor Agroecosystems

Tierra Yai encompasses a total area of approximately 2.8 hectares located in Vereda del Carmelo, Santuario (Antioquia, CO) and represents a collaborative effort led by Natalia

Sanin Acevedo, a biologist with expertise in conservation leadership, and Natalia Valencia Granados, an agro-environmental technician with 20 years expertise in agroforestry and permaculture. Up until the year 2012, this land was subjected to extremely intensive use. It was heavily overworked and consequently suffered from severe erosion. Prior to its rehabilitation, the land's condition was akin to a wasteland (the area was littered with a significant amount of waste discarded on the ground), with its natural resources severely depleted and its ecosystem disrupted. This degradation was a direct result of unsustainable agricultural practices and neglect, which left the land barren and unproductive.

The transformation of TierraYai since then has involved considerable efforts to restore its ecological balance: through syntropic agroforestry and agroecological practices, the aim is to enhance resilience to climate change, regenerate degraded landscapes and promote food sovereignty. Agroforestry, as exemplified by Tierrayai, epitomizes a form of regenerative agriculture wherein food cultivation coincides with conservation and regeneration of ecosystem, framing TierraYai not as part of the 'land sharing' versus 'land sparing' debate, but rather within the new paradigm of nature matrix by (Perfecto et al., 2019).

Figure 6, Drone view of Tierra Yai. From Tierra Yai archives, 2024.

The definition of an agroecosystem has varied over time and is not always straightforward or shared by different authors (León-Sicard & Vargas Ríos, 2018). Altieri (1999) pointed out that it is difficult to delineate the exact boundaries of agroecosystems and offers what we can call a broader definition, highlighting that agroecosystems are influenced by eco-socio-cultural elements: "*Agroecosystems are communities of plants and animals interacting with their physical and chemical environments that have been modified by* *people to produce food, fiber, fuel, and other products for human consumption and processing*." (Altieri, 2002, p.8). In an analogous way, León and Altieri (2010) define agroecology as the science that studies agroecosystems from the perspective of their cultural and ecosystemic interrelations, advocating for a broader definition of an agroecosystem. León (2009) describes agroecosystems as:

> "*The set of relationships and interactions that occur between soils, climates, cultivated plants, organisms of different trophic levels, weeds, and human groups in specific physical and geographical spaces, when viewed from the perspective of their energy and information flows, material cycles, and symbolic, social, economic, and political relationships, which are expressed in different technological management forms within specific cultural contexts*." (p.10).

From this definition, arises the discussion about what should be the minimum unit that could be considered as an agroecosystem, whether it is the farm or the specific sites of cultivation, livestock or agroforestry activity within it? To resolve this dilemma, León (2012) proposes differentiating the terms, reserving the name Major Level Agroecosystem for the entire farm and the Minor Level Agroecosystem for the cropping, pasture, or agroforestry systems, to understand the complex ecosystemic and cultural dynamics (figure 1, from Leon Sicard, 2012, p. 40).

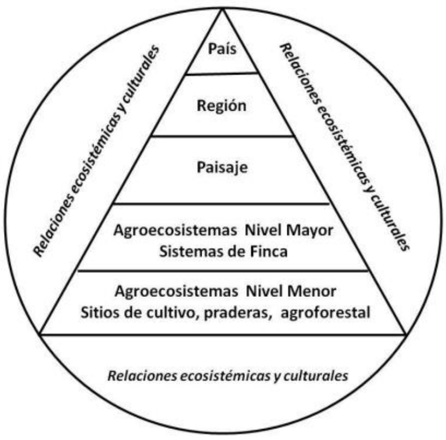

Figure 7: "Hierarchical position of agroecosystems in the territory" from (León-Sicard, 2012, p.40).

The reasoning is that, even though terms like *finca*, *chagra*, etc., are easily recognized in the Latin-American context, within the same *finca* there can be various minor agroecosystems. This can be observed clearly within the major agroecosystem TierraYai from the map (Figure 2).

Minor Level Agroecosystems:

This part of the report will delve into the details of several minor agroecosystems within TierraYai, including their history, current status, and specific activities I undertook during my internship.

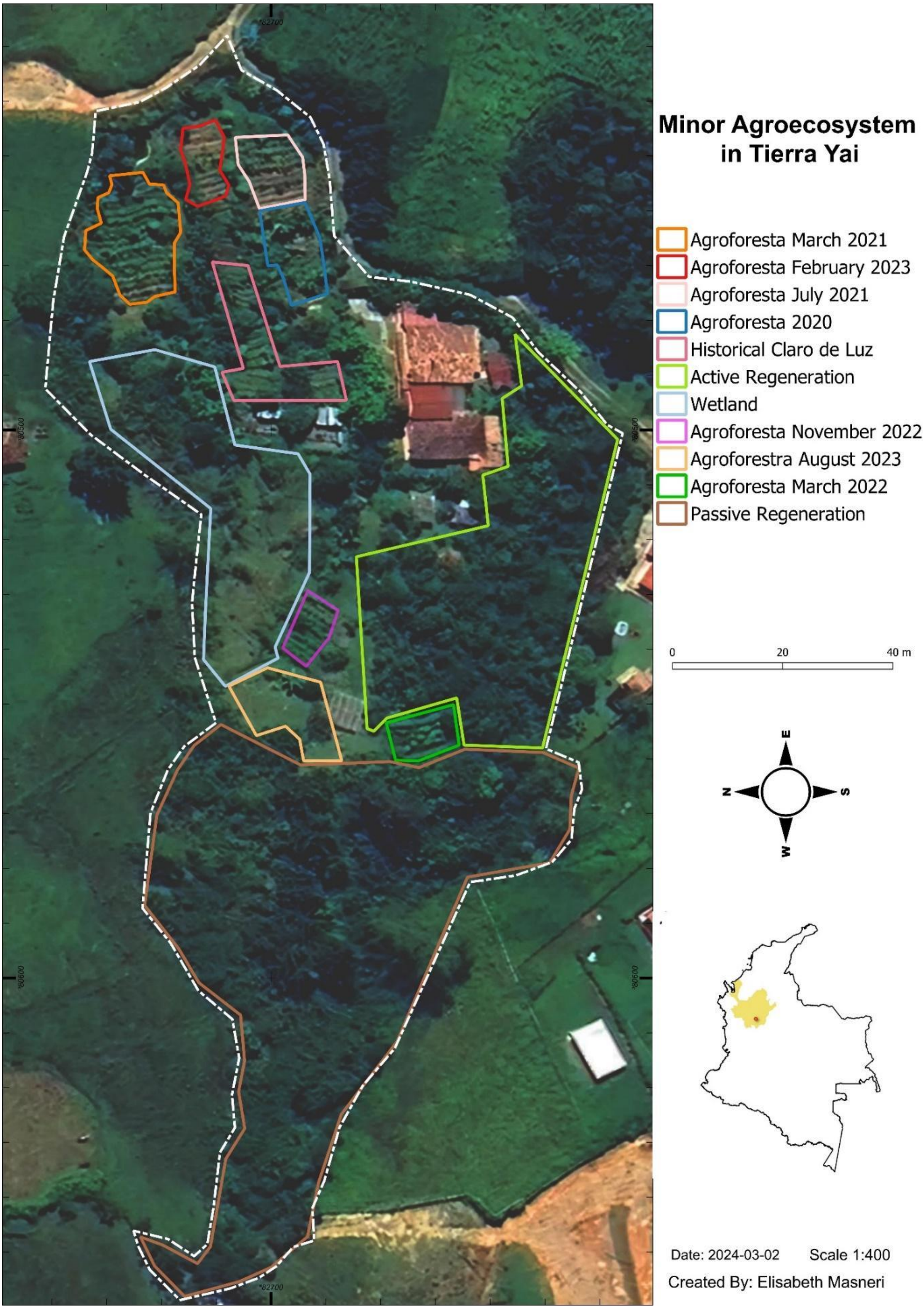

Figure 8, Minor Agroecosystems in Tierra Yai, Google Satellite 2023, personal elaboration of data with QGIS.

Living Fences

In 2013, the initial step to organize the major agroecosystem in TierraYai was the establishment of living fences. These fences delineate the spaces between various minor agroecosystems and were critical for the project's early phase: "*We planted pure living fences around the farm, mainly with acacias, wax olive, chirlobirlo, and quimula. Not in a syntropic manner, without chemicals, but not syntropic because the soil wasn't ready. If you planted anything, it wouldn't stick. And the first thing was to leave it alone*." (Valencia,).

This approach highlights the initial challenges faced due to the soil's degraded conditions, so the primary objective was to let the soil recover naturally before introducing more complex planting strategies. Initially, acacias were planted to improve the soil structure and fertility and, over time, species such as Dombeya (*Dombeya wallichii*), arbol loco (*Smallanthus pyramidalis*), and fique (*Furcraea*) were introduced, which further stabilized the environment. Eventually, more demanding species like palmicho (*Chamaedorea linearis*), macanas (*Wettinia*), and guamos (*Inga edulis*) began to thrive, signifying a healthy and self-sustaining agroecosystem.

Historic *Claro de Luz*

Since 2013, the vegetable garden in TierraYai has been managed organically, featuring permanent cultivation beds and it is considered inside the Major Agroecosistem as one of the two "*claros de luz*". In the context of agroecology and natural ecosystems, a "*claro de luz*" refers to a specific area where direct sunlight reaches the ground for a substantial part of the day. Such light clearings are common in forests, often resulting from events like the falling of entire trees that have reached the end of their life cycle, storms, or the breaking of branches. The material from fallen trees or branches decomposes through the action of microorganisms and macroorganisms in the soil, enriching it. Seeds lying dormant in the soil, waiting for increased light and improved soil fertility, can then germinate. This natural process of light clearings promotes the regeneration in forest ecosystems, however, human activities such as conventional agriculture, livestock farming, and extractive industries (e.g., mining) can also create light clearings. In these cases, the life in these areas becomes simplified, and the soil gradually degrades. Through natural succession, it is possible to restore life to these degraded light clearings, and this is precisely the regeneration process being carried out at TierraYai. Although the process involves complex and successional reforestation of the area, this space has been designated as a "*claro de luz*" to grow vegetables year-round (Valencia & Sanin, 2024).

In March and April, I planted in this *claro de luz* a *milpa*[14] with various associations. Our planting included the following species: Lulo (*Solanum quitoense*), Stuffing Cucumber (*Cucumis sativus*), Yacón (*Smallanthus sonchifolius*), Cassava (*Manihot esculenta*), Rocoto Chili (*Capsicum pubescens*), Tomato (*Solanum lycopersicum*), Garlic (*Allium sativum*), Tobacco (*Nicotiana tabacum*), Basil (*Ocimum basilicum*), Pigeon Pea (*Cajanus cajan*), Crotalaria (*Crotalaria spp*.), Fava Beans (*Vicia faba*), Corn (*Zea mays*), Cilantro (*Coriandrum sativum*), Soybean (*Glycine max*), Mortiño Bean (*Vaccinium meridionale*), Sunflower (*Helianthus annuus*), Marigold (*Calendula officinalis*), Castor Bean (*Ricinus communis*), Chocho (*Lupinus mutabilis*), Malabar Spinach (*Basella alba*), Wheat (*Triticum aestivum*).

In the sugarcane section of the *claro de luz*, we chipped the sugarcane to cover the first clearing where we had planted the previous week. Mulching is essential restore soil fertility so that it retains humidity and throught the mineralization of nitrogenous organic

[14] Milpa (from Nahuatl milpan from milli 'sown plot' and pan 'on top of') is a traditional agricultural system consisting of a polyculture. Its main species is maize, accompanied by various other species. In this agricultural system, plants, bushes and trees that grow naturally by providing fruit, fibre or seeds of local or regional interest are also used. There is not just one type of milpa, each milpa has its own particularities, so there is not just one milpa but many (Terán & Rasmussen, 2009).

matter, nitrogen becomes assimilable by plants (Patil Shirish, Kelkar Tushar & Bhalerao Satish, 2013). Mulching: A soil and water conservation practice. *Res. J. Agric. For. Sci*, *2320*, 6063.). Since syntropic agriculture is process-oriented rather than input-based (Rebello & Sakamoto, 2022) it is crucial to consider which species will be best for quickly covering the soil when starting out, because of that in this clearing it is present a sugarcane part. By using sugarcane mulch and strategically planting a wide variety of crops, the garden fosters a resilient and productive ecosystem.

Figure 9, on the right polyculture of corn, lulo, tomato, basil and beans; on the left the same milpa after a month with pathways recently managed. Foto by the author.

Agroforesta 2020

In 2019, Sanin and Valencia designed the first syntropic, successional agroforestry system focusing on lemon (*Citrus spp*.), plantain (*Musa spp*.), and avocado (*Persea americana*). This system, planted in late February 2020, features 8 permanent beds covering an area of 200 square meters. The system includes a diverse array of species such as chachafruto (*Erythrina edulis*), alder (*Alnus spp*.), arbol loco (*Smallanthus pyramidalis*), leucaena (*Leucaena leucocephala*), cedar (*Cedrus spp*.), guamo (*Inga edulis*), cordoncillo (*piper Bogotense*), yacón (*Smallanthus sonchifolius*), arracacha (*Arracacia xanthorrhiza*), cassava (*Manihot esculenta*), asparagus (*Asparagus officinalis*), chiripique (*Dalea coerulea*), lupin (*Lupinus spp*.), *Tephrosia*, turmeric (*Curcuma longa*), *Aloe vera*, and botón de oro (*Tithonia diversifolia*).

The management during my internship of this minor level agroecosystem consisted in removing old trees and harvesting bananas. The old banana plants were cut at the base, creating a cup-like shape that fills with water, aiding in healing and attracting insects, acting as a trap. The bodies of the banana tree were then chopped into pieces and placed in nearby beds to cover the soil and to “water” it constantly in the super dry season of this year. Additionally, old and dry leaves from other banana trees were removed, and general bed management was conducted. To enrich the agroforest, several plants were introduced, including castor bean (*Ricinus communis*), papaya (*Carica papaya*), Patagonian flower (*Magaskepasma erythrochlampys*), guaco (*Mikania spp*.), granadilla (*Passiflora spp*.), elderberry (*Sambucus spp*.), and yellow oleander (*Thevetia ahouai*).

Figure 10, on the left, photo of the minor agroecosystem 2020 after management, on the right, the cup-like shape of a cut banana tree. Foto by the author.

Agroforesta March 2021

In March 2021, a 700-square-meter agroforestry system was established. According to Sanin, the plan for this system was more elaborate and comprehensive than the previous one, with annual enrichments and continuous experimentation: "*It is the most experimental; nothing is static. Many times, agroforesters want to have everything planted at once and reach a climax, but for me, there is no climax. This agroforest has taught us that it always needs ongoing work*" (April 26, 2024).

Rows of imperial grass (*Axonopus scoparius*), chiripique (*Dalea coerulea*), botón de oro (*Tithonia diversifolia*) and arbol loco (*Smallanthus pyramidalis*) serve as productors of organic matter to nourish the soil while around 200 pineapples (*Ananas comosus*) make up the productive and restoration part, along with avocado (*Persea americana*), coffee (*Coffea spp*.), loquat (*Eriobotrya japonica*), guamo (*Inga edulis*), guava (*Psidium guajava*), jabuticaba (*Plinia cauliflora*), siete cueros (*Tibouchina lepidota*), *Musaceae*, wax palm (*Ceroxylon quindiuense*), madroño (*Arbutus unedo*), chachafruto (*Erythrina edulis*), and Camargo (*Verbesina arborea*).

During my internship, typical agroforestry management practices were performed, including selective weeding, pruning of chiripique (*Dalea coerulea*), botón de oro (*Tithonia diversifolia*), guava (*Psidium guajava*), and arbol loco (*Smallanthus* *pyramidalis*). Wooden pathways were re-established through organized biomass on the soil, starting with larger ligneous parts in contact with the soil, followed by smaller ligneous pieces, and finally finer cover such as leaves and grasses. These processes are important to restore the nutrient cycling of the agroecosystem, specifically, pruning generates biomass and stimulates nutrient recycling, allows light to penetrate the lower layers, encouraging new growth (Rebello & Sakamoto, 2022). So, unlike traditional agricultural systems, pruning is not just for increasing fruit production but for enhancing soil fertility through nutrient cycling facilitated by mycorrhizae: pruning produces high levels of growth hormones (auxins and gibberellins), which are distributed by the mycorrhizae of the pruned plants acting as a network communication (Simard, 2021). Continuous observation of the agroecosystem's response to pruning and reseeding is essential and was part of the internship, noting which plants need shade and how natural succession progresses.

Figure 11, before and after the Agroforesta March 2021 management. Photo by the author.

Agroforesta July 2021

This minor level agroecosystem is constituted by a *claro de luz* and two rows of native and biomass trees. During the internship I had the duty to prepare the beds of the claro de luz from start: the first step involved cutting all plants in the alleys and setting them aside to be used as cover. Then removing all plants from the beds, from small ones to shrubs. Subsequently, working the soil with a non-inverting ripping tool that maintains the soil layers, while enriching the soil with chicken manure from the finca mixed with rock flour and diatomaceous. Next, the alleys are covered with the previously removed plants and wood. To give the soil an extra boost, we prepared a liquid fertilizer by mixing carob molasses and bio-organisms (fungi, bacteria, forest litter). We let it rehydrate overnight and we applied it to the beds. We finished arranging the beds and planted various lines of carrots and onions in two beds, with corn every meter, while in the other two beds we planted various types of lettuce, cauliflower, corn, and spinach.

Figure 12, the process of preparation of the cultivation beds in Agroforesta July 2022. Photo by the author.

Reservoirs

In August 2021, the implementation of reservoirs marked the inception of a minor agroecosystem focused on water plants. These reservoirs were strategically constructed to enhance water management within the agricultural landscape, providing a sustainable approach to biodiversity enhancement and irrigation, using basically rain collecting reservoirs and gravity to water the other minor agroecosystems.

Figure 13, Flora and fauna in the Water Reserve Agroecosystem. Photo by the author.

Agroforesta August 2022

This agroforest focuses on lulos (*Solanum quitoense*) for production alongside native trees. There are 18 species in total between natives, endangered species, and those highly attractive to pollinators like ceibas (*Ceiba* spp.), palmichos (*Chamaedorea linearis*), macanas (*Acrocomia aculeata*), dividivi de tierra viva (*Caesalpinia coriaria*), siempre viva (*Sedum praealtum*), siete cueros (*Campsiandra laurifolia*) and navajuelos (*Anacardium excelsum*). One tree, Almanegra (*Magnolia ernandesi*), is critically endangered with only 70 individuals remaining in Colombia, two of which are in TierraYai.

During my internship, I conducted management activities where I pruned boton de oro (*Tithonia diversifolia*) and arbol loco (*Smallanthus pyramidalis*) to provide light to *Musaceas*, aguacate (*Persea americana*), quiebra barrigo (*Curcuma longa*), and *Citrus spp*. These experiences provided me with a practical understanding of how regenerative agriculture rejuvenates soil through biomass and pruning, as well as how regeneration functions above the soil. Here, more robust plants complete their life cycles and are succeeded by longer-lived and more demanding species:

> "*We will soon harvest the last lulos, which will be replaced by chachafrutos (Erythrina edulis). (…) The chilco (Gomortega keule) wasn't planted by us; when we manage, we proceed with great care, observing how natural succession has occurred without our intervention. Dumoloco (Dumetella glabriuscula) and espaderos (Cyperaceae) grow naturally, and I respect natural succession by leaving them be.*" (Sanin, May 5, 2024).

Figure 14, Agroforesta August 2022 from above. Photo by the author.

Agroforesta February 2023

This agroforest was established in February 2023 during a course with experts in Brazilian syntropic agroforestry, led by Patricia Vaz from *Mutirão Agroflorestal*[15]. It is an agroecosystem that I have not managed personally, as it is one of the most recent installations and is located at the border with a neighbouring property. As a result, it has been allowed to grow somewhat unattended due to time constraints and to serve as a cover. Here, I have only engaged in harvesting yuca (*Manihot esculenta*), yacòn

[15] MUTIRÃO AGROFLORESTAL is an NGO that aims to contribute to a network of people around learning, experience and experimentation of agroforestry production in Brasi. https://mutiraoagroflorestal.org.br/

(*Smallanthus sonchifolius*), and arracacha (*Arracacia xanthorrhiza*).

Figure 15, Photo of Agroforesta February 2023. Photo by the author.

Agroforesta August 2023

The minor agroecosystem comprises five agroforestry circles, each designed with an outer bed featuring turmeric (*Curcuma longa*), boton de oro (*Tithonia diversifolia*), arracacha (*Arracacia xanthorrhiza*), and cabbages (*Brassica oleracea*). This is followed by a pathway of logs and an inner circle containing various species such as cherimoya (*Annona cherimola*), arbol loco (*Pterocarpus acapulcensis*), jabuticaba (*Plinia cauliflora*), chachafruto (*Erythrina edulis*), and cassava (*Manihot esculenta*).

In this agroecosystem, I have weeded selectively and pruned boton de oro (*Tithonia diversifolia*), and I have planted turmeric (*Curcuma longa*) and bore (*Colocasia esculenta var. antiquorum*). These circles have facilitated mine understanding of the complexities of agroforestry, which operates within four dimensions: width, length, height (strata), and time. In contrast, conventional or organic agriculture typically functions in only two dimensions: length and width (Rebello & Sakamoto, 2022). The complexity of this agriculture stands in the constant observation to manage and understand the agroforestry matrix that interweaves trees with varying life cycles:

> "*The life cycles of the plants differ. We plant the arbol loco from seed next to a chachafruto seedling. Notice how the arbol loco, with its rapid life cycle, grows quickly and will exit the system sooner, whereas the chachafruto grows slowly and will remain in the system much longer. Cassava also grows very rapidly. Therefore, one must combine these elements and manage them accordingly. We plant the arbol loco to provide shade for the cherimoya; once the cherimoya is established, the arbol loco is removed. This system requires careful observation and frequent questioning: 'What does this plant need? Does it need light?' I then manage and prune.*" (Valencia, May 5, 2024).

Figure 16, Agroforestry Circles before and after management. Photo by the author.

Zones of Passive Recovery

This is an agroecosystem where natural succession occurs without human interference: the focus is on allowing the ecosystem to restore itself over time through natural processes. In these zones, human activities are minimized to enable the native vegetation and wildlife to recover autonomously, promoting biodiversity and ecological resilience.

Zone of Active Recovery
Not all minor agroecosystems are agroforests; there are also zones of active restoration. This area is largely left alone and undisturbed but is being enriched through human intervention. Instead of creating new beds, cutting down existing vegetation, and planting something entirely new, the focus is on enhancing what is already present. This enrichment includes adding *citrus* trees, tágualo (*Phytelephas*), the endangered *Magnolia ernandesi*, and other native species. In these areas, natural succession is allowed to occur, but we accelerated the process by placing dead or dry branches on the soil, managing biomass cover, and pruning when necessary. This approach helps to promote faster ecological restoration while maintaining the integrity of the natural ecosystem.

Wetland
In the wetland, nothing grows right now. A green and water management plan has already been developed for the future: "*We want to intervene by creating chinampas, water mirrors with bulrushes and papyrus, and to cultivate on the raised beds. We do not want to dry it out, which is what everyone wants to do with wetlands. We want to say, "Oh, you are a wetland? Let's treat you as a wetland."*" (Valencia, May 5, 2024).

List of conversations and interviews cited in Annex 2:

Name	Date	Topic	Place
Sanin Natalia and Valencia Natalia	April 26, 2024	Cartographic participatory lab.	Tierra Yai, Vereda el Carmelo, Santuario, Antioquia (CO)
Sanin Natalia and Valencia Natalia	2024	Course "Agroforestas: regenerando a través de la agricultura sintrópica"	Online on Regeneraccion en accion platform: https://regeneracionenaccion.org/courses/agroforestas-regenerando-a-traves-de-la-agricultura-sintropica/
Sanin Natalia and Valencia Natalia	May 5, 2024	Tierra Yai tour and Conversation with Red Semillas Libres de Antioquia	Tierra Yai, Vereda el Carmelo, Santuario, Antioquia (CO)
Valencia Natalia	March, 2024	Tool handling course	Tierra Yai, Vereda el Carmelo, Santuario, Antioquia (CO)

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c. Annex 3: Problems and proposals arising from the meeting on March 2, 2024, to build a *'Campesino Community Agenda en El Santuario'* (Farmer's Community Agenda in Santuario) by Colectivo Ruralidad and Grupo Confluencia at ASOCOMUNAL, Santuario. Process leader by Jimena Gomez, 2024.

Problems	Proposals
Social Dimension	
▪ Limited recognition of peasant knowledge, work, and products. ▪ Insufficient conditions to guarantee peasant rights. ▪ Few incentives for production. ▪ Risks associated with farming activities affecting the health of farmers. ▪ Lack of generational continuity, as young people do not usually farm or see opportunities in the countryside. ▪ Concerns about habits leading to inappropriate use of technologies and leisure time. ▪ Education not oriented towards the needs of the countryside. ▪ Little support for students and people with disabilities in rural areas. ▪ Undervaluation of the role of peasant women. ▪ Increased migration of peasant families to the city. ▪ Little recognition of the histories of the rural areas. ▪ Loss of knowledge and spaces for transmission between generations. ▪ Loss of close relationships among neighbors. ▪ Weakening of the social fabric. ▪ Impacts of the armed conflict on the personal, family, and community trajectories of the peasant population.	▪ Create spaces for neighbour recognition. ▪ Mobilize more support for rural areas based on their needs. ▪ Strengthen community capacities and activities led by communal action boards (JAC). ▪ Restore joint work between JAC and schools for community support strategies. ▪ Promote integration among youth, women, and leaders. ▪ Appropriate and proper use of technologies, providing training for the elderly. ▪ Policies for peasant women to highlight their work from a gender perspective. ▪ Foster community ties through solidarity and equity. ▪ Create spaces for knowledge exchange between generations. ▪ Educational campaigns for food consumers to value peasant work and knowledge. ▪ Conduct historical tours of rural areas to remember past events and their impacts on peasant communities. ▪ Recognize the impact of the armed conflict on the rural social fabric.
Economic dimension	
▪ Land use changes leading to underutilization. ▪ Displacement of peasant communities by urban projects (gentrification). ▪ Increased land valuation. ▪ Vulnerability in the production and marketing chain, with peasants receiving the least and lacking labor guarantees. ▪ Insufficient labor. ▪ High input costs. ▪ Difficulties in transporting food due to geographic location and poor road conditions. ▪ Many intermediaries. ▪ Extremely low and unstable prices, resulting in low profitability for peasant families. ▪ Low appreciation of peasant work. ▪ Limited financial support for production processes.	▪ Policies for labor formalization of peasant activities with respective social security. ▪ Market regulation to ensure fair pricing for peasant products. ▪ Public policy of economic and non-economic incentives for the transition to agroecological models. ▪ Training and knowledge exchange spaces on land and nature. ▪ Access to machinery and technologies for fieldwork. ▪ State subsidies for peasants. ▪ Consumer awareness campaigns to value peasant work and production processes. ▪ Improve peasant markets and their administration without losing focus on local production.

▪ Little support for transition and maintenance in alternative crop models. ▪ Loss of seeds, such as varieties of corn, carrots, beans, among others. ▪ Insufficient project management capacities with proper funding.	▪ Create collection centers and seed banks, promoting associations for reproduction. ▪ Training spaces for project formulation and resource management.
Environmental Dimension	
▪ Increase in land subdivision. ▪ Invasion of rural areas by constructions. ▪ Increase in vacation homes. ▪ Inadequate waste management without respective sanctions. ▪ Pollution worsened by visitor practices. ▪ Misuse of agrochemicals. ▪ Deforestation. ▪ Reduced care of watersheds. ▪ Little knowledge of water sources, their state, and management. ▪ Lack of environmental education. ▪ Loss of knowledge about plants considered weeds. ▪ Few options for managing organic waste in rural areas. ▪ Lack of regulation and enforcement of land use policies. ▪ Climate change.	▪ Protect, recognize, and appropriate community protected areas. ▪ Promote union among rural aqueducts and their members. ▪ Ensure clean water and aqueduct supply capacity. ▪ Treatment plants or decentralized systems for wastewater. ▪ Promote proper waste separation and management through circular economy initiatives. ▪ Conscious use and management of agrochemicals with crop and input management training. ▪ Conditions for transitioning to other production methods with good agricultural practices or agroecological. ▪ Recognize and contextualize watersheds. ▪ Plant native species to protect watersheds. ▪ Encourage initiatives related to agroforestry and agroecological transition. ▪ Strengthen environmental culture through educational strategies with rural schools and workshops with peasants. ▪ Recognize the properties of beneficial plants for use at home, farm, and crops. ▪ Strengthen the environmental movement. ▪ Ensure compliance with environmental regulations. ▪ State protection for the peasant population against climate change risks.
Political Dimension	
▪ Limited recognition of peasant identity and rights. ▪ Disunity among peasants. ▪ Lack of participation and low dissemination and appropriation of training spaces. ▪ Lack of transparency in the management and allocation of funds within JAC and projects in the territories. ▪ Insufficient organizational capacities. ▪ Fear of being a social leader. ▪ Little state support for rural areas. ▪ Limited policies addressing peasant living conditions.	▪ Social, political, cultural, labor, and economic recognition of peasant communities. ▪ Support for communal action boards (JAC). ▪ Review ways to encourage community participation in boards and aqueducts. ▪ Facilitate meetings between leaders for contextual readings and territorial articulation. ▪ More training opportunities and professional support to encourage peasant community participation. ▪ Actively involve children, youth, and women in participation and decision-making spaces. ▪ Protect social leaders.

	▪ Greater dissemination and internalization of existing policies for peasant communities. ▪ Demand greater state support and accompaniment, mobilizing structural changes and protection policies for peasants. ▪ Clear policies for rural areas and peasants at the local level.
Cultural Dimension	
▪ Consumer societies forcing abandonment of rural territories. ▪ Reduced conservation of ancestral knowledge, such as medicinal plants and recipes from food processing. ▪ Loss of artistic, musical, and craft practices. ▪ Disappearance of games and other cultural activities for community integration. ▪ Limited sports and cultural offerings. ▪ Schools without sports fields and with deteriorated infrastructure. ▪ Persistence of macho practices supporting gender-based violence.	▪ Practical training to encourage active participation of peasant communities. ▪ Revive ancestral and traditional knowledge in food, social, environmental, and economic aspects. ▪ Strengthen food sovereignty through meetings and dialogues to rescue recipes, food processing, and consumption. ▪ Recover artistic and craft creations. ▪ Decentralize institutional offerings to reach remote areas. ▪ Promote bartering, exchanges, and communal work. ▪ Promote care practices in all areas of life. ▪ Establish peasant schools for integration among different population groups with a differential, gender, and community focus.

d. Annex 4: Histories of Regeneration

I will present here two case studies of successful agroforestry agroecological regeneration of farmlands in the Eastern Antioquia region of Colombia. Recognizing that achieving the eco-social benefits of agroforestry requires understanding how and why farmers make these land-use decisions, I aim to identify the common technical aspects and practices that have regenerated these farmlands. This will contribute to the technical capacity pathway of the UN Decade on Ecosystem Restoration, helping farmers undertake similar regenerative transitions.

The methodology for presenting these case studies employs an ethnographic and biographical approach, striving to convey the regeneration narratives through the words of the farmers themselves. I interviewed the farmers through walking interviews method throughout all their agroecosystems, during these in-depth interviews, discussions were initiated on the history of the farms, their agricultural approaches, and the agroforestry and agroecological regenerative practices implemented for farmland restoration.

Case 1: Tierra Yai

TierraYai encompasses an area of approximately 2.8 hectares located in Vereda del Carmelo, Santuario (Antioquia, CO). It represents a collaborative effort led by Natalia S., a biologist specializing in conservation leadership, and Natalia V., an agro-environmental technician with 20 years of expertise in agroforestry and permaculture. Until 2012, the land was subjected to extremely intensive use with agrotoxic and chemical fertilizers, leading to severe overworking and erosion. Prior to its rehabilitation, the land resembled a wasteland, littered with waste, its natural resources severely depleted, and its ecosystem disrupted. This degradation was a direct result of unsustainable agricultural practices and neglect, leaving the land barren and unproductive.

Map 1: Satellite view of Tierra Yai regeneration from 2002 to 2024. From Google Earth Satellite, 2024, elaboration by author.

The transformation of TierraYai has involved significant efforts to restore its ecological balance through syntropic agroforestry and agroecological practices, aiming to enhance "*agriculturas para la vida*" (Sanin & Valencia, April 26, 2024). Agroforestry, as exemplified by TierraYai, represents a form of regenerative agriculture where food cultivation coincides with conservation and ecosystem regeneration. This positions TierraYai not within the 'land sharing' versus 'land sparing' debate, but rather within the new paradigm of biological conservation by utilization (Perfecto et al., 2019).

Their methods focus on soil health, as healthy soil leads to healthy plants. The regeneration process took time due to efforts in creating synergy between soil, trees, and mushrooms to rebuild soil in such a degraded farmland: "*Each soil is different, coming from varying degrees of degradation. A place affected by fire has minerals. Here, there was nothing—complete death. Recovering such soil takes time. First, it must detoxify. (…) Initially, it involved more arborization; these trees detoxify the soil*" (Sanin, March 15, 2024). In 2013, the first step to organize the major agroecosystem in TierraYai was the establishment of living fences. These fences delineate spaces between various minor agroecosystems and were critical in the project's early phase: "*We planted pure living fences around the farm, mainly with acacias (Genus Acacia), wax olive (Morella pubescens), chirlobirlo (Dodonaea viscosa), and quimula. Without chemicals, but not syntropic, because the soil wasn't ready. If you planted anything, it wouldn't stick. The* *first step was to leave it alone*" (Valencia, May 2024). This highlights the importance of using rustic species, even if considered invasive, as key to regenerating barren farmland too degraded for native species: "*We started working the soil by planting non-native trees, primarily acacias. Acacias helped immensely because they were the only resilient species. Not all trees thrive in degraded soils, which is a major issue in large reforestation projects. You can't simply reforest; degraded soils require specific species to recover*" (Valencia, March 15, 2024).

The management of these alloctonous plants involves constant pruning of biomass trees and organizing biomass on the soil, starting with larger woody parts in contact with the soil, followed by smaller woody pieces, and finally finer cover such as leaves and grasses: "*Agroforestry is 10% planting and 90% management*" (Valencia, March 15, 2024). These processes are crucial for restoring the nutrient cycling of the agroecosystem. Pruning generates biomass, stimulates nutrient recycling, and allows light to penetrate the lower layers, encouraging new growth (Rebello & Sakamoto, 2022). Unlike traditional agricultural systems, pruning in agroforestry also enhances soil fertility through nutrient cycling facilitated by mycorrhizae: pruning produces high levels of growth hormones (auxins and gibberellins), which are distributed by the mycorrhizae of pruned plants acting as a network of communication (Simard, 2021). Observing the regenerated system before pruning is essential: "*When we manage, we proceed with great care, observing how natural succession has occurred without our intervention. Dumoloco (Dumetella glabriuscula) and espaderos (Cyperaceae) grow naturally, and I respect natural succession by leaving them be*" (Sanin, May 5, 2024). Thanks to natural succession and active planting, the TierraYai agroecosystems now host hundreds of species of which 18 between natives and endangered species like ceibas (*Ceiba spp.*), palmichos (*Chamaedorea linearis*), macanas (*Acrocomia aculeata*), dividivi de tierra viva (*Caesalpinia coriaria*), siempre viva (*Sedum praealtum*), siete cueros (*Campsiandra laurifolia*), and navajuelos (*Anacardium excelsum*). Notably, the critically endangered Almanegra (*Magnolia ernandesi*), with only 70 individuals remaining in Colombia, has two specimens in TierraYai.

The major agroecosystem of Tierra Yai is divided in 8 agroforestries and 2 zones of active and passive restoration. These two areas are largely left undisturbed but sometimes enriched through human intervention. Rather than creating new beds and cutting down existing vegetation, the focus is on enhancing what is already present. This enrichment includes adding citrus trees, tágualo (*Phytelephas)*, the endangered Magnolia ernandesi, and other native species. In these areas, natural succession is allowed to occur but is accelerated by placing dead or dry branches on the soil, managing biomass cover, and pruning when necessary. This approach promotes faster ecological restoration while maintaining the integrity of the natural ecosystem: "*In this agricultural approach, natural succession, life cycles, and strata occupied by various species of trees, shrubs, herbs, staple crops, vegetables, fruit trees, and pastures are utilized. This allows farmers to restore water flows, nutrient cycles in the soil, improve the microclimate, capture carbon, control erosion, and cultivate highly nutritious food, thereby enhancing the social and economic benefits derived from previous practices*" (Sanin, 2024).

Indicators of regeneration and biodiversity are evident in TierraYai. There has been a significant return of mesofauna and microfauna, including green vine snakes (*Leptophis ahaetulla*), Andean opossums (*Didelphis pernigra*), various migratory birds such as tortolitas (*Columbina minuta*), turpiales (*Icterus nigrogularis*), barranqueros (*Momotus aequatorialis*), and many others, frogs, numerous insects, and pollinators. A special indicator for soil health is the presence of fungi, which thrive with the abundance of organic matter and accelerated nutrient cycles: "*Fungi have made me fall in love with this agriculture. Organic farming rarely shows fungi, but when you place wood on the soil, you see incredible diversity. This speaks volumes about soil quality. The presence of fungi indicates a balanced soil ecosystem. We are still working on it, starting from clay and degraded soil. The soil has already changed significantly*" (Natalia V., May 5, 2024).

Case 2: Finca B.

Finca B. is a 1.,658-hectare farm completely regenerated from grazing land, located in Vereda Camargo, Carmen del Viboral municipality, Antioquia. This transformation represents a 20-year effort by a *campesino* family of five to link agroecological agroforestry transition with their campesino identity, connecting agroecology to the biocultural heritage of the Andean landscape. Don I. began this process in 2004 with his family on farmland previously dedicated to pasture and conventional agriculture: "*When we arrived, we only had one goat, and there was no pasture across the entire farm because it was overgrazed. I had to ask the neighbours to give me food for her. That's when I started planting cut-grasses and trees*" (Don I., 2024). Don I. started with pine trees (*Pinus* spp.) because they were the only species that could thrive in the degraded farmland: "*Pine trees are often demonized, but they also represent abundance, in their own way. (…) But obviously, one understands why they are demonized because pine has been planted by cutting native forests. We did the opposite; we started with a pasture, and now we have reached a phase where there are restoration areas under the pines with* *native woods emerging, like espadero (Myrsine coriacea). (…) Livestock farmers fight with the forest, they cut it because it*

ruins the pasture. For us, it was the opposite" (Don I., 2024).

Map 1: Satellite view of finca Buenaventura regeneration from 2002 to 2024. From Google Earth Satellite, 2024, elaboration by author.

Here, too, the process of creating soil can be described by the motto: "*Compost and cover, always, everywhere*" (Don I., 2024) based on making compost through human and animal waste, kitchen scraps, and pruning constantly biomass-species to create soil and a healthy agroecosystem: "*I keep pruning this one, look at the biomass, look at the soil being built.*

The soil needs to be covered and by covering and making soil, trees arrived, like the laurel (Laurus spp.), which came by itself, and I take care of it" (Don I., May 2024).

"*We also have a lot of 'ojo de poeta' (Aristolochia ringens), which requires management, but it doesn't scare me. This poor plant has a bad reputation. We need to change this concept of "maleza" (weeds). It's because of its strength that we fear it, but it unlocks where others can't. And when you walk through the farm, you manage. People get desperate, 'how do I get rid of it? Where do I put it?' I say: remove it and leave it on the ground, it will break down and create soil. 'But it sprouts again,' manage it again. Management is continuous*" (Don I., 2024).

When asked about his concerns regarding climate change and ecology, Don I. responded immediately: "*The issue of water and soil worries me a lot. If we don't correct our work* *with the land, we will end up in a desert. (...) Now, with changing rains and droughts, people talk badly about torrents, but the problem is not more rain; the problem is that we have more unprotected soil, and the water doesn't infiltrate; it runs off*" (Don I., May 2024). Don I.'s regeneration efforts come from the awareness that agroforestry and water management should go hand in hand. His family's reserve connects various gardens and agroforestry ecosystems through water reserves that manage rainwater and a nearby stream, all designed to infiltrate and slow down water to recharge the underground aquifer. "*Here, I create ponds (...) some water infiltrates, and some ends in this torrent below, and it makes me happy because, over time, you see this filling with clean water. But when I got this, it was all mud, not to mention when it was a potato field. Now water frogs, and other animals inhabit it*" (Don I., May 2024). In these water reserves, Don I. has many aquatic plants to purify the water, such as tripaepollo (*Pistia stratiotes)*, lechuga de agua (*Lemna minor)*, lechito de agua (*Hydrocotyle ranunculoides)*, barbasca (*Thalia geniculate)*, and enea (*Typha latifolia)*, which he considers bioindicators of the health of the agroecosystem. Additionally, he observes, "*Fungi have only been appearing in the last two years; before, they didn't. There have been many beautiful indicators, like the water spider. The soils and waters are now purified from a lot of poison*" (Don I., May 2024).

Figure 4: Water pond in finca Buenaventura, full of aquatic plants for water purification. Photo by author.

In this case, the agroforestry agroecological transition is linked to campesino identity, connecting it to the biocultural heritage of the Andean landscape, creating future natures linked to the past through communities and memories: "*To regenerate at that time, I made purely living fences, planted a lot of bean (Phaseolus vulgaris) to let the soil rest. And many little trees over time. The living fences and this knowledge came from campesino knowledge, from my father. There was a time when living fences were highly valued, along with planting in key lines. There was a strong concept of key lines; my father did it, but it was forgotten*" (Don I., 2024).

Figure 5: Photo of 2004 of finca Buenaventura, showing the farmland landscape at the time. Photo by Don I.

This type of agroecological regeneration is not disconnected from social and cultural regeneration. Material regeneration comes with immaterial regeneration and questioning of mainstream values, like the dichotomy between nature and culture: "*This story that 'nature lives without me, I can't live without her', it's not like that. I am part of nature. As long as we see ourselves as separate, there will be no change. Like weeds have a function, so do I. I must understand what it is and cooperate, not compete*" (Don I., May 2024). From this perspective, Don I. and his family have found their role in agroecological regeneration, placing themselves perfectly within the new conservation paradigm based on high-quality matrices, in this case made of forest, agroforestry, gardens, and water ponds. They find ways to live and sustain themselves, selling products like honey, alongside the non-human counterparts inhabiting their farm: "*The challenge for me is: how do we inhabit the forest without destroying it? Why do we have to destroy it to inhabit it? Here, we've seen that it's possible to inhabit and not destroy*" (Don I., May 2024).

Figure 6: Don I, showing me the agroforestry in finca Buenaventura. Photo by author.

Insights from Buenaventura and Tierra Yai : synthesising lessons learned from existing farmland ecosystem restoration initiatives

Ecosystem restoration initiatives at TierraYai and Finca Buenaventura offer valuable lessons on effectively transitioning degraded farmlands into thriving, sustainable agroecosystems. These case studies highlight the importance of integrating agroforestry and agroecological practices with a deep understanding of local environmental and cultural contexts. This project is pivotal for obtaining useful information on agroforestry regeneration that could be beneficial for the technical capacity of UN Decade on Ecosystem Restoration. The following principles are intended as agro-ecological principles that come directly from the farmers interviewed, meaning they are not prescriptive recipes, thus adaptable to different territories and designed to spark creativity and solutions in diverse settings.

Soil Restoration: Composting and Pruning

Both initiatives emphasize the critical role of soil restoration through composting: by adding organic matter from human and animal waste and kitchen scraps, soil fertility is enhanced. Additionally, planting trees in agroforestry systems facilitates soil regeneration as consistent management and pruning are essential for soil health. Pruning is strategically done to stimulate root regeneration and the biomass derived is always placed on the soil in layers, starting with larger woody parts followed by finer materials. This method protects the soil surface, facilitates the creation of organic matter, and promotes nutrient cycling. Moreover, different tree species produce biomass with varying chemical characteristics, fulfilling different functions in the agro-ecosystem: leaves and branches decompose quickly, providing rapid nutrients due to their lower levels of recalcitrant compounds like lignin and polyphenols, while tree trunks and thicker branches decompose slowly, protecting the soil from direct rain and sun exposure for longer periods (Duarte, Cardoso, & Fávero, 2008). This practice leads to the proliferation of diverse soil microorganisms, which are essential for restoring the soil's physical and biological properties, ultimately leading to greater fertility.

Water Management: Integration of Water in Agroforestry

Effective water management is intertwined with agroforestry practices. By planting trees and shrubs, water from deep soil layers is redistributed by roots to upper soil layers, making it available for other shallow-rooted plants (Bayala & Prieto, 2019). Moreover, trees around water bodies and along contours slow down water flow, enhance infiltration, and reduce runoff (Siriri, Tenywa, Ong, Black, & Bekunda, 2006). Both TierraYai and Finca Buenaventura incorporate water ponds and other water management systems, such as trees designed in key lines, to capture and infiltrate rainwater. These systems are designed to recharge underground aquifers and maintain soil moisture levels, thus eliminating the need for irrigation.

Use of Both Rustic Alloctonous Species and Native Species

Initial restoration efforts often begin with rustic or non-native species capable of thriving in degraded conditions. The critical factor is not the species per se but their management: these alloctonous species are managed continuously to prevent their spread and are gradually replaced by native species as the soil and ecosystem improve. This staged approach ensures a robust and lasting restoration process. Additionally, it incorporates a deep understanding of natural succession while managing and planting. Successionality goes hand in hand with biodiversity, and both projects highlight its importance in ecosystem restoration as diverse plantings enhance ecosystem resilience and attract a wide range of microorganisms, insects, and mesofauna in an agroecosystem that mimics natural ecosystems.

Continuous Management and Observation

Restoration is not a one-time effort; it is a continuous process. Regular management practices such as pruning, composting, and biomass distribution are essential for maintaining soil health and supporting plant growth. For example, in TierraYai, these practices are performed daily across various agroecosystems. Management in a regeneration context takes time because it is not standardized: close observation and adaptive management are critical. By constantly monitoring the ecosystem's progress and making necessary adjustments, these initiatives ensure that restoration efforts are responsive to environmental and social changes.

Integration of Cultural Practices

Linking agroecological practices with local cultural heritage enriches the restoration process. It fosters a deeper connection between the community and the land, helping regenerate biocultural memories and immaterial landscape heritage (Toledo & Barrera-Bassols, 2008).

In summary, the restoration efforts at TierraYai and Finca Buenaventura demonstrate that successful ecosystem restoration requires a holistic approach. Therefore, these initiatives offer a model for regenerating degraded farmlands through combining technical agroecological practices with continuous management, deep observation, and respect for both socio-ecological processes.

e. Annex 5: Results Summary Table

Case Study	Location	Members	Women	Young (<30)	Hectare	Selling	Main Products	Tree Relationship/ Agroforestry	CAET Results
Doña L.	Vereda El Salto, Santuario	3	1	1	0.80	Home delivery at Santuario women's market, local restaurant	Cow's milk, goat's milk, vegetables	Few trees scattered, no integration	65%
Doña P.	Vereda Aldana Abajo, Santuario	3	2	1	0.64	Home delivery to neighbours, Santuario	Eggs, milk, cheese, vegetables	Few trees scattered, no integration	68%
Tierra Yai	Vereda Carmelo, Santuario	2	2	0	2.8	Agroforestry services and courses, no food-production selling	Vegetables, fruits	Regenerative successional agroforestry, complex integration	81%
Don C.	Vereda la Milagrosa, Carmen del Viboral	1	0	0	0.28	Market, own restaurant in Hoja Rasca	Vegetables	Some trees scattered, living fences with multiple trees	70%
Don F.	Carmen del Viboral	1	0	0	0.90	Market, local store Hoja Rasca	Vegetables, lemons, avocado	Some trees scattered, little integration	58%
Don O.	Vereda Betania Baja, Carmen del Viboral	4	1	0	1.40	Rionegro and Medellín markets, HojaRasca store	Avocados, vegetables	Monoculture of avocados, living fence, scattered trees	71%
Y.	Vereda la Milagrosa, Carmen del Viboral	7	2	2	0.53	Home delivery, self-consumption	Milk, cheese, eggs, dulce de leche	Very little agroforestry, living fence, few trees	65%
Fam B.	Vereda Camargo,	8	4	2	1.65	Bee products,	Fruits, plantains, vegetables	Complex regenerative agroforestry,	85%

	Carmen del Viboral					on-site restaurant		recognized civil natural reserve	