CULTIVATING REGENERATION

AGROFORESTRY CONTRIBUTIONS FOR ECONOMIC TRANSITION

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MA Economics for Transition

Schumacher College

University of Plymouth

2019

Cultivating regeneration: Agroforestry contributions for economic transition

Study how a society uses its land, and you can come to pretty reliable conclusions as to what its future will be.

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2019

ABSTRACT

This action research inquired into the role that successional agroforestry can play, as a regenerative practice, in economic transition in Brazil. Through participant observation, I gained first-hand insight on the economic dynamics of three agroforestry farm typologies managed by middle-class back-to-the-landers, land-reform settlers, and a large-scale commodity producer. Agroforestry systems are analysed through the lens of heterodox economic thinking as to their potentials and challenges for economic transition. Systemic conditions for agroforestry at the policy level are also discussed. The results suggest that successional agroforestry can provide relevant practical and philosophical contributions to transition towards a regenerative economy. Such contributions stem from the understanding that humans have a role as ecosystem managers, especially through conscious interventions in deforested areas. Balance between technology, scale, and design, together with commitment to long economic cycles, can assure dignified and pleasant livelihoods, adequate income, and healthy routines. A large-scale transition depends on redesigning public policies to create systemic conditions that favour regenerative over extractive economic dynamics.

ACKNOWLEDGEMENTS

I express deep gratitude to everyone who made the learning journey that culminated with this work possible.

I'm very grateful to my dear partner, Marina, whose first wish to experience a life abroad was the tipping point for the Schumie experience, walking with me every step of this amazing journey.

Thank you also for my family, always supporting my different moves through life. Special thanks to my mom, who offered her precious academic skills, experience and enthusiasm to mentor and proofread this work.

Thanks to all the great agroforestry practitioners who shared their insights with me, helping to shape this inquiry in the early stages of this work, in special: Alan Safro, Sérgio Olaya, Eric Lassmann, Antonio Gomide, Olívia Gomes.

Thanks to Sérginho, Elaine, Átila, Lívia, Nei, Érica, Vitória, Daniel, Henrique and Ernst, who generously accepted to be a part of this work, sharing their time, thoughts, experiences and their homes for the unfolding of this inquiry. You all manifest the regeneration of agroforestry way beyond the land!

Deep gratitude for Schumacher College, it’s students, faculty, staff, volunteers, alumni and everyone else who gives life to this oasis of transition. Special thanks to Jonathan, for supervising this work and running the E4T program, a precious space to re-humanise our economic paradigm.

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1. INTRODUCTION

Transition to a regenerative economy has never been more urgent. The high levels of social inequality, the weakening of democratic governments, the sixth mass extinction, and the threats of global warming are factors that call for systemic responses capable of motivating and engaging various actors towards an economic transition.

The search for sustainability is not sufficient (Wahl, 2016); need to regenerate, reverse many of the ecological and social damages, and re-establish the necessary conditions to achieve and maintain systemic health in our planet.

In this context, agroecological transition is paramount. A specific branch of agroecology, known as successional agroforestry, has gained momentum in the past two decades and shown great potential not only as a powerful systemic solution for ecosystem regeneration and carbon storage but also as an engaging narrative that brings hope and a sense of meaning to many farmers and practitioners.

Policymaking for agroforestry is a challenge. The diversities of scale, needs, and potentials of the different farm typologies that adhere to this agricultural system must be acknowledged. Adopters of successional agroforestry range from small-scale farmers to large-scale commodity producers. In-depth qualitative investigation of the adaptation of different typologies to the framework remains to be conducted.

This research proposes an immersion into different successional agroforestry systems in Brazil in order to investigate the relevance, challenges, and contradictions of agroforestry as a catalyst for economic transition. The farmers analysed were peasants from land reform settlements[1], middle-class back-to-the-landers, and large-scale commodity producers.

Through this immersion, I aimed to answer the inquiry question: 'What is the role of successional agroforestry in economic transition in Brazil?'

1 Land-reform settlement: rural settlement allocated to peasants through the Brazilian government program of land reform (INCRA, n.d.).

1.1 Personal motivations and involvement with the topic

I first heard of agroforestry in 2015, when I took a weekend course on agroforestry gardening in Brasília, Brazil. The name intrigued me; how can the act of gardening, which I related to herbs, vegetables, flowers, and other small plants, be associated with forests, vast areas covered by tall trees? During the weekend course, many exciting and counterintuitive insights were offered about the connection between forests and agriculture, changing completely the way I felt about these themes.

Since then, I have been marvelled by the proposal and potential of agroforestry. In the three years that followed, I helped friends manage agroforests; took two more agroforestry-related courses, one about interventions in established systems and another about pruning; and implemented a system from scratch in my own backyard (Figure 1).

Figure 1- My backyard in Brasília, Brazil, before (left, November 2016) and after (right, February 2018) implementation of an agroforestry system.

As an environmentalist and public servant of the Brazilian Ministry of the Environment, I was deeply transformed and inspired by the experience of taking an active part in regeneration through alignment with nature's processes, thereby promoting life and abundance. This dissertation is an attempt to understand the role that this transformative practice can play in the broader context of economic transition and in social and environmental regeneration.

2. LITERATURE REVIEW

2.1 Why economic transition? The multiple crisis of our time

This dissertation proceeds from the premise that we are facing a multidimensional crisis that challenges the foundations of contemporary society. The symptoms are many: global warming (IPCC, 2018), increasing social inequality (Hickel, 2018), the sixth mass extinction (Ceballos, Ehrlich & Dirzo, 2017), peak oil (Kerschner, 2014), debt crisis (Keen, 2011), plastic crisis (UN Environment, 2018), and weakening democracies (Niman, 2019). Some authors argue that these symptoms are not isolated; their interconnectedness becomes clear from a systemic or holistic perspective. Therefore, a shift in paradigm is necessary, as no single solution is possible (Capra & Luisi, 2016; Scharmer & Kaufer, 2013).

Economic debate is essential to understand, in-depth, the global crisis and its causes, as economics came to be in the 20th century 'the mother tongue of public policy, the language of public life, and the mindset that shapes society' (Raworth, 2017:p.5). The past 50 years of research on the relationship between economics and the planet are a compelling illustration of the limits of the dominant economic paradigm.

In terms of scientific debate, the report 'The Limits to Growth' (Meadows *et al.*, 1972), written by a team from the Massachusetts Institute of Technology and the Club of Rome, is very emblematic. The study modelled for the first time our economy's dependence on natural resources and ecological systems on a global scale, setting off a strong debate on the limits of the current economic paradigm. The authors modelled the limits to the use of non-renewable resources and the limits of Earth's capacity to absorb pollution from agriculture and the industry. The main conclusion was that the trends in population growth, industrialisation, pollution, food production, and resource depletion would overshoot the planet's carrying capacity within the following 100 years. Different scenarios were modelled to understand the alternatives. The only scenarios that avoided overshoot and collapse were those that included, in addition to better resource use and pollution control, population stabilisation and industrial output restriction. Without limiting these factors, overshoot could be postponed (e.g. through technological development and better use of resources) but not avoided. The

implications of limiting industrial output challenged a crucial pillar of economic and political thinking in vogue since World War II: the pursuit of endless economic growth.

The report's reception by the general public was both strong and polarised. On the one hand, it attracted much criticism from mainly economists and business leaders, who argued that technological development would allow indefinite growth and that pessimistic predictions would be proven wrong over the years (Jackson & Webster, 2016). On the other hand, the book was considered by many as the founding text of the environmental movement and remains the greatest environmental bestseller until the present day. On the other hand,

The Limits to Growth started a field of research on planetary boundaries, which, over the years, proved crucial to understanding the current systemic crisis and its relationship with economy. A 20-year update concluded that the outcomes of the 1972 report were still valid; the ozone hole, global warming, and increased deforestation supported the data showing that the world's economy had already overshot Earth's carrying capacity (Meadows *et al.*, 1992). Although environmental awareness and policies improved greatly since then, the 30-year update of the report found that societal dynamics was still in overshoot, with compelling consequences, including intensification of global warming effects, increased costs of natural disasters, and conflicts about the distribution of freshwater and fossil fuels (Meadows, Randers & Meadows, 2004).

Other authors reached similar conclusions about ecological overshoot through different approaches, such as the peak-oil theory, permaculture principles (Holmgren, 2018), the ecological footprint (WWF, 2018), the planetary boundaries framework (Stockholm Resilience Centre, 2009), and climate change (IPCC, 2018).

Nowadays, climate change is probably the most detailed and convincing evidence of overshooting. It is subject to periodic modelling and analysis from one of the largest international initiatives on scientific cooperation, the Intergovernmental Panel on Climate Change (IPCC). IPCC's most recent report (IPCC, 2018) modelled different scenarios to compare the consequences of a 1.5 and 2 °C increase in global temperature, the former being a non-mandatory goal; and the latter, the

official threshold of the Paris Agreement under the United Nations Framework Convention on Climate Change.

IPCC (2018) estimated robust differences in regional climate characteristics between the present-day global warming scenario (1.0 °C above pre-industrial levels) and the 1.5 °C scenario, and even greater differences between global warming of 1.5 and 2 °C, including increases in mean temperature, extreme temperature and precipitation events, and drought. To remain below the 1.5 °C target, global greenhouse gas emissions must be reduced by 45% by 2030 and to zero by 2060. The individual commitments of countries to the Paris Agreement are not enough to achieve the goal, not even considering the increase in emission reduction rate after 2030. The report is very clear about the urgency of solutions: a global warming greater than 1.5 °C can only be avoided if greenhouse gas emissions begin to decline well before 2030. Appropriate solutions would imply a rapid and far-reaching transition in all societal systems: energy, agricultural, urban, infrastructure, and industrial. This transition would be unprecedented in terms of scale but similar in terms of speed to the efforts expended in adaptation during World War II. In addition, there would be a need to maximise synergies between mitigation and adaptation in social and environmental achievements while minimising trade-offs.

The implications of these conclusions are relevant and involve almost all domains of human society. But in the international political arena, the debate has, so far, been dominated by a narrative that does not acknowledge the depth of the changes needed.

2.2 The economics of crisis: a dominant narrative

Underpinning the multiple crises is a dominant worldview, a set of beliefs widely shared by individuals and institutions that Michaels (2011) termed ‘monoculture’. This worldview has an economic dimension that is adopted by mainstream global institutions and governments and hardly ever questioned. For the system thinkers Capra & Luisi (2016), it is a heritage of a reductionist, mechanistic, and materialist view of the world based on the 300-year-old breakthroughs of the Enlightenment. This narrative is not only inadequate to deal with the current crisis but also believed to be part of its cause.

The narrative emerges from the beliefs that humans have a competitive, rational, and self-interested behaviour (*Homo economicus*); human needs are insatiable (and, consequently, society lacks the means to meet them); free markets are the most efficient strategy to allocate scarce resources (as opposed to 'tragedy of the commons' or 'inherently' inefficient public management); and nature is a subsystem of economy, providing resources to be exploited according to an economic logic (Capra & Luisi, 2016; Michaels, 2011; Raworth, 2017).

The outcome of such beliefs is the dominant economic narrative we have observed in politics over the past decades: priority of profit maximisation (or economic growth) over any other goal, overemphasis on the virtues of 'economies of scale' (and thus of mega-projects, large-scale agriculture, urbanisation), rejection of limits on resource exploitation, and attempt to monetise all domains of life to enable trade-off decisions (such as between financial, social, and environmental capital).

Since the Rio+20 Conference in 2012, this economic narrative took on a 'green growth' concept, promoted by leading international institutions in the policy arena, such as the Organisation for Economic Cooperation and Development (OECD), the United Nations Environment Programme (UNEP), and the World Bank. Hickel & Kallis (2019) analysed the implications of this narrative for the current environmental challenges in face of the Paris Agreement, especially the proposition of endless economic growth through eco-economic decoupling. The hypothesis that technological development can lead to absolute decoupling of gross domestic product (GDP) growth from resource use and greenhouse gas emission (i.e. GDP can grow while resource use and emissions diminish) is the main argument for supporting the indefinite growth of the economy. However, the authors concluded, on the basis of the most updated data, that absolute decoupling of GDP growth from resource use is impossible and that complete decoupling from greenhouse gas emission at the necessary rate to prevent a 1.5 or 2 °C global warming is theoretically possible but unlikely, even under highly optimistic conditions. To the authors, insistence on green growth is based on the assumption that 'it is not politically acceptable to question economic growth' (Hickel & Kallis, 2019).

Tim Jackson and Kate Raworth are contemporary economists who have explored the reasons for the long-lasting political consensus on economic growth. In 'Prosperity Without Growth', Jackson (2016) proposed that this is due to a 'dilemma of growth': if, on the one hand, infinite growth is clearly unsustainable, on the other hand, 'de-growth' under the present economic conditions is unstable and leads to rising unemployment, decreased competitiveness, and a spiral of recession. (Raworth, 2017) named this phenomenon 'addiction to growth' and explored the factors that keep our society 'hooked' on the growth imperative, financially (e.g. a debt-based money system in which economic growth is necessary to enable payment of interest), socially (e.g. our need for meaning has been psychologically linked to consumerism, making economic growth a proxy for prosperity), and politically (e.g. growth is a compensation for job losses when labour productivity increases and is seen as a substitute for income redistribution). A post-growth economy would necessitate completely different approaches to economy and to our goals and meanings as a society.

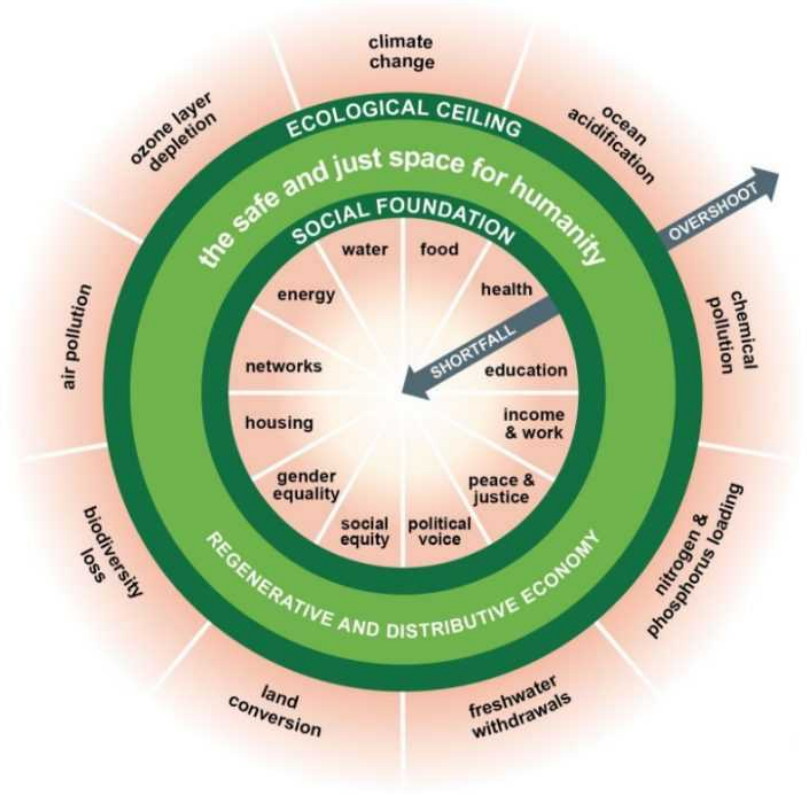
2.3 Heterodox approaches to economy: nurturing diversity

A number of heterodox economic thinkers have offered alternatives to the dominant economic narrative. Max-Neef (1991) and Mies & Bennholdt-Thomsen (1999) proposed an economic system focused on promoting well-being and self-determination rather than economic growth. Schumacher (1993) suggested pursuing appropriate scale and technology instead of economies of scale or elimination of redundant human labour. Jackson (2016), Kallis (2017), and Raworth (2017) argued for an economic model that respects planetary boundaries and embraces the complexity and uniqueness of life domains without attempting to attach a price to life or turn every decision into a financial one.

Seeking to address essential human needs within planetary boundaries, Raworth (2017) developed the Doughnut Economics framework (Figure 2). The concept is represented by a diagram with an inner and outer circle. The inner circle symbolises a social foundation based on minimum thresholds that need to be surpassed to assure basic human rights, in line with the United Nations' Sustainable Development Goals agreed by the international community in 2015 (United Nations, n.d.). The outer circle depicts the planetary boundaries proposed by

researchers from the Stockholm Resilience Centre (2009), out of which humanity would operate in overshoot mode. The space between the social foundation and the ecological ceiling forms the 'Doughnut', a safe and just space for humanity.

Figure 2-Doughnut Economics framework (Raworth, 2017)

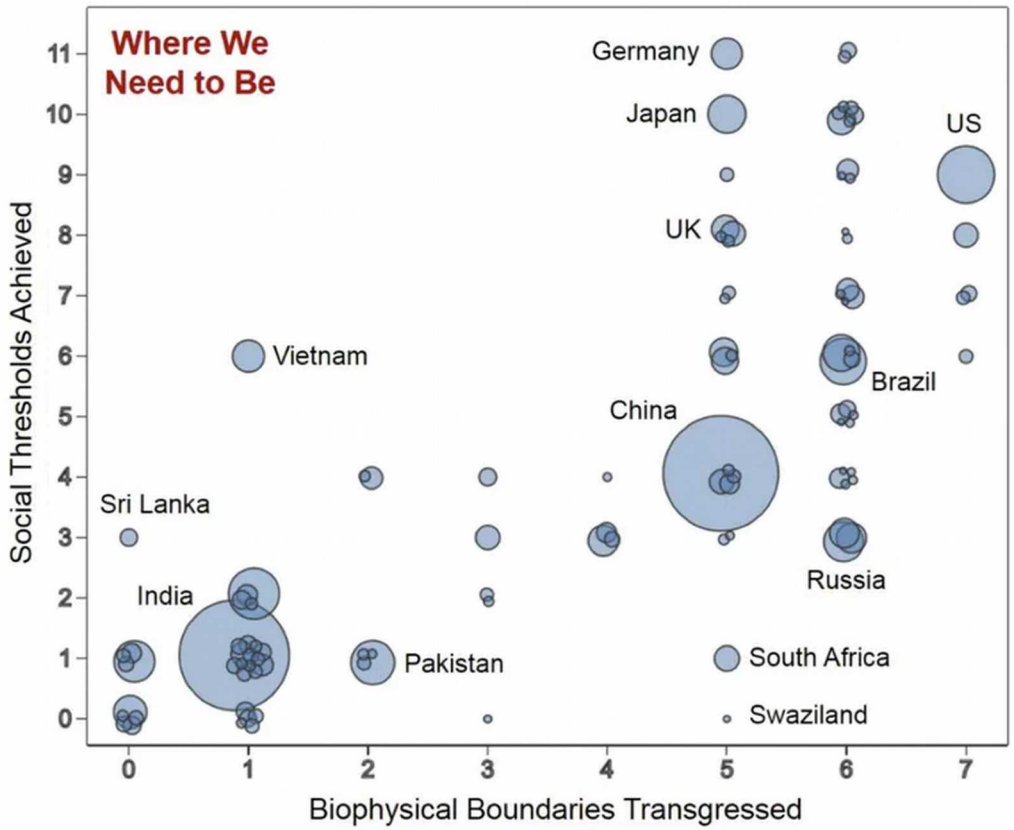


O'Neill *et al.* (2018) used international data to gain an overview of how countries perform regarding the Doughnut framework. The results showed the complexity of the needed transition: no country is concurrently living within Earth's boundaries and meeting basic human needs (Figure 3).

According to advocates of economic transition (Jackson, 2016; Kallis, 2017; Kuhnhenn, 2018), a deep reorientation of the way we organise as a global society is very unlikely or even impossible to happen within our current economic paradigm. And a paradigm shift is no simple task. It requires a radical change in our patterns of production and consumption, in the way we relate to work, money, profit, and investment. It implies redefining what we understand as 'prosperity' (Jackson, 2016). It necessitates reshaping the role of politics in our lives, nurturing communities, relating differently to property, rethinking dominant narratives about human nature (D'Alisa et al., 2015; Raworth, 2017). It is not simply a matter

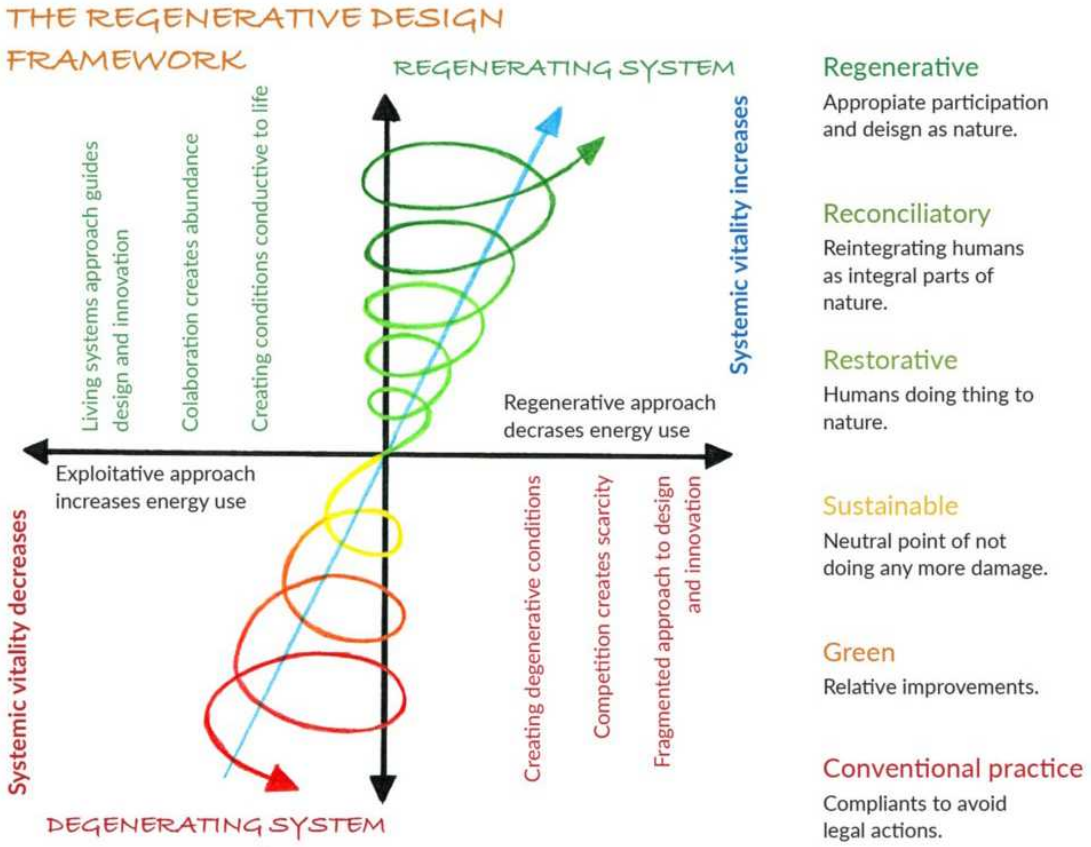
of adopting different policies. A paradigm shift means changing our ways of thinking, feeling, and collaborating towards a new way of being.

Figure 3-Social thresholds achieved and biophysical boundaries transgressed by different countries, as presented in O'Neill et al. (2018).



If we intend to stop the systemic overshoot that has been evidenced by the methodologies outlined previously, it is no longer enough to avoid causing harm to ecological and social systems. We need to reverse the damage that has been done. In his book 'Designing Regenerative Cultures', systemic thinker and designer Daniel Wahl extensively reviews the literature on transition and sustainability and makes a point about the need for regenerative cultures. According to Wahl (2016), whereas 'sustainability' is the neutral point on the damage scale, 'regeneration' refers to the deeper concepts of 'appropriate participation' and 'designing as nature' (Figure 4).

Figure 4-The regenerative design framework, as presented in Wahl (2016:p.46).



In the economic domain, Wahl (2016) echoes the foundational idea of ecological economics, arguing that true wealth and well-being can only emerge out of healthy ecosystem functions. Life processes would be the true source of abundance and cooperation would be the main form of sharing this abundance in a regenerative economy. Other characteristics of a regenerative economy would be a circular flow of resources; multiple forms of capital other than financial, including cultural, intellectual, and spiritual capitals; and a better balance between efficiency and resilience.

2.4 The role of agriculture and agroforestry

Agriculture is a core part of society. In the model adopted by The Limits to Growth (Meadows et al., 1972), agriculture and industry were the basic sectors modelled for resource use and pollution. Industrial agriculture is especially demanding of resources. It uses large amounts of water and relies on fossil fuels for mechanised farming operations, transportation, and production of fertilisers and chemicals (Schnepf, 2004). In Brazil, agriculture is directly responsible for 33% of greenhouse

gas emissions and indirectly (through deforestation and land use) for another 18% (MMA, 2014).

This scenario illustrates the dependence of agricultural systems on extractive activities and non-renewable resources. Such agricultural paradigm has departed greatly from the etymological sense of the word 'agriculture', which is a combination of two Latin words, agri/ager, meaning 'land', 'soil', or 'territory', and cultura, meaning 'care', 'honouring', or 'cultivating' (Latdict, n.d.). This dissertation is based on the premise that economic transition implies reconnecting with the etymology of agriculture; that is, a transition towards taking care of the land and living on what the land can offer. Thus, agroforestry is approached in this work as an attempt to rescue this original agricultural ethos, as better explained in the following sections.

2.4.1 Agriculture in Brazil

Brazil is the fifth largest country in the world (851 million ha), the fifth most populous nation (over 210 million inhabitants), and the eighth largest economy by nominal GDP (about US$ 2 trillion as estimated for 2019) (IBGE, n.d.). Its continental surface area is occupied as follows: 67% by forests and native vegetation, 29% by agriculture and pastures, and the remaining 4% by water bodies, cities, and infrastructure (Observatório do Clima, 2019). Conservation units and indigenous reserves represent 30% of the territory (Observatório do Clima, 2019). The country ranks second in forest area (after Russia) and first in a tropical forest area (Observatório do Clima, 2019).

Observatório do Clima (2019), a network of civil society groups, consolidates updated data on agriculture and forests in Brazil. According to their report, agribusiness generates about US$ 100 billion a year in exports, equal to the value of ecosystem services (such as soil and water conservation and climate regulation) provided by forests. The revenue from all forest products excluding timber amounts to US$ 300 million annually.

2.4.2 Agroforestry

According to the World Agroforestry Center (ICRAF, n.d.), the simplest definition

of agroforest is “agriculture with trees”. An agroforest can also be viewed as a complex system in which trees are integrated and interact with crops and/or livestock in a managed farm or agricultural landscape (Buttoud, 2013). Such systems are often diverse and able to produce different outputs (e.g. food, fibres, fuel, timber) in an integrated fashion (King, 1979; ICRAF, n.d.).

Forests have long been cultivated and managed to meet human needs. As a systematic practice, King (1979) reported that the taungya forest cultivation system has been practised in Burma since 1856, from where it spread to the rest of Asia, Africa, and Latin America, under different names and modifications.

Other pieces of evidence indicate that humans have been cultivating and reshaping forests for millennia. Maezumi *et al.* (2018) found evidence of pre-Columbian polyculture agroforestry in the Amazon region dating from 4,500 years ago. The authors concluded that pre-Columbian Amazonian populations attained long-term food security through closed-canopy forest enrichment with edible plants, a practice whose legacy is seen today in a hyperdominance of edible species in many Amazon regions. The main methods for agroforest management at the time were limited to clearing for crop cultivation and low-severity fire management.

In Brazil, agroforestry has been a the preferred cultivation method of many indigenous populations and, in recent decades, a subject of research and development by academic institutions and technical assistance agencies, such as the Brazilian Agricultural Research Corporation (Embrapa).

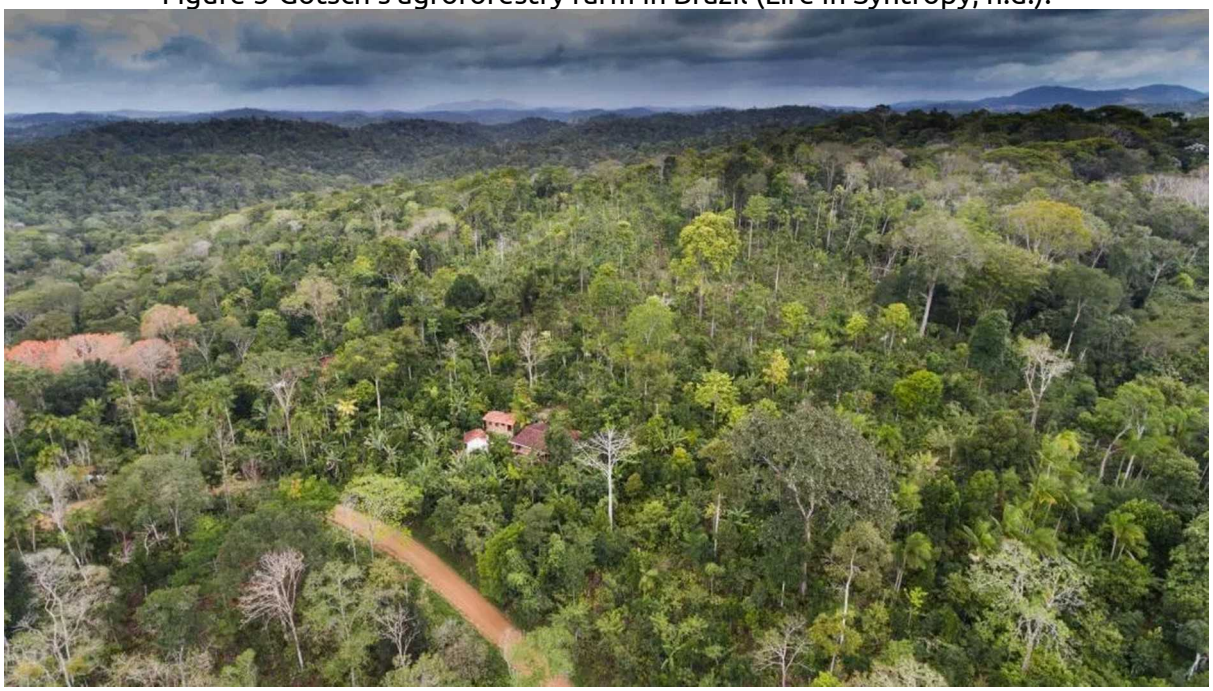
This dissertation is focused specifically in the works and teachings of the agroforestry practitioner Ernst Götsch. Götsch has been playing a significant role in spreading the concept and importance of agroforestry throughout Brazil and the rest of the world.

2.4.3 The work and vision of Ernst Götsch

Ernst Götsch, a swiss farmer and former genetics researcher, has been experimenting with ecological agriculture since the 1970s. He migrated to Northeastern Brazil in the 1980s and began to reforest a degraded farm in order to cultivate cocoa within a biodiverse system (Figure 5) (Pasini, 2017). Over time,

Götsch developed a concept of agroforestry that is at the same time intuitive, empowering, regenerative, and systemic. His views have engaged the public, attracting attention from beyond the farming sector. In 2016, Götsch's concepts were incorporated into the narrative of 'Velho Chico', a prime-time soap-opera broadcast by the most popular TV channel in Brazil, Rede Globo.

Figure 5-Götsch's agroforestry farm in Brazil (Life in Syntropy, n.d.).



Götsch has provided consultancy services and courses about his understanding of agroforestry systems since the 1990s. In recent years, his proposals have gained a lot of momentum, with the number of practitioners, academic research groups (see section 2.4.4), and organised groups devoted to practising and spreading his concepts increasing greatly in Brazil and internationally. Mutirão Agroflorestal[2], Life in Syntropy[3], and MAIS[4] are examples of organisations for the promotion of agroforestry. In 2013, Götsch labelled his work as 'syntropic agriculture', although practitioners formed by him also refer to the method as 'successional agroforestry' because of the importance of natural succession to Götsch's practice (Pasini, 2017).

Pasini (2017) searched the major databases related to agriculture for the term 'successional agroforestry' and found that all publications on the subject refer to Götsch's work. The first scientific study on the topic is a dissertation written by

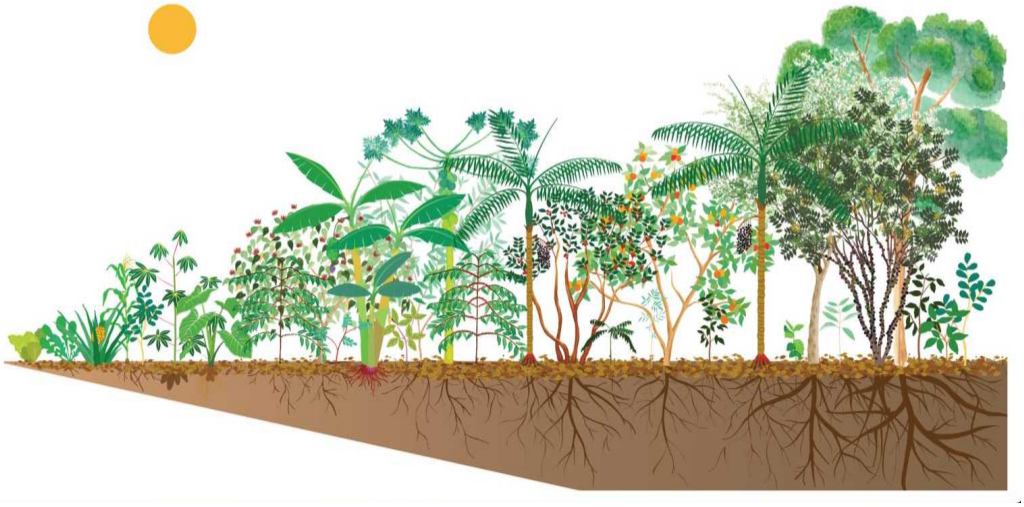
2 http://mutiraoagroflorestal.org.br/
3 http://lifeinsyntropy.org
4 https://www.facebook.com/movimentodeagroflorestoresdeinclusaosintropica/

Peneireiro in 1999. For the purposes of this dissertation, Götsch's method will be referred to as 'successional agroforestry'.

But what is exactly successional agroforestry? The following paragraph, based on personal notes taken in agroforestry courses, provides a brief introduction to the concept.

Forest dynamics can be mimicked to create an agricultural system that benefits from natural regeneration processes. When a clearing is formed in a forest, e.g. by a tree that falls, it creates an environment rich in organic matter and with ample sunlight. This is the original natural environment of many food plants domesticated by humans, including, for instance, corn and tomatoes. These plants require direct sunlight and tend to grow fast, rapidly occupying different height strata and covering the clearing. In doing so, they create an environment that enables the development of other plants, ones that grow slower and demand some level of shade. In a continuing process of regeneration (illustrated in Figure 6), groups of plants succeed one another until the site reaches the climax of forest development, characterised by the presence of tall, long-lived trees such as redwoods, rosewoods, mahoganies, and oaks. Mimicking the dynamics of clearings results in an agriculture system based more on processes than inputs, whereby human intervention accelerates natural regeneration of biodiversity, energy accumulation, and soil fertility with minimal (and eventually no) need for external inputs.

Figure 6-Illustration of a natural succession process (SMA/SP, 2018).



Some examples of practices adopted in successional agroforestry are planting consortiums, selective weeding, frequent pruning for multiple purposes, abundant mulching, and managing the system to occupy multiple height strata (Rebello, 2018).

2.4.4 Research on successional agroforestry

To illustrate the scientific knowledge about the subject, I performed a search for the terms 'successional agroforestry' and 'syntropic agriculture' in Google Scholar[5] and in the official database of university research in Brazil[6].

The search identified 48 academic works published between 1999 and 2019 at bachelor (10), master (32), and doctoral (6) levels. Most publications consist in agronomic and environmental analyses of agroforestry systems. Others are related to education, economy, technology and public policy.

The studies bring evidence of the importance and great potential of successional agroforestry for agroecological transition (Rocha, 2006; Cardoso, 2012; Gomes, 2015; Iha, 2017) and its capacity to accelerate ecological restoration and build resilience in degraded environments (Peneireiro, 1999; Silva & Pereira, 2002; Formoso, 2007; Santos, 2017). Several articles confirmed the economic feasibility of successional agroforestry and its multiple benefits (ecological, social, economic) over conventional agriculture (Brito, 2010; Albuquerque, 2012; Moura, 2013; Silva, 2013; Matsumura, 2016; Araújo, 2017; Azevedo, 2018).

3. METHODS

Motivated by the issues exposed in section 1.1, this research was also personally seen as an opportunity to engage with agroforestry activity and its practitioners and grasp its economic meanings through direct experience with people that make their livelihood out of agroforests. Thus, the way to carry this work forward emerges out of an intention of 'action research', understood as:

> *a participatory process concerned with developing practical knowing in the pursuit of worthwhile human purposes. It seeks to bring together action and reflection, theory and practice, in participation*

5 https://scholar.google.com.br/
6 http://catalogodeteses.capes.gov.br/catalogo-teses/#!/

> *with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities.* (Reason & Bradbury, 2008)

In action research, inquiries evolve collectively with the community engaged in the process through cycles of action and reflection (Reason & Bradbury, 2008). In this specific project, immersion as a volunteer was chosen as the main form of engagement, with each experience lasting from one to two weeks and including three different typologies of agroforests managed by land-reform settlers, middle-class back-to-the-landers, and a large-scale commodity producer.

Immersion experiences were designed in the early stages of the project, when its main inquiry was taking shape, after a process of informal exploratory conversations about agroforestry economics with five practitioners to whom I had easy access at the time (named in the acknowledgments). Conversations were unstructured, allowing practitioners to freely share their thoughts on the topic. From the conversations, it became clear that the economics of agroforestry is highly dependent on typology. The three agroforestry typologies investigated in this work were the most cited by all practitioners.

The immersion experiences took place in three of the five geographic regions of Brazil (South, Southeast, and Central-West), in two of the six main biomes of the country (Atlantic Forest and Cerrado).

The qualitative approach adopted during the immersions was inspired by the understanding of ‘participant observation’ of the anthropologist Tim Ingold. To Ingold (2014), the essence of participant observation is engagement and correspondence rather than description and reportage. It implies observing with all human faculties (including feelings and intuition) ‘from within the current of activity in which you carry on life alongside and together with the persons and things that capture your attention’ (Ingold, 2014:p.387).

In this sense, the method of research had an important relational dimension, a dimension of attentively responding to events and situations in a way that co-creates the unfolding of the inquiry with the community engaged. Although immersion included more formal moments of recorded interviews and data

analysis, they emerged naturally from prevalent informal moments, when diverse conversations and activities took place. Through the long hours shared together at various moments throughout the day (planting, having a coffee, eating meals, playing songs), economic aspects that were relevant to the community were revealed, shared, and expanded in conversations and reflections.

Studies about the economy of agroforestry systems often adopt a quantitative approach centred around cost-benefit analysis of commercial production or pricing of environmental services. This work focused instead on the qualitative dimension of economic dynamics and the meanings of successional agroforestry. Quantitative data were used as a secondary resource, as a means in service of the discussion.

Other types of engagement were also carried out as the inquiry unfolded and opportunities emerged, such as conversations with experienced practitioners, a one-day visit to a fourth agroforest farm and a course with Ernst Götsch, which I attended just before the first immersion.

4. FINDINGS AND DISCUSSION

4.1 The economics of agroforestry: making sense of Götsch's vision

The fieldwork of this action research began with a course on syntropic agriculture led by Ernst Götsch and Fernando Rebello in Alto Paraíso de Goiás, Brazil, from 29 April to 1 May 2019. As stated in section 1.1, I had been studying Götsch's framework of agroforestry since 2015, but it was only during this course that I had the chance to meet him personally and get a first-hand insight into his ideas and vision.

During the course, Götsch and Rebello criticised the dominant economic paradigm, in which ecological, social, and technological domains are expected to adapt to the prevalent economic logic. They advocated instead for a system based on ecological principles that are determined by nature and, thus, unnegotiable. Human domains (social, technological, philosophical, and economic), in their view, should be subjected to the ecological domain, a vision that resonates with the foundational proposition of ecological economics.

Götsch conceded an interview on the last day of the course. He outlined his vision of the role of agroforestry in economic transition and stated that we need to shift from an economic system based on extraction/mining to one based primarily on local renewable resources. This philosophy also applies to agroforestry: agricultural inputs can be produced *in loco*, just as forests do through photosynthesis and other life processes, obviating the need to 'loan' accumulated resources from other areas.

His view about the economy embraces a particular understanding of the relationship between agroforests, technology, well-being and land ownership. Götsch discoursed about how humans have been fighting against forests for over 12,000 years, when instead trees and humans can be allies.

He talked about his endeavours in developing machines that enable an agriculture of processes, making it easier to manage both trees and crops. He advocates for light machines designed to favouring life processes as opposed to the current heavy machines derived from war technology that, for instance, compact soils and spread poisons. For Götsch, many, but not all, activities in agroforestry can be mechanised to make human work easier. Activities such as pruning and harvesting delicate crops (e.g. tomatoes) cannot and should not be mechanised. He frames them as 'agroyoga':

> *'they are very pleasant activities… the moments that are for me of utmost creativity, that activate the right side of the brain… it is not something that tires you'* (Götsch, 2019 Interview).

Götsch also envisions a transition to an economy where most of our needs are met by forests. Timber can be a very abundant subproduct of growing food. 'By growing wheat [in an agroforestry system], I can produce more timber than any reforestation project' (Götsch, 2019 interview). Wood could then have a wider role in economy, not only in the construction sector but in various others. Götsch claims that this type of synergetic production could allow us to have more free time, for instance, for music and other arts.

Although Götsch understands that large-scale, mechanised agriculture is essential for transition (because it occupies most of the territory), he defends that

agriculture is an activity more suitable for small-scale family systems. In his vision of economic transition, he sees a large portion of the population maintaining a healthy engagement with agriculture, practising ‘agroyoga’. He argues that all civilisations that concentrated most of their population in cities collapsed.

Götsch also talked about his view of ownership. He argued that land cannot be owned; it is our duty to steward the land and pass it on to the next generation enriched rather than mined.

During the course, Götsch and Rebello frequently cited Viktor Schauberger and the book ‘Living Energies’, by Callum Coats, a comprehensive account of Schauberger’s work and ideas. In the book, there is a particular image that illustrates well the economic logic that Götsch advocates (Figure 7): whereas nature’s economy leads to increased accumulation of resources (matter, energy, information), techno-mechanical economy dissipates resources, leading to decay, deterioration, and, ultimately, bankruptcy.

Figure 7- ‘The fateful choice’, as presented in Coats (2001).

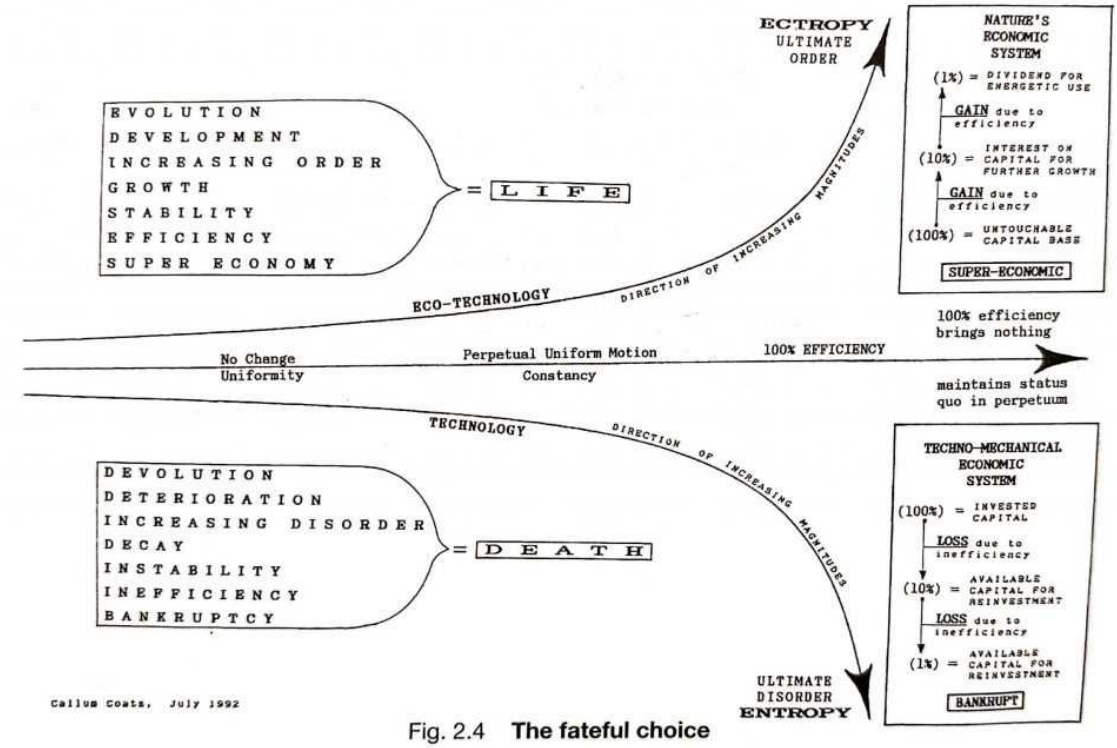


Fig. 2.4 **The fateful choice**

According to this logic, life’s processes always evolve towards increasing levels of energy accumulation and complexity, a trend that Götsch defines as ‘syntropy’

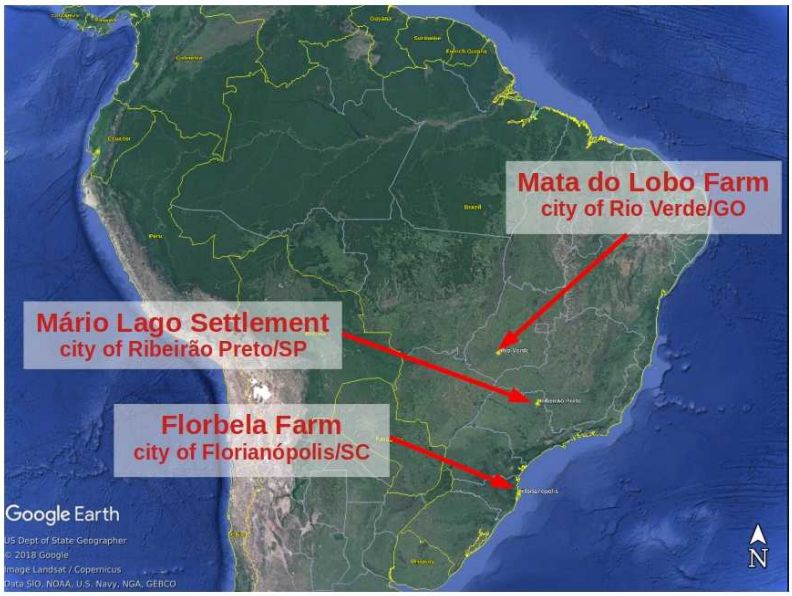
(Life in Syntropy, 2018). This understanding led me to the initial hypothesis that I would find an economic dynamics based on regeneration and abundance in the agroforestry immersions.

4.2 Volunteering in agroforests: learning through living

After the course, I volunteered in three agroforestry initiatives to experience the lifestyle and routine of its practitioners (Figure 8): the Florbela farm (from 19 to 31 May 2019), a neo-rural endeavour located in the city of Florianópolis, Southern Brazil; the Mário Lago settlement (from 24 to 28 June 2019), a land-reform settlement affiliated to the Landless Workers' Movement (MST) in Ribeirão Preto, Southeast Brazil; and the Mata do Lobo farm (from 30 June to 6 July 2019), a large-scale system located in Rio Verde, West-Central Brazil.

In the next sections, I describe each farm system and provide a brief overview of their history.

Figure 8- Location of the agroforestry initiatives I visited in Brazil.



4.2.1 Back-to-the-land agroforestry: the Florbela farm

The first immersion experience occurred at the Florbela farm (*Sítio Florbela*, in Portuguese), a 36 ha farm in Florianópolis, Santa Catarina, Brazil.

Florbela is owned by a couple, Sérgio Araujo and Elaine Vargas. Both have lived in

urban areas and continue to work and live near the city centre. Parallel to the urban life, they started a rural initiative in 2013, when they bought the lands that now comprise the Florbela farm, seeking healthier lifestyles. Their current routine consists in working on the farm on Wednesdays and Fridays (and staying there over the weekend) and living and working in the city on the other days of the week.

When bought, the land was composed of about 10–15% of native forest and the remaining area comprised pasture, farmhouses, a barn, and roads. The couple took many courses on permaculture, organic agriculture, and agroforestry and formed partnerships to take care of the land.

The first partnership was established with a permaculturist to produce organic strawberry. At that time, their vision of production was, in Sérgio's words, very 'technological', using greenhouses and 'lots of plastic'. The initiative lasted for one year, but failed commercially and personally, with conflicts over the terms of the partnership. A second partnership was established with an organic agriculturist to grow vegetables. The initiative lasted for almost 3 years, but the model was not commercially stable and production methods were still not satisfying for the owners. Soil erosion was one of the main problems. With time, some pests common to organic horticulture started to appear, increasing the use of organic inputs.

The owners came to know of Götsch's work on agroforestry through a YouTube video entitled 'From garden to forest'[7] and signed up for a course on the farm shown in the video, Sítio Semente, Brasília, Brazil. After the course, the owners implemented the first agroforest plots at Florbela and held several agroforestry courses led by experienced practitioners. With every course, new agroforest plots were implemented, which were viewed as experiments and had no commercial purposes.

A third partnership was established with an agroforestry practitioner, parallel to organic production, but competition between systems led to frictions, and the commercial agroforestry partnership ended after 7 months. In July 2018, a partnership was established with Átila and Lívia, a young couple who moved to

7 https://www.youtube.com/watch?v=C7h-JbaJjn4

Florbela to manage native, stingless bees for honey and propolis production (meliponiculture). By then, the responsibility of investments, administration, operational costs, and profit-sharing between owners and partners were becoming better established.

The new couple ended up also engaging in the agriculture jobs. At the beginning of 2019, the organic agriculturist left the farm and Átila and Lívia became the main partners of the horticulture business. They were also agroforestry enthusiasts and found the organic horticulture routine too repetitive. Owners and partners felt that they were constantly and unsuccessfully fighting against erosion and the weather. Managing the agroforest crops, on the other hand, was exciting and embedded with a feeling of improvement and evolution. Every new planting cycle began under better soil and environmental conditions than the previous cycle.

Owners and partners agreed to make a full transition to agroforestry. The first commercial agroforest plots were implemented in March 2019, and, since then, the former organic fields have been progressively redesigned into the agroforest model (Figure 9).

During my volunteering experience, the farm was in the third month of transition. Most of the activities that I engaged consisted in preparing and planting new beds, harvesting vegetables, and packing them for delivery.

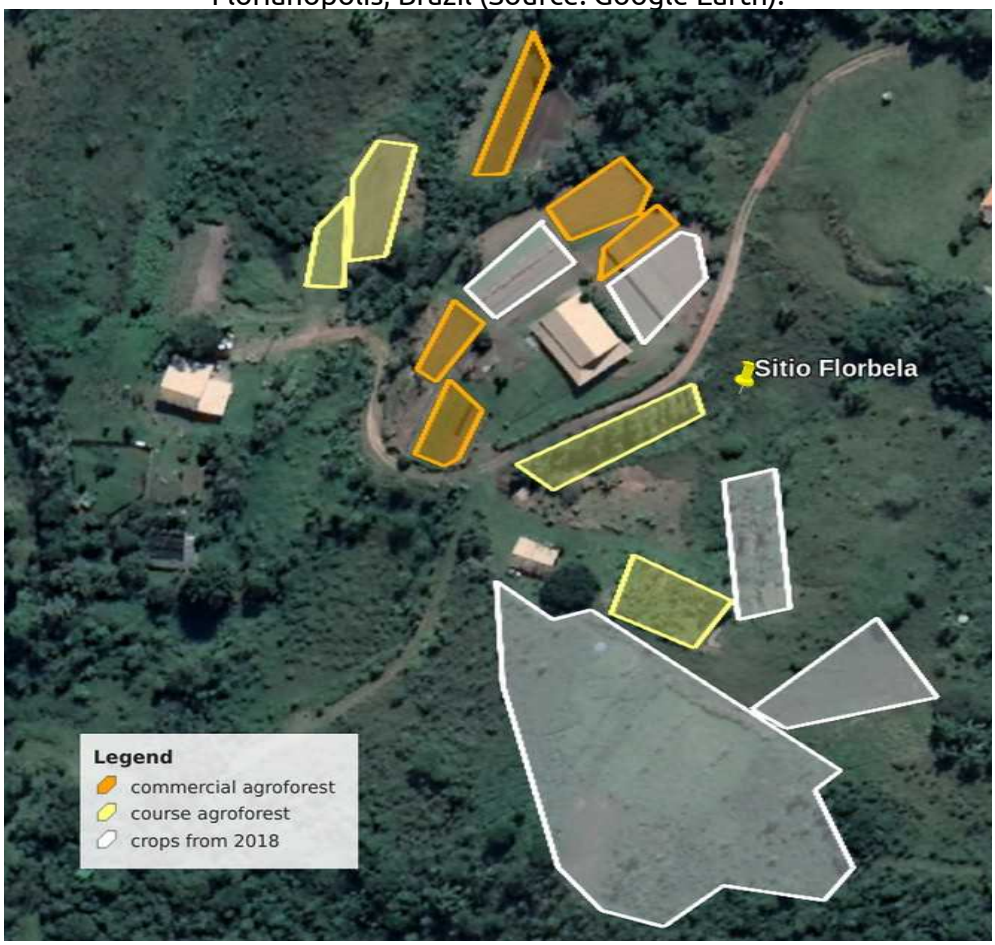
4.2.2 Land-reform agroforestry: the Mário Lago settlement

My second immersion experience took place at the Mário Lago land-reform settlement, Ribeirão Preto, São Paulo. The settlement was established after the expropriation of Fazenda da Barra, a large-scale sugarcane farm. Fazenda da Barra had been charged for several environmental crimes in the 1980s and 1990s. In 2000, an expropriation lawsuit was filed, and in 2003 the Landless Workers' Movement occupied the farm to pressure for land reform. Finally, in 2007, the Mário Lago settlement was officially established by the federal government.

I was received by Nei and Erica, one of the 260 families living in Mário Lago. They moved there in 2004 after joining the occupation camp. Now they are responsible for a 1.7 ha plot and a common plot that they share with nine other families. Erica

was born and raised in the city, but her parents had led a rural life. Nei grew up in the countryside, working on farms from childhood until the age of 18 years, when he moved to the city to work in a supermarket.

Figure 9- Satellite image of cultivated plots at the Florbela farm, Florianópolis, Brazil (Source: Google Earth).



For both, a rural background was associated with experiencing difficulties and deprivation, being subjected to harsh labour conditions, and living on other people's land. Even after joining the occupation camp, their main source of income came from employment in the city, where Nei worked as a bricklayer.

It was only in 2012, through the Agroflorestar Project[8], that Nei and Erica reconnected with agriculture and turned it into their livelihood. They found that agroforestry allowed for better working conditions and income than conventional agriculture. In 2016, a second phase of the project helped 80 families implement agroforest plots. Many families started selling organic vegetables in the city and in

8 A project of agroforestry transition for 400 families of peasants, financed by the national oil company, Petrobras.

2017 they came together to create a cooperative (Cooperativa Orgânica Agroflorestal Comuna da Terra). Currently, 23 families are part of the cooperative, and three other agriculture cooperatives operate in the Mário Lago settlement.

Nei and Erica own a 3-year-old fruit agroforest (6,500 m²), implemented with the help of the Agroflorestar Project. However, fruits still represent a small fraction of their income. Their main revenue comes from a 3,000 m² agroforest plot planted with horticulture in March 2019 (Figure 10). Almost all their production is sold through the cooperative to street markets and final consumers on a weekly basis (57% of their income) and to the government procurement program for school meals, PNAE[9] (27% of their income). Another 10% of their income comes from delivery services that Nei provides to the cooperative.

Figure 10- Satellite image of Nei and Erica's agroforest plots.

During the volunteering period, I worked mainly in the horticulture plot carrying out similar activities to those in Florbela: preparing new beds, reforming old ones, planting seedlings, and harvesting and packaging vegetables.

4.2.3 Large-scale agroforestry: the Mata do Lobo farm

The third immersion took place on the Mata do Lobo farm, Rio Verde, Goiás. The

9 PNAE, National School Meals Programme. The program enables public schools to purchase up to 30% of its food requirements directly from local farmers.

farm is owned and managed by Luiz Henrique and occupies 2,600 ha, most of which is under soya and corn cultivation or pig farming.

I was received by Luiz Henrique's daughter, Maria Vitória, and her husband, Daniel. The couple began working on the farm in 2015 to understand the dynamics and dilemmas of agroecological transition in a conventional large-scale system. In the past three years, the couple researched and experimented with different management practices. They were able so far to reduce the use of fungicide by 75%, eliminate the use of limestone, and completely replace chemical fertilisers with organic ones.

But transition to agroforestry is currently their main focus. In 2016, the couple learned about syntropic agriculture and took part in a course promoted by Fernando Rebello. After the course, they had a consultancy with Götsch and gathered an informal group of large-scale producers who were willing to experiment with a mechanised form of agroforestry grain production. The collective endeavour was publicly presented in a video by Life in Syntropy[10] in 2018.

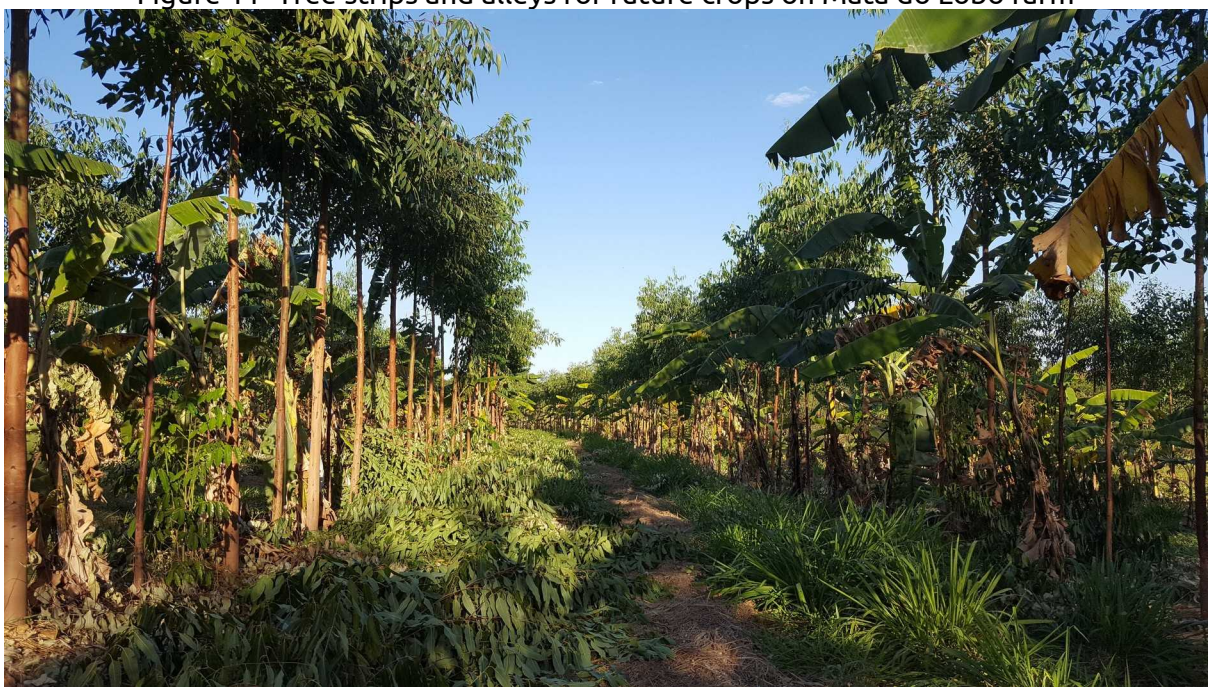
Two agroforestry systems were implemented, one focused on grains (soya and corn) and the other on coffee production. In 2017, a field of 13 ha was planted with strips of trees (mainly eucalyptus, banana and mahogany) in preparation for the plantation of the crops in the alleys between the trees (Figure 11). A similar system with tree strips and alleys was established in 17 ha for coffee production.

This was the first time such systems were implemented in a mechanised, large-scale fashion. The agroforests are expected to generate income as of 2020 with the first commercial harvests of corn and banana. However, the outcome is uncertain and the challenge demands important technological know-how. The aim is to achieve an equilibrated, resilient, and productive living system free of external inputs. Fertilisation of crops and trees is designed to be achieved using mulch made from pruned and shredded tree branches and cuted grass. Weeds are controlled with mulching and by planting grass at the lowest stratum. Currently, there are no machines available to perform these activities at large scale. Mata do

10 https://www.youtube.com/watch?v=T5NozFfHDpk

Lobo and other farms involved in the initiative have financed projects to design and adapt machines. A harvester is being adapted to perform a clean cut of grass and distribute it along the planting strips. Two other machines are also planned: an apical pruner and shredder and a seed sower for planting grains between grass strips.

Figure 11- Tree strips and alleys for future crops on Mata do Lobo farm



During the volunteering period, I mainly pruned eucalyptus, banana trees, and green manure (such as pigeon peas) for the production of mulch and reduction of shade in preparation for the first corn crop in October 2019.

4.2.4 A mature agroforestry system: the Ouro Fino farm

Although not initially planned, I had the chance to join Henrique Sousa for a one-day experience of agroforest management on the Ouro Fino farm[11]. The 30 ha property, comprising plots at all stages of natural succession, is located in the state of Bahia, Northeastern Brazil. Henrique has been practising agroforestry under Götsch's guidance for over 20 years and currently manages about 20 ha of agroforests with a diverse production system focused mainly in açaí, cupuaçu, and cocoa alongside Brazilian nuts, honey, annual crops such as cassava, and many species of hardwood trees. The farm is an incredibly rich place to learn about

11 http://www.fazendaourofino.com.br/fazenda-ouro-fino/

successional agroforestry because of its age, high species diversity and Henrique's long term experience and dedication.

My visit to the Ouro Fino farm took place on 18 July 2019. Although it was a short visit, I had the opportunity to observe a mature agroforestry system that included areas renewed by the 'clearing to clearing' dynamics (Figure 12, more detailed in section 4.3.2). I was also able to discuss my hypothesis and observations of the immersion period with a very experienced practitioner, which was of immense value to enrich the discussions presented in the following sections.

Figure 12- Recently renewed plot at Ouro Fino farm (re-establishing clearing)

4.3 Inquiry development

As stated in section 1.1, the initial inquiry of this research was to investigate the role of successional agroforestry in economic transition. The method consisted in engaging with different agroforestry practitioners to observe the economic dynamics (Table 1) that emerge in each of them. On the basis of the successional agroforestry course (section 4.1) and the interview with Götsch, I formed the hypothesis that successional agroforestry leads to economic regeneration and abundance as a result of synergy with nature's processes and a positive balance between resource (energy, matter, information…) generation and use when working with nature's flows.

Table 1- Summary of economic systems analysed.

Farm	Size	Ownership	Governance	Investments	Products	Costumers	Technology
Florbela farm	36 ha (1 ha cultivated)	Owned by a couple	Owners take responsibility for most of the investments and decision making. Profits are shared with business partners (responsible for day-to-day production and administration).	Owners finance most of the investment with income from their city jobs. Business partners make non-monetised investments (labour and expertise). Monetary and non-monetary exchanges are carried out (housing, labour, projects).	Over 70 products (vegetables, herbs, crops, fruits) for commercial and subsistence uses	Local market: restaurants, local groceries, weekly food baskets.	Manual and mechanised equipment (chainsaw, small tractor, shredder, grass trimmer).
Mario Lago settlement (Nei and Erica's plot)	1.7 ha (private area) + 1.7 ha (collective area)	The land is public, but settlers have an inheritable right to the land. If a family decides to leave, they are reimbursed for the structures but not for the land, which is allocated to other settlers.	The couple manages their individual plot and participates in the management of the collective plot and cooperative.	Most investments (equipment, technical assistance, initial inputs) were possible through public funding (land-reform support) and projects financed by public companies. Currently, the cooperative is able to provide credit for working capital.	Over 60 products (vegetables, herbs, fruits, eggs) for commercial and subsistence uses	Local market: school meal programmes, weekly food baskets, restaurants.	Mainly manual tools, some mechanised equipment (grass trimmer, cooperative tractor).
Mata do Lobo farm	2,600 ha	One owner	Family company with centralised management.	Investments are made using internal resources and subsidised loans for agriculture.	Soya, pig, and corn. In the near future: banana, coffee, and timber.	National and international markets: multinational food industries.	Mainly mechanised equipment (chainsaws, large tractors, planters, harvesters), and some manual tools for small activities (secateurs, pruners)

I was able to observe a more complex and nuanced scenario than I had initially imagined. Successional agroforestry was clearly promoting ecological regeneration, as evidenced by improved soil conditions and increased biodiversity in all cases. It also granted practitioners a more resilient and healthy lifestyle, wider availability and diversity of subsistence resources (vegetables, fruits, herbs), and better working conditions (less time spent weeding, shaded environments, less repetitive activities). All practitioners felt that they had a sense of purpose in their work and were building a positive legacy.

However, these positive aspects were accompanied by uncertainty regarding financial sustainability. Such observations led me to further inquiries and reflections about the relevance of monetary and non-monetary aspects of the economics of successional agroforestry. A discussion on these topics is presented in sections 4.3.1 and 4.3.2.

A second inquiry stemmed from the widespread idea that an agricultural routine is painful and physically demanding, implying a certain sense of burden for those who make it their livelihood. This common sense is often invoked to justify the virtues of mechanisation and imply that the global trend towards urbanisation of almost all the population represents an improvement of living conditions of the society as a whole. Götsch's idea of humans as natural forest managers and the sense of purpose commonly shared among agroforestry practitioners challenge these assumptions. The outcomes of this inquiry are presented as discussions about technology (section 4.3.3), scale (section 4.3.4), and routines (section 4.3.5). In section 4.3.4, I also present reflections on agroforestry transition and their relationship to the owners' socioeconomic reality.

The influences of systemic conditions at the policy level on the management of the farms I visited are presented in section 4.3.6. The relevance of this *in loco*, in-depth, with a small-sample research to policymakers is also discussed.

4.3.1 On non-monetary aspects

While inquiring on the role of agroforest for economic transition during the volunteering experience, the atmosphere of environmental and social

regeneration that I experienced on all farms was remarkable.

Until 2013, 85% of the Florbela farm was covered with pasture and treated with agrochemicals. Nowadays, virtually all unbuilt areas are occupied by either agroforests, organic crops, or regenerating native vegetation, and no agrochemicals are used (Figure 13). The cultivated area currently provides over 70 species of edible plants (vegetables, herbs, fruits, and crops) that are used for subsistence and commercial purposes. At the time I volunteered, at least seven people, most of who are neo-rurals looking for a meaningful lifestyle far from the urban possibilities, had their livelihoods linked to agroforestry.

Figure 13- Satellite images of the Florbela farm in March 2014 (left) and June 2019 (right) (Source: Google Earth).

Nei and Erica's plot at the Mário Lago settlement was once completely covered by a monoculture of sugarcane (Figure 14). Now, more than half of its surface is covered by a biodiverse agroforest. The couple cultivates over 60 species of edible plants and raises chickens for eggs. The Agroflorestar Project was able to convince the couple to give up their jobs in the city and live out of agriculture. The cooperative they participate in is exclusively dedicated to commercialising agroforestry products and is one of the few agriculture initiatives in the settlement that is managing to thrive in the current context of prolonged economic recession and withdrawal of public policies aimed at peasant agriculture in Brazil. Agroforestry and the cooperative restored the couple's sense of dignity by allowing them to manage their own systems and be their own bosses.

Figure 14- Satellite images of Nei and Erica's plot in September 2002 (left) and April 2019 (right) (Source: Google Earth).

Agroforests on the Mata do Lobo farm had lower biodiversity than those on the other farms. Nevertheless, the pronounced presence of trees, insects, birds, and other living beings contrasted strongly with the thousands of hectares surrounding the area, which were covered solely by either corn or pasture. In addition to biodiversity, agroforests provided comfortable working conditions (Figure 15). Together with eight other people, I engaged in pruning trees during one of the afternoons. Instead of suffering under the scorching sun, we were able to carry out the activity at a reasonably comfortable temperature under shade provided by a canopy of young eucalyptus trees. It was very hard to imagine that someone would be able to work under reasonable conditions for a whole day under the hot sun. Indeed, I hardly saw anybody working on the surrounding monocultures, except for the occasional worker operating a large harvester. Vitória and Daniel also cultivated a small plot of subsistence agroforest near their house. Carefully managing the small but highly diverse plot is, in Daniel's words, 'the most pleasant of agroforestry activities'.

Although the signs of regeneration are evident and astonishing, most are hard to quantify and, consequently, take into account in economic analysis. The potential of successional agroforestry to regenerate the ecosystem has been demonstrated by many studies in the past two decades (Peneireiro, 1999; Silva, 2013; Formoso, 2007; Santos, 2017). Social and personal benefits are more difficult to measure but, nevertheless, are direct, non-monetised or qualitative outcomes of agroforestry. Can they be considered a relevant aspect of the economics of agroforestry?

Figure 15- Mata do Lobo farm in September 2017 (left) and June 2019 (right) (Source: Instagram profile @matadolobo).

In conventional economic thinking, monetary and quantitative measurements are prioritised over non-monetised and qualitative ones, facilitating large-scale and centralised decision making. In this mindset, the complexities and subtleties of people's livelihoods are often avoided or even condemned. Non-monetary forms of self-provisioning, for instance, are usually associated with poverty. As anthropologist Marshall Sahlins put it, subsistence economy is 'condemned to play the role of bad example in treatises of economic development' (Sahlins, 2017:p.1).

Alternative economic thinkers offer different perspectives on the topic. For Mies & Bennholdt-Thomsen (1999), a less monetised life does not necessarily equate to poverty. Especially when considering traditional forms of subsistence, anthropological accounts provide evidence that the opposite is more often true:

> *Whatever one may think of the lifestyle of these 'Stone Age people' [referring to Aborigines in Australia and Bushmen from the Kalahari Desert] one thing is certain. They were not poor and they did not starve. On the contrary, they were rich societies. They worked less than 'civilised' people, their food was healthier, richer in calories and diversity than the average for the 800 million people in the world whom the FAO defines as malnourished.* (Mies & Bennholdt-Thomsen, 1999, p. 55)

Self-provisioning is also associated with the more subtle realms of feelings, emotions, and spirituality. Through it, the interconnection and interdependence of all beings is a living reality, including a deep relationship with the land (Mies &

Bennholdt-Thomsen, 1999). Max-Neef (1991) argues that subsistence has a synergistic potential to meet multiple human needs, such as the psychological need of perceiving one's own potential and capabilities. He sees self-reliance not as a substitute for trade, which will always be necessary for obtaining goods and services that cannot be provided locally, nor as an individualistic act, but as a form of reducing economic dependence and cultivating a healthy sense of interdependence. In this manner, 'solidarity prevails over blind competition' (Max-Neef, 1991:p.65).

The farmers analysed in this study consume fresh organic food daily in a country that is the world's largest pesticide user (Bombardi, 2017). It is also remarkable that such healthy food is grown in biodiverse forest systems, while Brazil has the highest deforestation rates in the world (Observatório do Clima, 2019). Whereas agroforests are carbon-negative systems (Steenbock *et al.*, 2013), deforestation and agriculture are responsible for over 50% of Brazil's greenhouse gas emissions (MMA, 2014). Added together, these factors are meaningful symbols of the regenerative trends of successional agroforestry, illustrating its potential for the transition towards an economy that promotes healthy living.

4.3.2 On monetary aspects

Although the main focus of this work is not the financial performance of agroforestry systems, discussions and reflections on the topic occurred in all immersion experiences.

The Florbela farm had good financial control of expenditures and revenues. Analysis of data from the four months of transition from organic agriculture to commercial agroforestry showed that they had not yet reached break-even. Financial data from Nei and Erica showed they were making profits from commercialisation through the cooperative, but their average monthly earnings were equivalent to only one minimum wage per person. Although they had their own house and good subsistence conditions, their economic situation was still fragile, e.g. not having much room for reinvestment. In Mata do Lobo, there was some uncertainty about future income, as agroforest plots had not yet produced commercial harvests.

Although two of the systems were relatively recent (Florbela and Mata do Lobo), the concept of syntropy had led me to expect an easier and more comfortable financial situation in all cases. This dissonance between my expectations and what I had actually observed resulted in in-depth inquiries regarding the financial logic of successional agroforestry.

A first aspect to emerge from conversations as a relevant challenge to the financial performance of agroforestry systems was their complexity. The diversity of plants and harvest methods in different spaces and times makes it difficult to estimate financial indicators when compared with simpler systems, e.g. a monoculture. Practitioners seemed to implement a design without fully modelling its financial behaviour over time, relying on the logic of syntropy to bring good financial outcomes. This problem motivated efforts to develop financial planning tools for agroforestry, such as AnaliSAFs (The Nature Conservancy, n.d.) and SAF São Paulo (SIGAM/SP, n.d.). However, these tools have not been widely adopted by practitioners so far. Although useful for financial modelling, the programs require a large amount of information, and the validity of the effort is often met with scepticism by practitioners. The three agroforestry initiatives relied more on control of costs and revenues and short-term planning than on long-term financial modelling.

The length of economic cycles also adds complexity to financial planning. To reap all the benefits of working in harmony with natural succession, practitioners should plan to harvest short-cycle crops only in the first three years, when there is enough sunlight for vegetables to grow. The following years (or even decades) should be focused on harvesting non-timber tree products (fruits, nuts, oils, fibres) until reaching the final phase, dedicated to timber harvesting. This economic cycle lasts 15 to 30 years or more.

Another challenge in agroforestry is the fact that commercial dynamics varies according to economic phase. My conversations about the topic with practitioners eventually started to be framed as ‘economic succession’. Each agroforest phase has a certain economic logic, importance, and dynamics that change as the system evolves. To deepen discussions, I found it useful to classify the economic cycle into

three phases and underscore the differences among them (Table 2).

Table 2- Economic phases in successional agroforestry.

	Main products	**Length**	**Economic importance**
Phase 1	vegetables, annual crops	1 to 3 years	fast gains, it ideally pays for the implementation of the whole system
Phase 2	products from bushes, trees and shaded areas, e.g. fruits, nuts	from year 3 until year 15 or more (depends on the lifespan of commercial trees or until reaching phase 3)	stable gains, ideally with products of greater added value (e.g. coffee, cocoa, acai)
Phase 3	wood, for timber or other applications	commercial wood would ideally be harvested all at once, just after phase 2	the “savings account” of the practitioner, providing considerable financial gains at the end of the cycle.

Phase 1 products are usually sold fresh to local markets and families in nearby cities. Harvests can start within only 20 days (e.g. radish or rocket) and also include annual crops. Ideally, the income from initial harvests should be sufficient to pay for implementation of the whole system, including the planting of fruit and hardwood trees for phases 2 and 3. Florbela’s (Figure 16) and Nei and Érica’s business model were based mainly on phase 1, with the logistics of weekly delivery of fresh vegetables set up and running well. In the case of Mata do Lobo, there was no emphasis on commercial harvest of phase 1 products; their focus was on creating conditions for phase 2: planting lines of eucaliptus and other pruning trees to fertilise the coffee and annual crops.

After two to three years, trees generally cast too much shade on horticulture and annual crops. From this point on (phase 2), fruits and other plant materials derived from bushes and trees become the main products. This phase also calls for different economic dynamics because of seasonal harvests. Food processing (e.g. production of frozen pulp and jam) is an alternative to extend the shelf life and add value to products. Phase 2 products will likely be sold to a wider market or even exported, as a the weekly demand for fresh vegetables for a family, for instance, is much higher than that for fruits.

Florbela and Nei and Erica (Figure 17) had some agroforest areas in phase 2, which were undermanaged in terms of pruning and optimisation for commercial

harvesting. In both cases, management was focused on cultivating new phase 1 areas or renewing phase 2 areas through heavy pruning to keep the horticulture business going. This action can lead to two financial problems. First, farmers fail to harness the economic potential of fruit production. Second, by continuously disrupting the process of natural succession before reaching a stage of abundance (forest climax), soil conditions can be negatively affected, impacting on the quality of horticulture production (which is very demanding in terms of soil fertility). In other words, if natural succession is not allowed to fully develop, farmers might find themselves again fight against nature (who seeks complexity), with increasing dependence on external inputs.

Figure 16- Horticulture plot (phase 1) at Florbela farm

Phase 3 is the final stage of the agroforest cycle. Agroforest plots are then abundant in resources and are ready to be renewed with improved conditions, completing the management cycle framed by Götsch as 'from clearing to clearing'. This phase takes place when commercial harvests start to decline (ageing trees) or when trees planted for timber are ready to be cut (this usually takes 15 to 30 years). They are commonly called 'trees of the future' among practitioners and are seen as a 'savings account' because they generate substantial revenue at the end of the cycle. Trees of the future have important ecological functions, promoting biodiversity and encouraging longer management cycles, which enhances the

stability of the regeneration process.

Figure 17- Fruit agroforest (phase 2) at Nei and Érica's plot

The economics of phase 3 is still quite challenging. Although the presence of trees of the future in successional agroforest plots is quite common, there are not yet many examples of systems that have succesfully reached phase 3. Moreover, the market possibilities for small- or medium-scale production of valuable timber (usually native species) are scarce. The Ouro Fino farm is an example of this scenario. The high-quality timber they harvested after 20 years of agroforestry was challenging to sell; they have been só far using it mainly for furniture and structures on the farm.

Because of the high deforestation rates in other biomes, high-quality timber is usually extracted from the Amazon rainforest, whether legally or illegally (Pinto, 2016). Nevertheless, research by Embrapa indicated the feasibility of producing commercial timber from native species through collective arrangements of small-scale agroforestry (Baggio *et al.*, 2009). Such arrangements could revive the local and regional markets for native timber that existed some decades ago, when native forests were still abundant in all Brazilian regions. But for this to happen, the legislation must be redesigned, as will be discussed in section 4.3.6.

I proposed this simplified model of the economic phases of agroforestry to allow discussions on the subject. In reality, most farms have different plots under different phases but specialise on one of the phases for commercial purposes, as was the case of the farms evaluated in this study. Variations can also be made, as observed on the Mata do Lobo farm, where tree strips (phase 2 and, eventually, phase 3) formed alleys for planting crops (phase 1). Tree pruning is used to fertilise the alleys and allow crop cultivation throughout the entire economic cycle.

It is generally too expensive (and sometimes undesirable) to implement an agroforestry system all at once on the entire farm area. The experiences and discussions I had during the volunteering period suggest that adequate economic strategies are needed to thrive financially at all phases of natural succession. In the context of economic transition, business plans cannot solely be aimed at profit maximisation; they influence and are influenced by technology, scale, routines, and public policy, ultimately shaping the livelihood of practitioners. A different way of framing the financial goal in a regenerative economy might be, for instance, Kelly's (2012) concept of "sufficiency". Sufficiency in an agroforestry context can be understood as the level of profit that promotes system sustainability and adequate comfort for practitioners; a lower level would imply deprivation, whereas a higher level would imply undesirable trade-offs in the regenerative aspect of the system. The potential of agroforestry for economic transition lies on a complex balance among different factors, as discussed in the following sections.

4.3.3 Technology

It is remarkable how the adoption of conventional machines in agroforestry has led to meaningful shifts in their symbolism. The meaning of chainsaws is one of the strongest examples. Usually considered a symbol of environmental degradation through deforestation, the chainsaw represents, in successional agroforestry, the possibility of accelerating ecological restoration. The chainsaw makes it possible to plant and manage trees in high-density, which maximises photosynthesis and accelerates forest recovery and soil regeneration.

At Nei and Erica's, one of the afternoons of work during the immersion was dedicated to pruning trees from an orchard area. The goal was to cover and

fertilise the soil with organic matter and increase the amount of sunlight reaching fruit trees in lower strata. We had only manual tools available for the task, such as pruning saws, machetes, and secateurs. The huge amount of physical effort and the results achieved in terms of productivity and quality of the pruned material contrasted immensely with the results of a similar task performed at Mata do Lobo using chainsaws, when a larger area was managed with less effort and better quality.

Figure 18- Chainsaw and pruned material covering soil at Ouro Fino farm

Such episodes led me to the conclusion that for agroforestry to play a role in economic transition, it needs to be widely adopted, which in turns requires an adequate technology that enables lighter routines for its practitioners. In particular, equipment for an easy management of woody materials is of key importance for successional agroforestry.

Although agroforestry can be considered an ancestral practice, the main strategy used by indigenous people to manage forest areas has been fire, as studies such as

Maezumi *et al.* (2018) have shown. However, the use of fire in agriculture nowadays is no longer acceptable in the face of climate change, biodiversity loss, and soil erosion. The current context of increased population density, deforested areas, and environmental threats calls for different technologies.

The question remains whether conventional agriculture and industrial forest technologies are suitable for agroforestry.

Heterodox economic thinkers have often suggested that technological development is not system-neutral or value-free. In analysing the economy from a feminist perspective, Mies & Bennholdt-Thomsen (1999) argued that technology development has been predominantly aimed at saving labour costs, having more control over labour processes, and gaining an advantage over competitors rather than at making work lighter or more agreable. A change in values would certainly alter the quality of technology.

Götsch seems to resonate with these understandings when he argues that current agriculture technology is derived from war technology and embedded with a mindset of fighting against life. The heavy machines that compact the soil and spread herbicides, pesticides, and fungicides to kill unwanted life are outcomes of this logic.

The adoption and adaptation of technology to agroforestry should aim to accelerate natural processes (e.g. shredding branches for mulching), enable ‘clean’ interventions (e.g. sharp blades for mowing and pruning, promoting fast sprouting of grass and branches), and improve work conditions by being light and noiseless (e.g. battery-driven chainsaws as opposed to gasoline-fueled).

There are currently no commercial technologies designed specifically for successional agroforestry. Mindegaard (2019) outlined the main obstacles to the expansion of agroforestry in Brazil on the basis of a literature review and interviews with stakeholders, including Götsch and other successional agroforestry practitioners. The lack of adequate machinery and equipment was reported as a relevant obstacle by 40% of interviewees. They argued that such machines should be designed for lightness (for minimal soil compaction) and have the ability to

operate in slopes and perform multiple functions related to planting, managing, and harvesting complex production systems.

I add that biomimicry should drive technology development so as to combine functions for accelerating or facilitating natural processes, such as pruning and shredding, mowing and rowing. Götsch provided the example of tree harvesters that could perform some processing of wood on the field and collect a lighter, pre-processed commercial material while leaving behind shredded residues to facilitate reincorporation of organic matter into the soil (Götsch, 2019).

A production system that recognises humans as part of forests necessitates technology that facilitates and improves human work instead of replacing it. In the words of Schumacher:

> *we can interest ourselves in the evolution of small-scale technology, relatively non-violent technology, 'technology with a human face', so that people have a chance to enjoy themselves while they are working, instead of working solely for their pay packet and hoping, usually forlornly, for enjoyment solely during their leisure time.* (Schumacher, 1993:p.9)

4.3.4 Scale

E. F. Schumacher has been one of the strongest voices to question the blind belief in the 'economies of scale', a theory that is often invoked to justify bigger projects and investments. In his bestseller 'Small is beautiful', first published in 1973, Schumacher argued that society was suffering 'from an almost universal idolatry of gigantism' (Schumacher, 1993:p.49), with the continuously increasing size of some firms and industries leading to a general understanding that 'economies of scale' were an irresistible trend derived from modern technology. To Schumacher (1993), the question of scale is of utmost importance in human affairs and he advocated for 'appropriate scale', something that should be object of careful human pondering:

> *For every activity there is a certain appropriate scale, and the more active and intimate the activity, the smaller the number of people that can take part.* (Schumacher, 1993:p.50)

He exemplified his point by reflecting on the adequate size of cities and nations

and the effects of the technological revolution of mass transportation and communication. If, on the one hand, these technologies provided a new sense of freedom and possibilities, on the other hand, they made people 'footloose', decisively stimulating the 'pathological growth' of cities and draining people and life away from rural areas. In his view, these changes made people psychologically unrooted and created unhealthy logistical problems in big cities and megalopolises.

During my immersions, I was inspired by the notion of 'appropriate scale' to inquiry on the implications of different scales and socioeconomic conditions for economic transition. Whereas Nei and Érica managed a plot of 3.4 ha, Florbela occupied 36 ha and Mata do Lobo about 2,600 ha.

My first remark was that, although differing in farm size, Florbela and Nei and Érica's initiative operated under a similar production system, focused primarily on commercialisation of fresh vegetables. Both had phase 2 sites with fruit trees that were not managed commercially (as detailed in section 4.3.2) and were located near cities with a high demand for organic produce. The farms were also similar in cultivated area, Florbela being only slightly larger.

However, differences in socioeconomic conditions had a great influence on their perspectives. Nei and Érica's economic reality was deeply shaped by public policies. Their entitlement to a plot on the land-reform settlement, the projects that introduced agroforestry to the area, the funding for equipment, the support for structuring the cooperative, and the public procurements of fresh vegetables for school meals were all dependent on public funds. The history of these achievements was weaved by long processes of struggle, construction, and pressure of social movements for land reform and agroecology, permeated by values of social justice and solidarity. This trajectory is relevant to understanding the commercial structure of the cooperative, which allows Nei and Érica to, even with a small agriculture plot, benefit from the gains of scale of a collective structure. They have access to relatively expensive farming machines, such as a tractor and truck, and have the status of a legal entity to commercialise with local governments. When they talk about improvements to their economic reality, e.g.

processing fruits for juice, it is usually a collective desire, always connected with the cooperative's interests.

Figure 19- Cooperative truck at Mário Lago settlement

Florbela developed differently. The owners invested capital accumulated through their urban livelihoods in the farm. These resources were used to buy land, set up the entire production system, invest in tools and equipment, acquire know-how, hire technical assistance, and hold courses on the farm. The business model unfolded over time through partnerships with practitioners who now offer their expertise and labour while owners make the necessary investments. Independence from public policies and funds has given them the freedom and flexibility to experiment. Capital availability enabled them to experiment with value-adding practices, such as essential oil distillation and meliponiculture. On the other hand, the business has not yet been able to reach the break-even point, and owners are compelled to assume all financial risks. In terms of work routines, Florbela farm seemed to be in disadvantage compared to Mário Lago cooperative, where the economies of scale in packaging and delivery resulted in lighter logistics for practitioners.

Mata do Lobo experienced both the benefits and burdens of large-scale agroforestry. As other large commodity producers, the farm operates as a

centralised company. Scale factors and institutional policies aimed at promoting the development of agribusiness led to easier access to subsidised credit, cutting-edge technology, and technical assistance for soya and corn production. Despite these advantages, commodity producers are facing financial difficulties. The business success achieved in past decades contrasts greatly with the current situation. Continuous application of the 'Green Revolution' package has resulted in soil depletion and an increasing need for inputs. Farmers are highly dependent on suppliers, and often indebted. According to Vitória and Daniel, there has been a great shift in the mindset of many commodity producers in recent years towards experimenting with an agriculture of processes instead of inputs, such as syntropic and other forms of regenerative agriculture that emphasise building fertility on-farm. A result of this trend is the Group of Sustainable Agriculture[12] (GAS, in Portuguese), of which Mata do Lobo is a part.

Successional agroforestry does not have the institutional advantages that currently apply to the Green Revolution package of practices, as it is not yet sufficiently mainstream to shape public policies, the equipment market, or agricultural research and development. What Mata do Lobo had available were the financial means to invest in new agroforestry systems and technological development. The field of machine development seems particularly important for the agroforestry movement, both for small- and large-scale farmers, who are focusing their efforts on the production of light and modular machines and are sharing their results to help advance research. Large-scale initiatives are playing an important role in technology development at a time when conventional public and private research institutions are not particularly active on the theme.

The fact that large-scale farms are in a privileged position to invest and experiment with the technical aspects of agroforestry is entangled with deeper and more complex challenges related to social and economic dimensions. In Vitória's opinion, these are the major challenges to an agroecological transition at Mata do Lobo farm, and she is not sure about which path to take. In her vision, many more families could be living out of agroforestry on the farm. But which types of arrangements could contribute to that? The current model of large-scale land

12 http://www.grupoagrisustentavel.com.br/

ownership in Brazil favours land concentration and a rentier mindset. As Daniel exemplified, the lease of large portions of land for production of commodities could enable them to purchase more land every three to four years.

Is it possible to develop non-rentist models for the inclusion of a larger number of families into agroforestry initiatives located in private lands? Is it possible to form stable partnerships for land stewardship that can provide a good livelihood and a fair distribution of economic output on large farms? These are some of Vitória's and Daniel's enquiries. Such questions are part of a greater debate regarding more equitable forms of ownership and governance, including cooperatives, community land trusts, and employee-owned firms. Kelly (2012) frames this search as a transition from 'extractive ownership' (with a focus on maximising financial extraction) to 'generative ownership' (focused on generating and preserving real, living wealth).

On reflecting about the socioeconomic conditions of the visited agroforests, I understood the advantages and contradictions of economies of scale for different realities. But to answer what is the 'appropriate scale' for agroforestry, I still felt the need to explore the implications of scale for the working conditions and routines of practitioners. This is discussed in the following section.

4.3.5 Routines

Other than the forms of production and commerce, scale and technology also influenced the work routines and the well-being of practitioners. For the purpose of this discussion, I analysed the routines for production of horticulture crops (phase 1 agroforestry), fruits and nuts (phase 2 agroforestry), and grains (phase 1 agroforestry).

Átila and Lívia (Florbela farm) and Nei and Érica (Mário Lago settlement) dedicated most of their time to horticulture, i.e. to the production of short-cycle crops. This implied harvests and deliveries one to two times a week and planting new beds weekly. Fresh products are fragile, need to be harvested at the right hour of the day, and cannot be stored for long periods without losing their commercial appeal (e.g. withering). The result is a production system with tight logistics. Átila and

Lívia often worked on weekends and until late at night on delivery days. A 30-day annual leave (as is the norm in Brazil) was far from the reality of agroforestry practitioners of the Florbela farm and Mário Lago settlement. Any delay in planting new beds (as in the case of a week of heavy rain) would generate a harvest gap some weeks later. These factors led some practitioners to frame the horticulture routine as 'enslaving'.

Although practitioners enjoyed the fast return of investments in horticulture, they also pondered about how to make their work routines lighter. Nei stated that his dream was to have fruit agroforests as their main source of income, and horticulture as a secondary activity (the opposite of the current reality). At Florbela, similar reflections were offered as well as the suggestion of better implementing the tree rows to improve phase 2 output. Expanding horticulture to the 36 ha of land available on the Florbela farm would demand huge investments and many employees, but managing most of these areas as phase 2 plots seemed more feasible.

Whereas horticulture areas as small as 0.3 ha occupied all working hours at Nei and Érica's and Florbela, established agroforestry orchards are much less demanding in terms of management. Götsch stated that he was able to manage a 5 ha cocoa agroforest by himself, working only part-time. Henrique estimated that, if he worked by himself, he would probably be able to take care of a 2 ha agroforest of cocoa, cupuaçu, açaí, and other fruits. Management of these fruit trees consists generally in two prunings per year, in addition to the harvest. Thus, it is possible to manage a much bigger area of a successional agroforestry system in phase 2 than it would be possible to manage a horticulture-based agroforest. Furthermore, fruit trees allow for a lighter routine, as I was able to experience when helping Henrique manage his fruit agroforest.

Grains require different dynamics. In contrast to vegetables and fruits, which are suitable for small-scale production, the planting, harvesting, and processing of expressive amounts of grains such as beans, rice, and corn are very demanding in terms of work and usually require mechanised equipment. Practitioners on the Florbela farm, for instance, were self-sufficient in vegetables, herbs, and fruits but

had to buy beans for subsistence, even though this crop was cultivated on the farm. Mechanisation seemed a logical solution to the commercial production of grains on the visited agroforests, but would need adequate technology and a certain scale of production to be feasible, especially because there are no machines for small-scale grain production currently available for sale in Brazil. Note that mechanising grain production and increasing scale does not necessarily imply abandoning agroecology or peasant farming. A Landless Workers' Movement cooperative in Southern Brazil is the largest producer of organic rice in Latin America. Composed of over 350 families, the cooperative cultivates 3,500 ha of agroecological rice (Rauber, 2019). This suggests the possibility, for instance, of creating a cooperative of farmers who manually manage strips of agroforests in phase 2 and share mechanised equipment to cultivate grains in-between strips.

The experiences and reflections of this action research suggest a certain vision of the role of successional agroforest for economic transition, inspired by Schumacher's concept of 'appropriate scale'. In this vision, successional agroforest invites to an understanding of economic succession that enables, in the same plot, the production of fresh products (phase 1, e.g. vegetables), medium term harvests (phase 2, e.g. fruits, nuts) and long-term timber (phase 3).

Horticulture (phase 1) seems to be suitable for small-scale production near cities and play a very important role in enabling healthy subsistence for agriculturists and their communities. With the prevalent forms of cultivation, such systems can hardly reach 1 hectare of horticulture fields *per* family of farmers. Although fresh vegetables are an important part of a healthy nutrition, the economic reliance exclusively on horticulture seems not to be suitable to the successional logic due mainly to incomplete ecological regeneration processes and harsh routine conditions. The high demand for fresh vegetables near cities doesn't need to be entirely met by successional agroforests thou; it can also make use of the huge amounts of organic waste that are generated in the cities in order to fertilise horticulture plots of urban and peri-urban agriculture, thus establishing a virtuous cycle of nutrients and organic matter in urban areas.

Phase 2 systems generate more stable and long-lasting financial income and can be

managed under more flexible and lighter working conditions than phase 1 systems. Such systems demand the work that Götsch considers the most enjoyable and creative, such as 'conversing with fruit trees' through pruning. Farmers can produce high added-value products without necessarily being close to big cities. In this system, families can manage areas greater than 4 ha, depending on the design. Production does not need to rely solely on food products but can also focus on natural fibres, biofuel, gum, bioplastics, and other renewable materials with the potential to replace petroleum-derived products. Phase 2 agroforestry systems represent a possibility to shift towards an economy in which most of our material needs can be met by ecosystem cultivation rather than extraction.

Collective forms of processing and commercialising products from phases 1 and 2 can leverage economic conditions by facilitating logistics and work. Farmers can then better focus on production. Even simple processing techniques, such as freezing or drying fruits, can be too expensive to be carried out at commercial scale by individual peasants or families.

Phase 3 can be the natural outcome of phase 2, boosting financial gains after a long economic cycle and producing high-quality wood as a byproduct of phase 2. Through phase 3, it is possible to reintroduce native trees to the agricultural landscape, reviving local markets of native timber that once existed all over Brazil (Baggio *et al.*, 2009) while concomitantly re-establishing many ecosystem functions that are not possible in other forms of agriculture.

This vision can be considered as an inspiration of the potential of successional agroforest for economic transition. It's not the only possible vision, but it emerged out of real life experiences with practitioners, as well as evidences from literature data, and I hope it can contribute to feed the imaginaries about transition towards a regenerative economy. But manifesting the full regenerative potential of successional agroforestry does not solely depend on farmers' individual actions. In the next section, I discuss some implications of this vision at the policy level.

4.3.6 Agroforestry economics at the policy level

All agroforestry farms evaluated in this research were subject to Brazilian

institutional and policy conditions. Thus, it's necessary to understand what are those systemic conditions in face of what was lived during the immersions.

In a report on policymaking, the World Agroforestry Centre (ICRAF, 2011) reviewed the impact of public policies on agroforestry in Brazil and performed case studies in the five geographic regions of the country. The study concluded that there were major policy obstacles to agroforestry resulting from inadequate technical assistance, financing, and regulation. Technical assistance and financing mechanisms lacked information and knowledge about agroforestry and specific procedures to deal with its inherent complexity. Regulations lacked recognition of the beneficial aspects of agroforestry and established rules for production and commerce that did not take into consideration the limitations of small-scale farmers, who are responsible for most of the agroforestry initiatives in the country (ICRAF, 2011).

ICRAF (2011) recognised that some policies had helped expand agroforestry, particularly those related to public procurement of food. The Program of Food Purchase (*Programa de Aquisição de Alimentos*, PAA, in Portuguese) was launched in 2003 by the federal government to simplify the bureaucratic procedures necessary for public institutions to purchase food directly from family farmers. PNAE, that adopted in 2009 the same logic of PAA, allowed up to 30% of public school meals to be purchased from local farmers. Although none of the programs specifically targeted agroforestry, ICRAF (2011) concluded that these policies were the ones with the largest impact on agroforestry expansion, by creating a stable market for small-scale farmers all over the country.

This conclusion also resonates with Henrique's testimonial. I asked his opinion about which policy measure could boost transition to agroforestry. He answered that conventional farmers would be more interested in agroforestry if its products had more attractive prices and easier commerce logistics, both of which are influenced by policy measures. For Henrique, policies that simplify logistics of commerce would allow him to dedicate more time to production, the activity that he enjoys the most.

In Mindegaard's study on the barriers and opportunities for agroforestry

expansion in Brazil, the lack of incentives and support from public policies was identified as one of the major constraints to growth, as regulations and the tax system favour conventional agriculture (Mindegaard, 2019). For instance, the fact that inputs (e.g. pesticides) are taxed less than labour in Brazil creates a market distortion favouring conventional agriculture over agroforestry, as illustrated by Belarmino (2017) in a case study on orange production. Furthermore, the costs associated with health and environmental problems caused by conventional agriculture are not included in the price of its products; as a result, the costs of production in agroforestry systems are usually higher than those in conventional systems (Mindegaard, 2019).

The structural challenges of agroforestry in the policy arena seem not to be exclusive to Brazil. A Food and Agriculture Organisation guide on agroforestry for policymakers (Buttoud, 2013) diagnosed that:

> *The development of agroforestry is often impeded by legal, policy and institutional arrangements, its environmental benefits are mostly unrewarded, and investment is discouraged by the long time between adoption and returns.* (p. ix)

I was able to notice these difficulties during the volunteering experiences. I observed that practitioners were somehow 'swimming against the tide'. Florbela and Mata do Lobo were independently transitioning to agroforestry without any type of public policy support. The ecological regeneration their work promoted did not bring them direct economic benefits (e.g. payment for ecosystem services[13]). In contrast, Nei and Erica benefited from PNAE through the cooperative but lacked technical assistance and finance mechanisms to achieve a more robust agroforestry system.

Current policies are still set on an extractive mindset. While the costs of soil degradation, pesticide contamination, and water shortages caused by conventional agriculture are incurred to the society, the collective benefits of agroforestry (e.g. carbon sequestration, increased biodiversity, ecological restoration) do not translate into better economic conditions for agroforestry farmers. Vegetables

13 'Arrangements through which the beneficiaries of environmental services, from watershed protection and forest conservation to carbon sequestration and landscape beauty, reward those whose lands provide these services with subsidies or market payments' (WWF, n.d.).

produced at Mário Lago and Florbela, for instance, were often sold at lower prices than organic or even conventional products to be competitive. This was the case for the vegetables sold through PNAE by the cooperative at Mario Lago, that had to practice the standard market price of conventional vegetables in the region in order to participate in the program. Ecological regeneration services were thus not able to add value to products.

Another example of this distortion is that less bureaucratic impediments are imposed on the economic management of exotic than on native trees (Baggio *et al.*, 2009; Pinto, 2016). The original rationale of this legislation was the protection of native forests, but that ended up stimulating the isolation of protected areas while favouring economic dynamics disconnected from the original ecosystems, such as monocultures and agrochemical use. Legislation has not yet been redefined to acknowledge and favour regenerative economic activities in deforested areas in detriment to extractive activities.

Although the complexity of successional agroforestry may represent a challenge in policy design, native hardwood trees, one of the most important symbols of regeneration, might serve as a proxy to help find solutions. Native trees are highly valuable products of deforestation and the hardest elements to be reintroduced into economic activities in deforested areas, mostly because of their long payback time under the prevailing monoculture systems. In previous sections, I discussed how long-cycle trees play important ecological and economic roles in successional agroforestry and have a huge potential for reconnecting native ecosystems to local and regional economies. It is clear that agroforestry cannot be reduced to the introduction of trees in agriculture, but knowing how to favour it in the policy level is part of the path to ending the 12,000-year-long ‘war against trees’, as Götsch put it.

For this regenerative potential to be unleashed, the legislation must be redesigned to favour massive reintroduction of native trees in the 245 million hectares (28% of the Brazilian surface) of deforested areas that are currently dedicated to farming in Brazil (MAPBIOMAS, n.d.).

Other measures could include phasing out subsidies for conventional agriculture

and redirecting them to agroecological transition, for instance, through ecological taxation and payment for ecological services. However, redesigning legislation is probably not enough to unleash transition. As outlined in chapter 2, economic transition is part of a greater paradigm shift, thus demanding that we discuss deeper levels of transition.

One of the values of this action research through participant observation is the possibility of physically, emotionally, and intuitively feeling the implications of the subject of research. This would not be possible if I had chosen to work only with statistics and figures on agroforestry. And a key part of my inquiry is dependent on the dimension of felt reality, notably the 'regenerative' quality of the economy we need to transit to. Whereas there have been important attempts to define regenerative economy (Kelly, 2012; Wahl, 2016; Raworth, 2017), its meaning seems to be more accurately accessed through our innate shared capacities as living beings.

In section 4.3.1, I made an effort to put into words my experience of being immersed in a 'regenerative atmosphere'. These felt experiences were not only subjective personal interpretations but also complex and rich information about the qualities of the farms I visited. By translating these experiences into objective concepts (such as ecological restoration, the pleasure of managing trees, and the dignity found in collaborative work) I can discourse with others who have also inquired into the topics at a deeper qualitative level, making possible more complex and detailed interpretations of data.

A relevant illustration of this phenomenon occurred on my last day of volunteering at the Mário Lago settlement. In a conversation at dinner time, Nei told me that his father and grandparents had lived and worked for many years on the farm that had been expropriated (which gave way to the Mário Lago settlement). One of his grandfather's main jobs was to clear cut the forests for pasture. While Nei's grandmother and father had had a hard time accepting that Nei was living in a place filled with so many harsh memories, his grandfather enjoyed visiting to observe the regeneration of the forests. To Nei, cultivating forests carried an emotional significance of paying off an intergenerational debt to the territory and

a deep connection with his grandfather. The sense of purpose that agroforestry gave to Nei became a felt and profound reality to me, something that transcends economic calculations and is impossible to be captured by statistics.

I find it relevant to emphasise this qualitative dimension at this point because the debate on policymaking can easily become centred around costs, investments, productivity, and other quantitative aspects that overshadow the inherent qualitative dimensions of values, meanings and the ultimate purpose of those same policies. In other words, policy debate may easily become 'stuck' to the dominant economic paradigm, whose limitations were outlined in section 2.2.

Schumacher (1993) illustrated the importance of the qualitative dimension when analysing the 1970s' European trend of subjecting agriculture to an industrial logic. To him, agriculture implied life's processes and imperatives, and industries represented the opposite, to gain predictability, standardisation, and quality control. He argued that balance between both principles would be necessary to civilisation. Nevertheless, it is important to acknowledge that whereas human life can continue without industries, it cannot without agriculture. Other than simply increasing productivity and lowering costs, agriculture relates to 'the whole relationship between man and nature, the whole lifestyle of a society, the health, happiness and harmony of man, as well as the beauty of his habitat' (Schumacher, 1993:p.89). Schumacher (1993) proposes an alternative approach to conventional agriculture centred on health, beauty, and permanence, which should fulfil three tasks:

> *- to keep man in touch with living nature, of which he is and remains a highly vulnerable part;*
>
> *- to humanise and ennoble man's wider habitat; and*
>
> *- to bring forth the foodstuffs and other materials which are needed for a becoming life.* (p. 90)

The journey of this dissertation made it very clear to me the potential of successional agroforestry to fulfil these three tasks. If, however, the great insights of agroforestry are seen only as means to increase productivity, i.e. to better fulfil the third task only, it is unlikely that any policy will be able to promote a

regenerative dynamic in the society. As system thinker Donella Meadows argued, changing subsidies, taxes, and other parameters of a system is a very low leverage point of intervention (Meadows, 1999). A higher leverage point would be to change the goal or, even higher, the paradigm from which the system itself emerges.

Agriculture in Brazil can be understood as a system based on an extractive paradigm, in which nature is seen as a source of resources to be exploited. Therefore, its goal is to work towards cheaper and more productive ways of obtaining those resources. Using successional agroforestry to achieve these goals might improve some environmental conditions in the short term, but it will not ultimately lead to a regenerative economy.

From a systems' perspective, a regenerative economy needs a regenerative paradigm/mindset. A paradigm that acknowledges our interconnectedness and interdependence of nature (Capra & Luisi, 2016; Weber, 2013). Such a paradigm invites different goals for agriculture, as the ones proposed by Schumacher. In such context, successional agroforest consists in a powerful means towards a regenerative agriculture and economy. Policies to support successional agroforest such as technical assistance, research, finance mechanisms and value chains development, could be designed to and evaluated in face of its results to promote, for instance, well-being, right livelihood, social stability and economic resilience.

Out of this understanding, some phenomena discussed in this research should be seen not as isolated examples but as relevant inputs for systemic policy design. What messages does longing for connection with nature among urban people convey to urban planning? How can the neo-rural phenomenon be channelled towards creating better living conditions with healthier ecosystems and self-sufficiency in urban environments and improved infrastructure and basic services in rural areas? How could a more balanced flow of money between urban and rural areas be achieved? Which types of technologies, logistics, and management support could enable small-scale farmers to benefit from both human-scale land management and the economies of scale of collective arrangements to add value to and commercialise production? How could large-scale farmers' interest in

regenerative agriculture be directed towards a rapid large-scale transition from monoculture and pasture to biodiverse agroforests while favouring models that allow more families to live off the land and promote equitable governance and ownership structures?

Successional agroforestry provides important practical and philosophical insights to the path towards a truly ecological economy. An economy that knows how to mimic forests to cultivate a sustainable type of abundance, the abundance that stems from life processes. An economy where sentient human interventions in degraded lands are able to accelerate the natural regeneration of ecosystems until they reach their ultimate expression of diversity and abundance, as forests. Forests that are able to reach such a stage of abundance that their surplus material (nutrients, water, energy, and information) can be used as food, fuel, fibres, and other products that make possible our material existence on this planet.

5. CONCLUSION

The world faces a systemic crisis that calls for a paradigm shift. At the society level, there is the need to transit from an economic system that is plundering the planet to one that allows for regeneration, re-linking social thriving to ecosystems' health.

This action research inquired into the role that successional agroforestry can play, as a regenerative practice, in economic transition in Brazil. By volunteering in agroforests, I was able to experience the economic dynamics and meanings of agroforestry in different socioeconomic contexts. On the basis of these experiences, I discussed its importance for economic transition.

Successional agroforestry, as advocated by Ernst Götsch, is not only an agricultural method but also a philosophical and economic ethos that is subjected to ecological imperatives, in particular, nature's trend towards life, complexity, and abundance (syntropy). I experienced different systems that followed this ethos while regenerating land and livelihoods and promoting abundance. This abundance translates into several non-monetary benefits, such as healthy, resilient, and biodiverse landscapes, healthy subsistence products, decreased dependence on external inputs, and a sense of purpose.

The extent to which this abundance results in monetary benefits depends both on the practitioners' dedication to adequate systems' design and management and on systemic conditions generated at the policy level. As long as public policies are not re-configured to favour regeneration, a large-scale transition away from the conventional model based on monoculture and agrochemicals is unlikely to happen.

Inadequacies at the policy level reflect the limitations of the dominant economic paradigm. Redesigning policies towards regeneration calls for a different mindset and economic thinking: one that acknowledges interconnectedness and overcomes the reductionist goals of increasing productivity and reducing costs.

In the course of this study, I grasped the potential practical and philosophical contributions of successional agroforestry to a restorative mindset. Such contributions stem from the understanding that humans have an important role in managing ecosystems, especially through conscious interventions in deforested areas and degraded land. This work need not be painful or a burden. The balance between technology, scale, and design, together with the commitment to long economic cycles, can assure dignified and pleasant livelihoods, adequate income, and healthy routines. From this understanding, a different set of policies can be crafted to create systemic conditions of constraints and benefits that favour regeneration over extraction.

Economic transition demands more than new theories and methods; it demands new narratives that make interconnectedness between ecology and economy tangible while enabling people to participate in a generative manner. There is a need for new forms of making sense of the world around us, as well as practical forms of linking the way we meet our human needs (both material and immaterial) to the dynamics and health of ecosystems. The holistic approach by which successional agroforestry is able to engage practitioners to dance between practice and theory, rationality and intuition, and beauty and pragmatism is a great contribution to this much-needed paradigm shift.

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