Economic feasibility study for forest landscape restoration banking models: Cases from southern Amazonas state

WORKING PAPER

January 2019

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JANUARY 2019

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This product is a partnership between CSF-Brazil and WWF-Brazil

Acknowledgements

CSF-Brazil thanks WWF-Brazil and WWF-Germany for support and partnership; to Beto Mesquita (BVRio) for the partnership articulation; IDAM (Institute of Agricultural and Forestry Development of the State of Amazonas) and IDESAM (Institute of Conservation and Sustainable Development of Amazonia) and with logistical support and exchange of experiences, and all producers and managers consulted for research. A list of names is presented in alphabetical order: Aparecida Sardinha (Idesam); Carlos Gabriel Koury (Idesam); Carlos Ueda (IDAM); Claus Ronnan (Produtor Rural); Cleber Santos (Logística); Dalcir Saatkamp (Viveiro Santa Luzia); João Hilário Bastos (IDAM); Laís dos Santos (Estudante); Luiz Fernandes (Munícipe em Apuí); Marco Lentini (WWF-Brazil); Mariano Cenamo (Idesam); Melkesedeq Alcantara (Idesam); Moises Agnoni (Produtor Rural); Odomar Nery (Produtor Rural); Paulo Alves (Produtor Rural); Ramom Morato (Idesam); Raylton Pereira (Idesam); Ronaldo Moraes (Produtor Rural); Shirlane Santana (Agropecuária Garote); Thuany Angelin (Amazon Flora); Valcir Dall´Agnol (Produtor Rural); Vanilse Constante (Idesam); Yougha Von Laer (WWF-Germany).

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Preface

Mobilizing funds is a major challenge to close the financial gap and achieve scalable Forest Landscape Restoration (FLR) projects. In order to address the investment pipeline of FLR projects, *Conservation Strategy Fund* (CSF-Brazil), in partnership with the World Wild Fund (WWF), assessed the most promising restoration business models for private investment in southern Amazon. The considers and analyses government regulations, subsidies and legislation applicable to this region, considering that restoration strategies must be not only ecologically but also economically feasible.

The aim of the feasibility study is to identify and evaluate the economic feasibility of three promising business cases for private investment in place in the south of Amazonas state – which encompasses nine municipalities. The cases were based on initiatives already in place by producers with legal restoration obligations, in areas of up to 5.4 ha, that could be scaled up to larger areas. The analysis provides models with different species with potential to be scaled up in the region, considering combinations of coffee, cocoa, guaraná, açaí, banana. Although it might have economic potential, restoration initiatives based on timber species were not found in the region, and then were not included in the analysis.

Feasibility results show that the private investors can be attracted by these compelling business cases, which had internal rates of return ranging from 10% to 36%, and payback period ranging from 5 to 10 years. Recommendations are proposed in the context of WWF's participation strategy in Brazil, that may affect the environment of attracting funds for forest restoration, including issues such as government regulations, enforcement and capacity, subsidies, legislation related to environmental issues, mainly at local level.

Introduction

Forest restoration is the intentional human intervention to facilitate the process of the vegetation's ecological succession (Brancalion et al., 2015), and is considered an essential activity to the planet's climate stability (Brazil, 2009; IPCC, 2014) and to the Brazilian environmental agenda's compliance (Brazil, 2012). The government's Native Vegetation Recovery National Plan (Planaveg) presented estimates of the national deficits of Permanent Preservation Areas (APP) and Legal Reserve (RL) in private areas, totalling 12 million hectares (Brazil, 2017; WWF-Brazil 2017). Out of this deficit, about five million hectares are located in the Amazon biome - from which 14,161 ha in RL areas in the southern part of Amazonas state (Imaflora, 2017) - and must be restored by landowners by 2030 with the potential support of the State and civil society (MMA 2017).

Challenges for the forest restoration in the Amazon include several issues due to the biome's complexity and the existence of political contradictions combining destructive and nature-supporting forces (WRI-Brasil, 2017; Fearnside and Lovejoy, 2017). The biome region is characterized by low governance (Cenamo et al., 2011), land conflicts (Santos et al., 2015) and high deforestation rates (Prodes, 2018). From the forest restoration perspective, these characteristics are even more challenging given the predicted climate change impacts, which include higher temperatures, more frequent fires, longer droughts and changes in the hydrological cycles in the Amazon (Fearnside, 2003; Borma e Nobre, 2013; Aragão et al., 2018). However, the plant species biological responses to these climatic conditions are almost completely unknown (Nobre et al., 2016).

The consequences of human activities in the Amazon can be catastrophic for biodiversity, ecosystem services and the existence of the biome for future generations (UNEP, 1988; Brazil, 1994; Fearnside, 2003; Lovejoy and Nobre 2018). Some studies designate the Amazon's southern region as the most vulnerable to environmental changes in the biome (Nobre et al., 1991; Borma and Nobre, 2013). These vulnerabilities put at risk millions of Brazilians, culturally differentiated as indigenous peoples, extractive communities, riverine and andirober, natives of the region, as well as thousands of families settled by the State (INCRA, 1987; Brazil, 2007; Yanai et al., 2017). On the other hand, forestry restoration planned for the Amazon until the year 2030 can represent a unique opportunity for the development of an agriculture new logic linked to nature conservation (Benini and Adeodato, 2017).

The State plays a central role in forest restoration agenda in the Amazon and, in fact, has made articulations with the Global Environment Facility (GEF) and the Amazon Fund to finance interventions in the biome (Amazon Fund, 2017; MMA 2017). The Brazilian Ministry of the Environment mentions the southern region of the Amazon as strategic, since it concentrates the largest deforested area of the biome (MMA, 2017). This region has particular characteristics that distinguish it from the biome's complex conditions, such as occupations planned by the state and started in the 1970s (Carrero and Fearnside, 2011) and characteristics of climate and soil (Arruda et al., 2017). However, these observations are relevant in the projection of a large-scale and long-term forest restoration system centered in the southern Amazon region, in the Amazonas state, Brazil.

The Decree that instituted Planaveg defines ecological restoration and human intervention is intentional in altered or degraded ecosystems to trigger, facilitate or accelerate the natural process of ecological succession, concept also used by the literature (Brancalion, Gandolfi and Rodrigues, 2015), and can guide the feasibility study for financing to the large-scale forest restoration in the Amazon.

The forest stocks governance is mainly related to the native vegetation protection law (Law 12.651/2012). This law defines as alternative land use the substitution of native vegetation and successive formations by other land coverages. In its article 72, the law clarifies that the silviculture activity, when carried out in an area suitable for the alternative use of the soil, is assimilated to the agricultural activity. Thus, forest restoration in the perspective of the producer is an agricultural activity and then subject to public agricultural policies. Still on forest stocks, in the Amazon, it is necessary to consider the Law n° 4,406 of 2017, which deals with the Environmental Regularization Policy, the Environmental Rural Registry (Portuguese acronym, CAR), the Environmental Rural Registry System (Portuguese acronym, SISCAR) and the Environmental Regularization Program (Portuguese acronym, PRA) in the State of Amazonas.

It is necessary to clearly understand the costs, productivity and income of forest restoration interventions in the Amazon. Besides, it is necessary to simulate and test how forest restoration system can function on a large scale, in a value chain logic, with financial sustainability in the long term. Therefore, this study seeks to understand how forest restoration can be economically viable, reducing the compliance costs of landowners, supporting the establishment of links between those who have environmental liabilities and those who can finance them. In fact, without this knowledge, few producers and investors will take the risk of restoring degraded areas with plant species, especially when dealing with a region that is expanding livestock production.

There are so many public policies, knowledge and arguments in favor of forest restoration that it is surprising to see how much the economic issue has been neglected (Wortley et al., 2013). To a large extent, part of this may be due to the economists' attention focused on the modernity processes, where environmental degradation is treated as an externality. However, the development of national Forest Landscape Restoration (FLR) systems can become feasible if fundamentals in law, mathematics and scenario building are used. This will be crucial for climate adaptation measures and to enable forest restoration to represent an important economic asset for the Amazonian populations.

The study analyses 3 restoration models based on agroforestry that were found in the field: (1) Guaraná; (2) Coffee, cocoa and guaraná; (3) Coffee, cocoa, guaraná, açaí and banana. The economic analysis presents a cash flow model for the most attractive FLR businesses model, presenting results such as the Internal Return Rate (IRR) and Net Present Value (NPV); It evaluates private investment incentives and options to support FLR, as well as knowledge on, acceptance and ownership of FLR potential; Identify potential business risks. From the legal and political perspective, it analyzes the political, administrative and legislative contexts, land tenure and conflicts for natural resources in the region. In the final section, we propose recommendations on an effective and efficient strategy to address the FLR, and evaluate the external factors that influence the feasibility for the development of the FLR case in southern Amazonas.

The report is developed as followed: A first section is a literature review of restoration costs currently developed in the Brazilian Amazon region; Then it narrows down to discuss which species could be used to compose the restoration models in southern Amazonas to be assessed by the economic analysis; the restoration initiatives already in place in southern Amazonas; and the characterization of landowners that can be the target population for economically feasible restoration projects. The research methodology is presented, followed by the description of the selected restoration models assessed in the field. Financial results are described, followed by a discussion on risks, bottlenecks, opportunities, and a gap analysis aiming at next step for the implementation of restoration models in southern Amazonas.

Research methodology

The work's methodology involved literature reviews and interviews with specialists about restoration costs, restoration projects in the region, and most promising restoration models from the financial perspective. After selecting those models, a fieldtrip was undertaken in order to validate them, collecting detailed information about prices, production, bottlenecks and opportunities for restoration initiatives in the region.

The restoration models were based on plantations found in the visited areas, located in Apuí municipality, state of Amazonas. The field visits occurred on August 14-21, 2018, and data were collected through semi-structured interviews with farmers. At the end of the collection process, the information was used to calculate the financial indicators.

The study assessed 3 restoration models based on agroforestry that were found in the field. For the analysis, we considered "ideal average conditions", which means the price and productivity data refers to averages found on the field: if one producer on the field had abnormal problems, we didn't directly include in the analysis; and a producer learned that a new species was interesting only after some years of trials, we included it as soon as possible in an "improved model". The productivity uncertainty was considered in the analysis by asking the amount and the chance to have a high and low productivity, which implies considering the mean and average standard deviation for each species' productivity.

For each model, we present the species with economic potential that compose the restoration, and a schematic draw detailing the number of trees and space between them.

The economic analysis presents a cash flow for the FLR models, with a summary of costs and benefit for a period of 30 years, when all the species' productivities are stabilized, and values of costs and benefits discounted on time are not considerably significant. Since the data was collected on local currency, the values of the parameters were converted into Dollars by the 3.62 BRL/USD exchange rate, which was the average observed rate from January to October 2018.

The financial results are presented using the following indicators:

- Net Present Value (NPV): NPV is the sum of the cash flows (costs and benefits) of the project, discounted on time by a discount rate[1].
    - Discount rate: Is a rate that considers the investor's temporal preferences and the opportunity cost of capital. It is composed by the sum of a risk-free rate and a risk premium rate – the remuneration that an investor would demand to risk its capital in a business. Therefore, future costs and benefits have less weight then present costs and benefits in the economic analysis.

[1] Reminder: The NPV represents an extra income for the farmer, since he earns for the worked hour. One NPV of $0 does not imply that the producer has no monetary gains, but that they are only equal to the opportunity cost, so that the only gain he/she will have is equal to an average labor value, set at R$80 per day.

- Internal Return Rate (IRR): The IRR is a rate that, when applied to a cash flow, makes the sum of costs and benefits to be equal to zero when brought to present value.
- Profit per hectare: Is the NPV divided by the project's area extension.
- Benefit / Cost Ratio: Is the ratio among the total benefits and total costs when brought to a present value.
- Payback: Shows the number of years necessary to payback all the initial investments and costs.

In the following sections we evaluate private investment incentives and options to support FLR and Identify potential business risks. From the legal and political perspective, we analyze the land tenure issues, public policies and legislation related to restoration. In the final section, we propose recommendations on an effective and efficient strategy to address the FLR, and evaluate the external factors that may influence the feasibility for the development of the FLR case in southern Amazonas.

We also collected farmers perceptions over price and productivity variation, and base on this information, developed normal curves of these parameters. On the productivity figures, we considered the values of a mature culture.

Restoration Models: Costs according to the Literature

The forest restoration costs depend on the combined use and potential of natural regeneration (Brancalion et al., 2015). This is the reason why there is a huge variation range of the forest restoration costs (Table 1). There are studies that indicate different combinations of native and exotic plants for forest restoration of Legal Reserve with financial return (Martorano et al., 2016, Instituto Escolhas, 2015). Such studies provide subsidies for rural producers to invest in forest restoration and to make the restored areas an important and long-term economic asset. Although there are forest restoration experiments in the south of Amazonas state, the lack of economical understanding limits the gain of scale of these initiatives. Besides, most restoration models developed so far focus only on ecological results, not considering different species compositions that can generate economical results and benefits.

Tabela 1 - Official and recognized information on the implementation costs of 1 hectare of forest restoration in different models in the Amazon biome

Forest Restoration Models	Cost per hectare (US$)	Place	Reference
Natural Regeneration with Ant Control	50	Amazon region	Benini e Adeodato 2017
Adhesion / Enrichment (Seeds)	309	Amazon region	Benini e Adeodato 2017
Natural Regeneration Conduction	454	Amazon region	Benini e Adeodato 2017
Total Planting (seeds)	624	Amazon region	Benini e Adeodato 2017
Natural regeneration with pasture abandonment without fencing	630	Pará state	MMA, 2017
Conducting Natural Regeneration	659	Amazon region	Benini e Adeodato 2017
Compensation / Enrichment (seedlings)	881	Amazon region	Benini e Adeodato 2017
Adhesion / Enrichment (Seeds)	1,034	Amazon region	Benini e Adeodato 2017
Natural regeneration with enclosure	1,099	Pará state	MMA, 2017
Low enrichment with regeneration conduction	1,666	Pará state	MMA, 2017
Compensation / Enrichment (seedlings)	1,916	Amazon region	Benini e Adeodato 2017
High enrichment with regeneration conduction	2,037	Pará state	MMA, 2017
Total Planting (Seedlings)	2,052	Amazon region	Benini e Adeodato 2017
Total Planting (seeds)	2,518	Amazon region	Benini e Adeodato 2017
Total planting with fences	3,106	Pará state	MMA, 2017
Total Planting (Seedlings)	4,832	Amazon region	Benini e Adeodato 2017
Native + Cedar + Timber	5,390	Mato Grosso state	MMA, 2017
Silvopastoril (Cedar)	5,792	Mato Grosso state	MMA, 2017
Native + Mahogany + Timber	5,906	Mato Grosso state	MMA, 2017
Silvopastoril (Mahogany)	5,921	Mato Grosso state	MMA, 2017

Southern Amazonas Regional Context

This section presents the results of a literature review about the general characteristics of land owners with private preservation areas (Reserva Legal) deficits, as well as information collected during the field trip to identify those characteristics and validate the economic models.

The following map shows the legal deficit of conserved areas in private properties per municipality. Values range from zero up to 5 thousand hectares per municipality, reaching 14 thousand for all region. The municipality of Apuí, focus of this case study, has a total deficit of around 200 hectares.

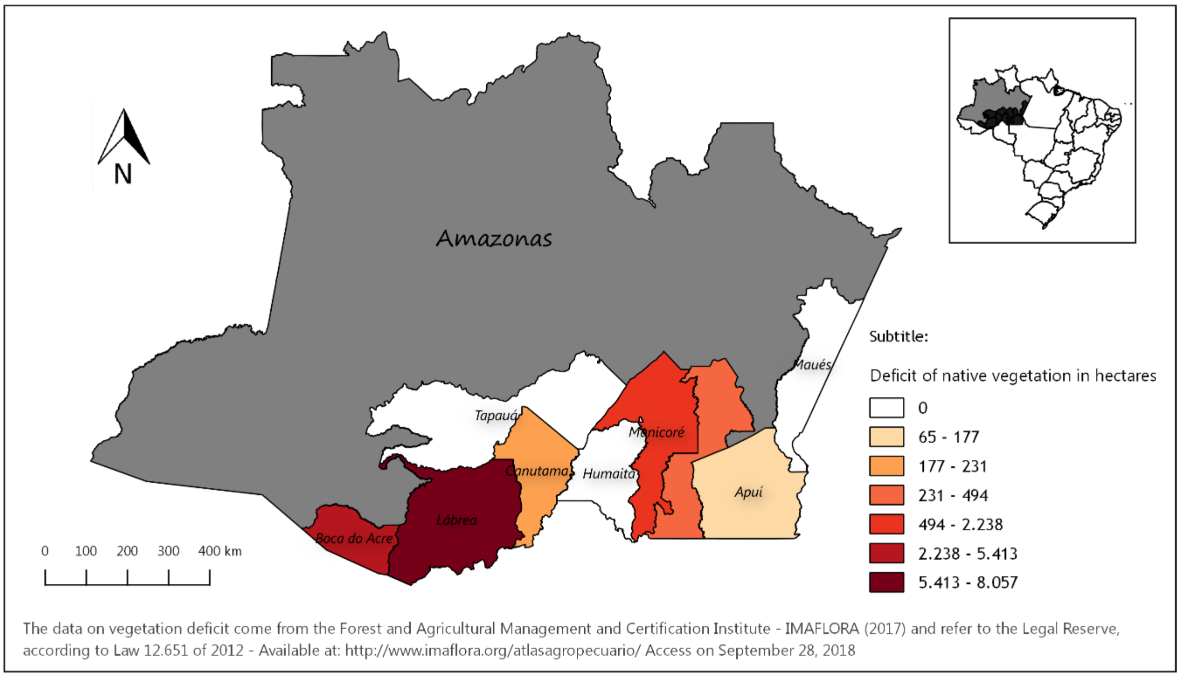

Figure 1 - Southern Amazonas – Native Vegetation Deficit Map

Source: Imaflora *available in the Brazilian Agricultural Atlas (http://www.imaflora.org/atlasagropecuario/), accessed on September 28, 2018.*

Standard Land owner: Characterization of rural producers with Legal Reserve deficit in southern Amazonas state

The studies that characterize the southern region of the Amazonas state have been frequent (Cenamo et al. 2013, IEB 2017, WWF-Brazil 2017), but little has been done to characterize this region’s rural producers. Official figures indicate that rural producers in Amazonas state are made up of 79% men and 21% women. In relation to age, 88% are 30 years old or more. In relation to schooling, 20% of the rural producers in Amazonas never attended school, 26% have only attended the elementary or middle school, 13% have completed high school, 3% are university graduates and only 0.1% are postgraduates (IBGE 2018).

Regarding the native vegetation deficit (Brazil, 2012), the Forest and Agricultural Management and Certification Institute (Imaflora) presents information that allows estimating the Legal Reserve deficit in each municipality in the southern region of Amazonas state (Figure 1). Altogether there are about 14 thousand hectares of vegetation deficit concentrated mainly in the municipalities of Lábrea and Boca do Acre, which together account for 90% of the region's liabilities. The data indicate that 72% of this deficit is concentrated in the average properties (IMAFLORA, 2017).

The property's size is counted in terms of "fiscal modules", a measure used in Brazil to determine the profile of the rural producer. This measure varies according to region and environmental legislation. For the study area, properties considered small have a maximum size of four "fiscal modules" (400ha). Medium properties are larger than four and smaller than 15 fiscal modules (1500ha). Large properties are larger than 15 tax modules.

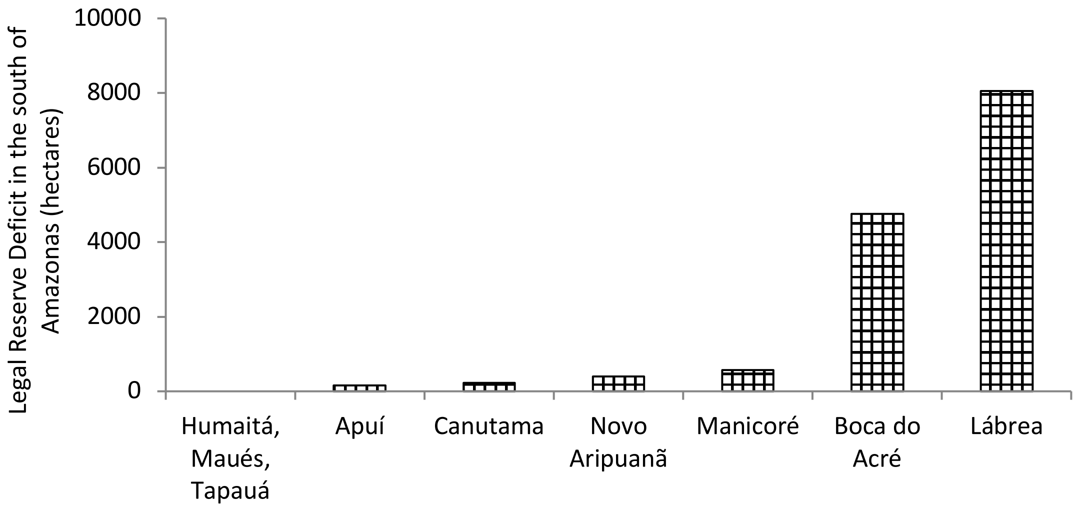

Figure 2 - Legal Reserve areas deficit representation in the municipalities of southern Amazonas

Source: Imaflora, available in the Brazilian Agricultural Atlas (http://www.imaflora.org/atlasagropecuario/), accessed on September 28, 2018.

Rural producers in the southern Amazon region are characterized by the majority of adult men and elderly people with low educational level, from the south and southeast regions of Brazil. These producers have low investment capacity and little vocation for sustainable forestry activities (Gonçalves et al., 2015) and were encouraged by the State to clear and plant pastures. In fact, the field activities in Apuí allowed to observe these characteristics (CFS-Brazil, 2018), although rural producers with Legal Reserve deficits are concentrated mainly in the municipalities of Lábrea and Boca do Acre.

It is important to consider that the region occupation is linked to State planning, mainly with the construction and paving of the Transamazonian Highway and the incentives to cattle raising (Fearnside, 1979). There are indications that the dominant source of migration to the south of Amazonas state is the movement of families from southern and southeastern Brazil who lived on old expansion frontiers in the central-west or northern regions of Brazil (Carrero and Fearnside, 2011). In this region, many producers tell that, in the 1970's, the National Institute for Colonization and Agrarian Reform (INCRA) recommended deforesting 50% of the area for the producer to guarantee the land document (IDESAM, 2012) and, in fact, the Federal Public Ministry considers INCRA to be the main culprit by deforestation in the Amazon (MPF, 2013; INCRA, 2013).

In the field, it was noticed that the main economic activity of the region of Apuí is the livestock production. According to (RAZERA, 2005) and (CARRERO & FEARNSIDE, 2011), the southern region of Amazonas state received large investments for the development of this activity, which is expansionist. Consequently, this area is included as part of the deforestation arc, presenting the highest rates of deforestation in the Amazon. National data indicate that the annual deforested area in the last three decades was, on average, around 1 million hectares (PRODES, 2018). It should be emphasized that this activity is not always profitable in regions of border expansion, and that the Forest Code provides for the recovery of Legal Reserve areas and Environmental Protection Areas that are impacted.

Forestry restoration projects and studies in southern Amazonas

Apuí Mais Verde Project: in 2008 and 2009, Idesam introduced the Apuí Mais Verde Project (Portuguese acronym, PAMV), in partnership with Apuí Municipality, to register rural producers who together would restore 1,500,000 hectares of Legal Reserve (LR) and Areas of Permanent Preservation (APP) in the municipality. During this period the project progressed in the registration phase of the interested parties and their respective rural properties, but the progress was partial in the aspect of raising the financial resources to implement the project in the desired scale. In 2011, Idesam obtained financial support from the Vale Fund to develop the PAMV´s structuring activities, through a project called Sowing Sustainability in Apuí.

Sowing Sustainability in Apuí Project (SSA): apparently obtained important results to the structuring of the PAMV. In a publication with partial results, it is stated that: "*Unlike PAMV, which predicted that the project would cover all costs, Sowing Sustainability counted on the owners' compensation. Idesam has guaranteed soil analyzes, seedlings, seeds and four years of technical assistance. The owner, in turn, paid for the isolation of the area and the planting staff.”* In addition to the effective part of the forest restoration, the SSA provided training and exchanges in the collection and processing of seeds and investments in structuring the local nursery. In 2012, forest restoration activities demanded about 300 kg of native species seeds and of green manure, and 10 thousand seedlings, and resulted in 15 hectares of forest restoration in five distinct rural properties (Cenamo et al. 2011; IDESAM, 2012; Carrero et al. 2014).

Coffee Project: Coffee in Agroforestry for the Strengthening of the Low Carbon Economy in Apuí, Amazonas state: this project has its historical roots in the 1990s, when the Apuí rural producers´ main source of income was from the coffee production. In the early 2000s, there was a drop in the price of coffee, leading to a significant decrease in the number of coffee growers, resulting in coffee plantations abandoned and replaced by extensive cattle ranching. The abandoned coffee plantations were naturally being colonized by tree species such as *andiroba, cedar* and *embaúba*. However, with the appreciation of coffee in mid-2004, the farmers resumed their activities and realized that the new conditions of the coffee plantations improved the maturation and flavor characteristics of the beans and the yield per area. In 2013, Idesam developed the project and received investment from the Vale Fund to deploy about 28 hectares of SAFs in 28 distinct properties in the municipality of Apuí (Gonçalves et al., 2015). Monitoring is currently being done, but the project is not implementing new areas.

SDS Amazonas Project: in 2011, the Amazon Fund started a financial partnership with the State of Amazonas, through the Secretariat of Environment and Sustainable Development (SDS), to develop activities that include forest restoration with an economic and ecological objective. The activities took place in the south of Amazonas state and involved residents in Boca do Acre, Lábrea, Apuí and Novo Aripuanã. The results released on the Amazon Fund website indicate that SDS implemented 1,073 hectares of forest restoration in the four municipalities, including the implementation of 767 small-scale agroforestry systems, 12 units for the execution of demonstration courses on three types of restoration: SAF, rotational grazing and crop-pasture-forest integration (Amazon Fund, 2018).

Altered Areas' Recovery in the Brazilian Amazon: It is a study that initiated in 2002, conducted by the International Center for Forest Research (CIFOR), which investigated the rehabilitation of degraded forests and degraded forest lands in Brazil to provide information for ongoing or future forest restoration efforts. The main characteristic of this study is to present activities developed by a company in the timber sector. The study identified activities related to artificial planting and/or the promotion of natural regeneration of trees in pasture, shrub or non-vegetation areas formerly covered with forests, in order to improve their productivity, the livelihoods of the population and/or the environmental benefits of the forest. The study was published in 2006 and there are records of forest restoration activities in southern Amazonas state, specifically in Boca do Acre, Humaitá, Lábrea, Manicoré and Apuí (Almeida et al., 2006).

Restoration models with economic potential

The idea behind ecological-economic restoration is that it is possible to finance ecological restoration with a combination of additional human capital (technical assistance and labor) and private financial capital (infrastructure and other investments), which can yield forestry products, ecosystem services, and returns for investors. The figure below shows one simple example to illustrate the different restoration approaches, its basic inputs and outputs. The simple ecological restoration is our baseline scenario, where landowners must invest in fences in order to comply with legislation, having no direct economic return. The ecological-economic restoration requires additional investments, but also generates returns that can payback these investments. Therefore, landowners must compare these two hypothetical scenarios, in which any result greater than the cost of fences (e.g. -US$1000 per hectare) would be economically attractive to the landowner that needs to comply with the forest law.

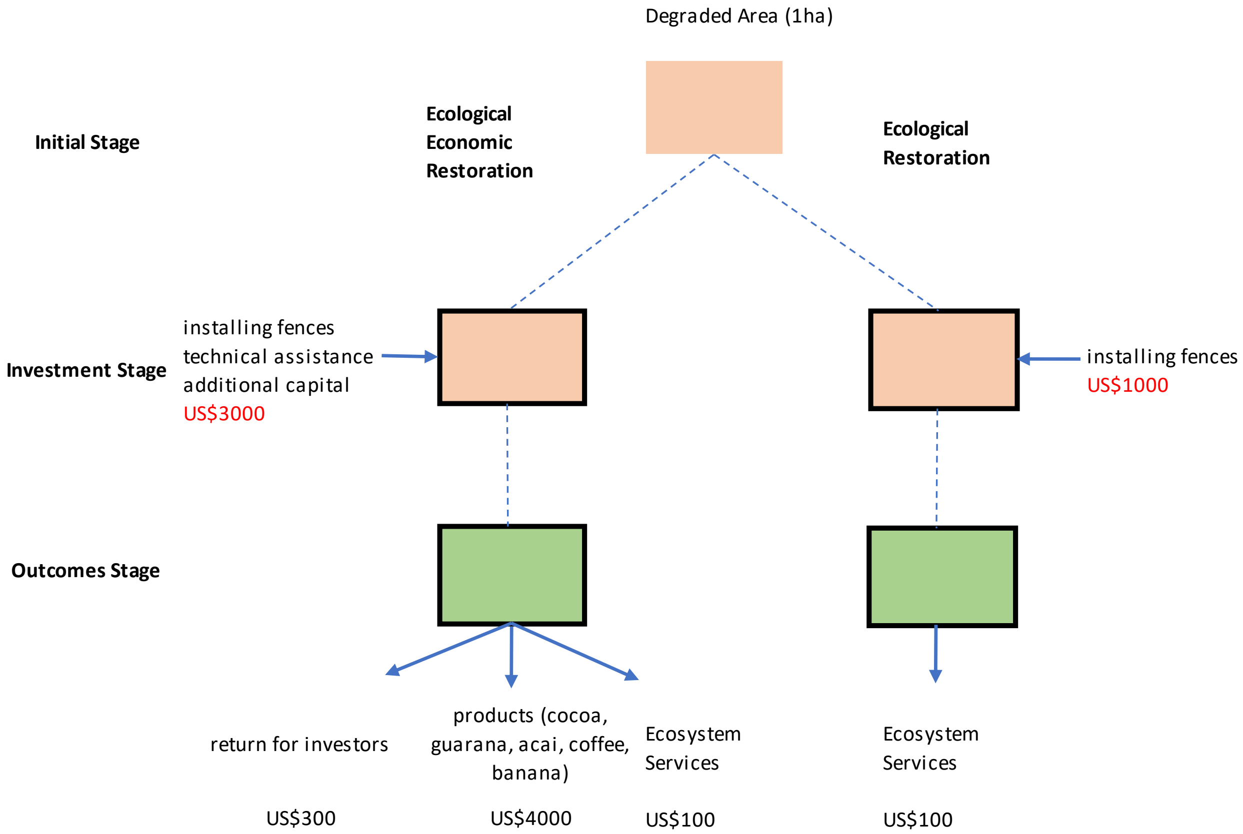

Figure 3 – Schematic model of Restoration Scenarios - Example

This section presents current restoration models developed in the southern Amazonas region. Some of key species tested so far for agroforestry studies includes: Andiroba – *Carapa guianensis;* Conil coffee – *Coffea canephora* (exotic - agricultural); Cedar – *Cedrela odorata;* Paricá - *Schizolobium amazonicum*; Rosewood - *Aniba Roseaodora;* Guaraná - *Paulinia cupana*. The initiatives already described by the literature are presented below.

Coffee Model in Agroforestry (Gonçalves et al., 2015) or multi-stratified Agroforestry Systems (Portuguese acronym, SAF) (EMBRAPA) or SAF Verena

To the Idesam and Imaflora, agroforestry coffee production consists of enriching coffee plantations with other agricultural and forestry species for shade maintenance, soil enrichment and of adding value to the final product. This concept could also be applied from the planting of coffee plants in deforested areas and in ecological succession. This intervention is a process of forest restoration, a type of SAF of precision according to the Embrapa definition or simply a multi-stratified SAF.

Alternative model: Multi-stratified SAF with Coffee or Guaraná and Rosewood

Enrich a deforested area with coffee to have costs and revenues cycles annually. Insert agricultural and rosewood species for shade maintenance and soil improvement. The extraction of rosewood leaves guarantees a second income. It is a type of SAF with a precision as defined by Embrapa or simply a multi-stratified SAF. The proposal of enrichment with rosewood is relevant because there are recent technical and scientific advances on this species leave´s management (Krainovic et al., 2017a, 2017b, 2018) that has already been intensely extracted from the Amazon, due to the essential oil of its biomass, causing local extinction in many regions. In addition, the species occurs naturally in Apuí, the oil has considerable demand, in addition to being known and desired by Apuí´s rural producers.

Agriculture Forest Model (Martorano et al., 2016)

The study by Martorano et al. (2016) was carried out by Embrapa researchers and describes a successful experiment integrating the production of an agricultural species with a native forest known as paricá (*Schizolobium amazonicum*). The article describes the distribution of paricás planting in 5 m x 2 m and the crop species between the lines. The article shows that the planting system reduces the effects of drought compared to conventional planting (monoculture), still used by many farmers in the Amazon. There is a productivity increase, efficiency in harvesting and production cycles control. In addition to these native species, the model can be represented with key agroforestry species. Embrapa considers the forest agriculture model as a type of SAF with the precision for productive recovery in the Amazon.

Economic Assessment of Forest Restoration Models for the South of Amazonas

The study analyses 3 restoration models based on agroforestry that were found in the Apuí region: (1) Guaraná; (2) Coffee, cocoa and guaraná; (3) Coffee, cocoa, guaraná, açaí and banana.

Article 66 of Law 12.651 states that the Legal Reserve (RL) can be recovered with up to 50% of exotic species (Brazil, 2012). Rural producers in the study's region use combinations of these species both to produce agroforestry systems and aiming to do forest restoration with the purpose of generating income. These plants can be divided into native (Guaraná, Cocoa and Açaí) and exotic (Coffee and Banana) and can be used for forest restoration within the limits of current environmental legislation. Thus, because they represent species that are used by the rural producers in the study area and because they are suitable for forest restoration, the analyzes of the models were made considering these species. However, it is feasible to consider other combinations of native and exotic plants. Average parameters were used to simulate the expected results for the models in a "standard context", while information on uncertainty (standard deviation) was captured for productivity and prices.

Restoration models observed on the field had the following size:

Table 1 - Restoration Models Areas and Species

	Models - species	Area (ha)
1	Guaraná	1
2	Coffee, cocoa and guaraná	5
3	Coffee, cocoa, guaraná, açaí and banana	1.5

Basic Financial Parameters

Investment in Fences

Cattle is the main threat to restoration initiatives. As the standard landowner in the region is involved with cattle ranching, installing fences to protect the area to be restored is one main investment. Some of the visited producers did not have their area fully protected by fences, either because they did not have cattle close by or because part of the restored land had other type of natural protection. As our intention is to provide a model to be generalized, we included the full fences cost in the model. There are important gains in scale for this.

The fence price was based on field data, collected on a local shop, located on the city of Apuí, Amazonas. Parameters used to determine fence cost in the models are listed above, and refers to the establishment of 1 hectare of fence (400 linear meters):

Table 2 - Fence pricing parameters.

Material	Quantity	Unit price (USD)	Total Cost (USD)
Gauge Wire	2	91.16	182.32
Wood Post	134	4.14	555.24
Fence Stretcher	6	22.09	132.59
Labor	1	331.49	331.49

Maintenance

Besides the costs related to the operation of the system, we also include maintenance costs for the initial investments in fences. Maintenance cost is set as an annual cost equal to 1% of the initial investment.

Discount Rate

The base discount rate used for the financial models is calculated using the WACC (weighted average cost of capital) model, based on the average of WACC values of four risk scenarios assessed by the Verena project (Batista *et al*., 2017). Values varies from 7% to 11%. A 10% discount rate (WACC after taxes, in real terms, in BRL Reais[2]) was used as the base discount rate (Batista *et al*., 2017), and further sensitivity analysis was made to consider different discount rates ranging from 5% to 15%.

Taxes

There are two types of taxes to be considered: sales taxes and income taxes. Besides, there are two possible tax regimes in Brazil (a) “presumed income revenues” and (b) “actual income revenues”. “If the firm is exporting the goods, then there might be tax exemptions. In this case, the analyst chooses 0% for sale taxes and consequently gross revenues will equal net revenues in the cash flow”. “The “Presumed” regime has a limit on the amount of revenues (BRL 78,000,000.00 per year) and for the model we assumed the limit increasing BRL 10,000,000.00 every 10 years. Both sales and income taxes

[2] Even though, results were presented in US Dollars.

are lower (3.65% sales and 3.08% on income) compared to the "Actual" regime (9.25% sales and 34.00% income). These values come from the "Brazilian IRS" – Receita Federal" (Batista *et al*., 2017).

Model 1: Guaraná

This model consists of one hectare of guaraná (*Paullinea cupuana* - a product used as energetic and flavoring for soft drinks), planted in lines interspersed with several native species of high stratum. The latter were planted with the purpose of shading the guaraná, which requires these conditions for its development, especially in the early years (TAVARES et al., 2005). The spacing of the guaraná was 5x3 meters, and 6x6 meters for the others.

The restored area had 1 hectare of pasture (*Brachiaria decumbens)*, and is located near a fraction of native forest. This last characteristic allowed the propagules of native species to be dispersed, aiding in the areas' recomposition. Due to its favorable topography, soil preparation machines were used, besides the manual planting of seedlings.

During the data collection, it was possible to visualize that in the places where the tall strata trees were shaded, and in the places near the forest, the brachiaria grass had been fought efficiently. However, the restoration process was recent (2016), and the area had been greatly impacted by extensive livestock farming.

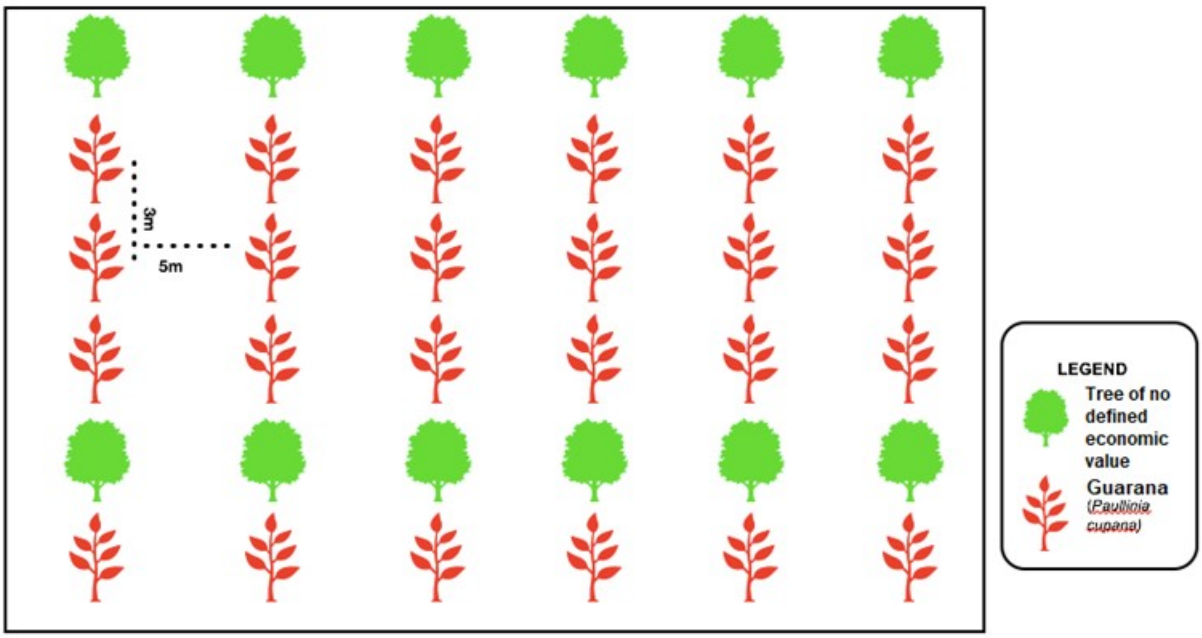

Figure 4 - Sketch of model 1 – Guaraná

The highest costs of the model come from the fences installation for enclosure, which prevents the impact agent (cattle) to access the restored area. From the ecological point of view, this model fulfills the role of restoration, due to its diversity of native individuals, and by the effective control of grasses, provided by the trees shade. The private technical assistance was included in the costs, given that the standard local land owners do not have sufficient knowledge to implement the restoration process.

Table 3 - Parameters used on models for a standard 1ha restoration

Item	Unitary value (USD[3])
Technical Assistance - Recovery plan for degraded areas (PRAD)	414.36
Fence and labor	934.53
Limestone	31.76
Labour (daily)	22.09
Agricultural machine (hour)	46.96

This model yields an average of 30 barrels (240kg) per hectare per year during the first 5 years, reaching then 50 barrels (300kg) from year 6 to 30.

Table 4 - Average annual productivity of model 1

Period (years)	**Average Productivity**
	Guaraná (Barrel – 8kg) per hectare
1st to 5th	30
6th to 30th	50

Guaraná's price has been pretty stable, with average of R$110 per barrel (US$30). According to the producer's perception, prices higher then R$120 would be reached with a 10% chance, and lower then R$95 with only 1% chance.

The simplified cash flowed is presented in the following table:

[3] Exchange rate used equal to the average from jan-oct 2018: R$/US$ = 3.62.

Table 5 - Cash flow of model 1 (US$)

Year	Gross Income	Tax on Sales (3.65%)	Costs & Investments	Cash Flow - before income tax	Tax on Income (3.08%)	Cashflow - after taxes
1	-	-	3,233.4	-3,233.4	-	-3,233.4
2	-	-	125.7	-125.7	-	-125.7
3	1,519.3	55.5	1,029.0	434.9	13.4	421.5
4	1,519.3	55.5	1,114.6	349.2	10.8	338.5
5	1,519.3	55.5	1,208.6	255.3	7.9	247.5
6	1,519.3	55.5	1,230.7	233.2	7.2	226.0
7	1,519.3	55.5	1,230.7	233.2	7.2	226.0
8	1,519.3	55.5	1,230.7	233.2	7.2	226.0
9	1,519.3	55.5	1,230.7	233.2	7.2	226.0
10	1,519.3	55.5	1,230.7	233.2	7.2	226.0
11	1,519.3	55.5	1,230.7	233.2	7.2	226.0
12	1,519.3	55.5	1,230.7	233.2	7.2	226.0
13	1,519.3	55.5	1,230.7	233.2	7.2	226.0
14	1,519.3	55.5	1,230.7	233.2	7.2	226.0
15	1,519.3	55.5	1,230.7	233.2	7.2	226.0
16	1,519.3	55.5	1,230.7	233.2	7.2	226.0
17	1,519.3	55.5	1,230.7	233.2	7.2	226.0
18	1,519.3	55.5	1,230.7	233.2	7.2	226.0
19	1,519.3	55.5	1,230.7	233.2	7.2	226.0
20	1,519.3	55.5	1,230.7	233.2	7.2	226.0
21	1,519.3	55.5	1,230.7	233.2	7.2	226.0
22	1,519.3	55.5	1,230.7	233.2	7.2	226.0
23	1,519.3	55.5	1,230.7	233.2	7.2	226.0
24	1,519.3	55.5	1,230.7	233.2	7.2	226.0
25	1,519.3	55.5	1,230.7	233.2	7.2	226.0
26	1,519.3	55.5	1,230.7	233.2	7.2	226.0
27	1,519.3	55.5	1,230.7	233.2	7.2	226.0
28	1,519.3	55.5	1,230.7	233.2	7.2	226.0
29	1,519.3	55.5	1,230.7	233.2	7.2	226.0
30	1,519.3	55.5	1,230.7	233.2	7.2	226.0

The final financial indicators are presented in the table below. The investment for this area was relatively low, around US$3,233, yielding an IRR of 5%. It is important to mention that this is the result of the "standardized model", that considers the full fence cost. In the case of the actual property visited, the landowner did not have costs with fences because that was no cattle nearby, which, in this case, would yield an IRR of 13% for the same model. However, as a "standard property" in the region have cattle, we applied the fence cost for this "standardized model".

Table 6 - Financial indicators of model 1

	-15%	Average	15%
Area (hectares)	1		
Investiment	$3,233.43		
Discount Rate	10%		
IRR	-10.4%	5.0%	12.0%
NPV	- 2,705	- 1,068	569
NPV/ha	- 2,705	- 1,068	569
Benefit/Cost ratio	0.8	1.0	1.1
Payback period (yr)	dna	dna	18

The average scenario shows the results using the average values observed in the field. On the average, producers stated common price variations around 15% lower or higher than the average. Based on this perception, we did a sensitivity analysis of a change in the prices of all products, and their impacts on financial results, with the alternative scenarios considering variations of 15% in income (that could be attributed either to variations in prices or productivity).

If investors consider a 10% discount rate (capital opportunity cost), the project is not able to payback its investments. If investors have a capital opportunity cost of 5%, this model would be feasible[4]. However, the landowner baseline scenario to comply with the law simply by doing natural regeneration has a net result of minus US$934 for fences installation - therefore even if investors demand a higher return of investments, the project would still worthwhile for the landowner - in this case, any NPV higher than a negative US$934 would worthwhile for the landowner[5].

The figure below shows the variations in NPV depending on the chosen discount rate – return on capital demanded by the investor.

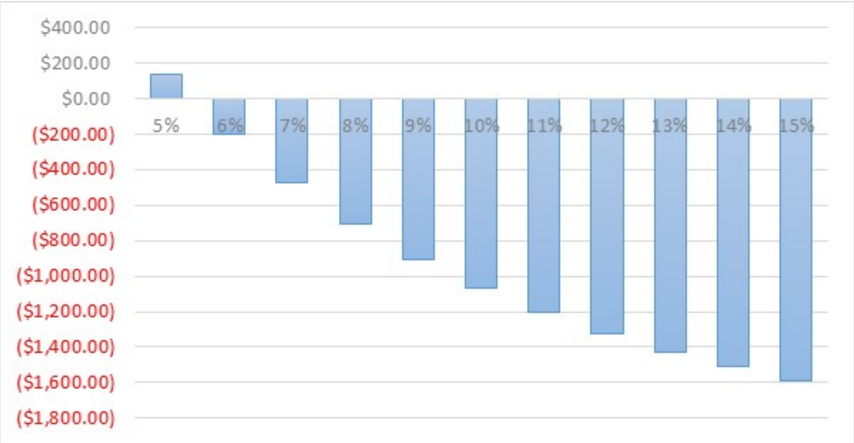

Figure 5 – Sensitivity Analysis - NPV per hectare vs Discount Rate – Model 1

[4] A "risk free rate" uses to be set between 2% and 4%, and additional to that there is a risk premium rate, that varies depending on the investor perception on the context risk (depending on factors such as: restoration sector risk, country risk, exchange ratio risk, etc).

[5] Another way to analyze these scenarios would be not to include the fences installation cost when comparing both scenarios (ecological restoration vs ecological-economic restoration) and then compare the results to a baseline of zero NPV.

Model 2: Coffee, cocoa and guaraná

The Coffee (*Coffea canephora*) is the main culture of this 5 ha model, which also introduces cocoa (*Theobroma cacao*) and guaraná in separate areas and interspersed with other timber species. The arrangement of the individuals of high stratum is given in such a way as to favor the development of the smaller species (similar to the previous model). The spacing used for guaraná was 3 x 5 meters, in an area of 0.5 ha, 2 x 3 meters coffee in 3.5 ha, and finally the 4 x 4 meters cocoa, planted in an area of 1 ha. It is important to point out that the relief of the area made it impossible for the mechanized labor force, which led to higher initial costs, since more labor was spent to perform a service.

Finally, the model is based on a plantation that presented a positive ecological response in the combat of exotic grasses, which implied in a minor need of labor for the handling. Larger individuals already contributed significantly to the nutrient cycling through the deposition of organic matter in the soil. There was also a strong presence of pollinating agents and avifauna.

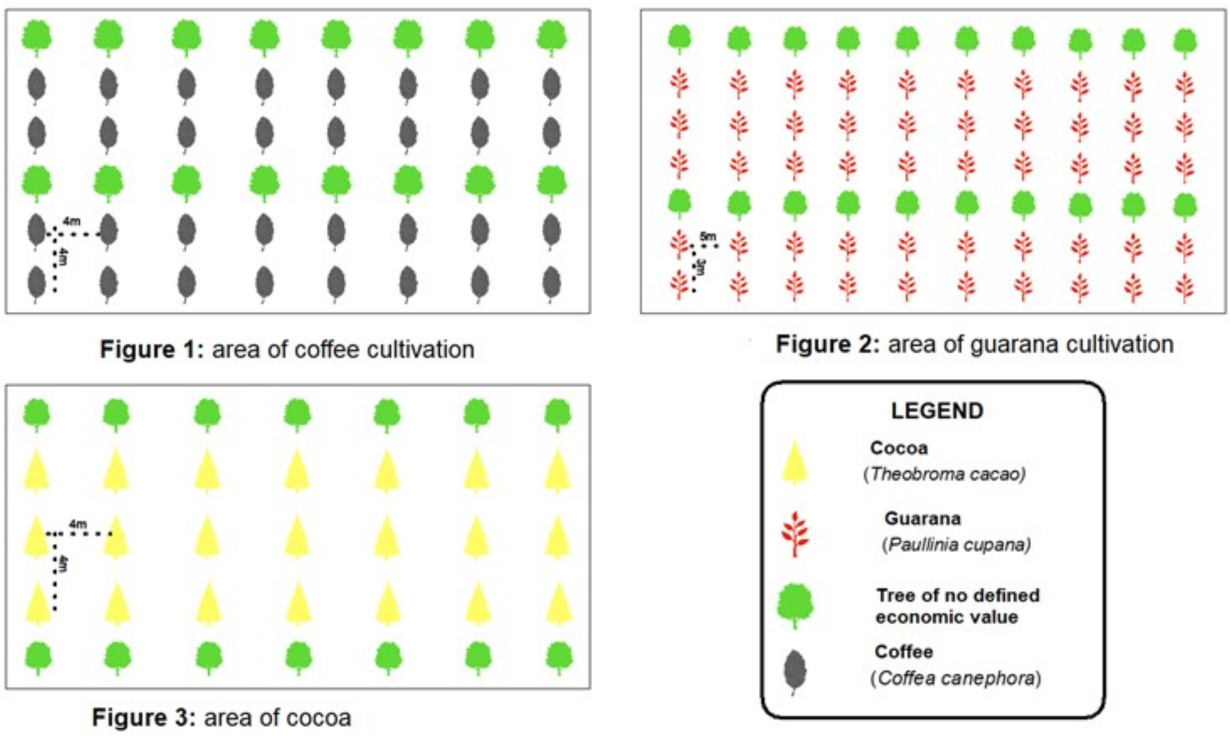

Figure 6 - Sketch of Model 2 – Coffee, cocoa and guaraná

The highest costs of the model come from the fences installation for enclosure, which prevents the impact agent (cattle) to access the restored area. From the ecological point of view, this model fulfills the role of restoration, due to its diversity of native individuals, and by the effective control of grasses, provided by the trees shade. The private technical assistance was included in the costs, given that the standard local landowners do not have sufficient knowledge to implement the restoration process. Furthermore, to maximize the plant productivity, local farmers replant Coffee trees every 15 years. It represents a significant cost, and a decrease of income in the system.

Table 7 - Parameters used on models for a standard 1ha restoration

Item	Unitary value (USD)
Technical Assistance - Recovery plan for degraded areas (PRAD) per hectare	414.36
Fence and labor per hectare	934.53
Limestone per hectare	31.76
Labour (daily)	22.09
Agricultural machine (hour)	46.96

The average productivities are described in the table below, being assigned different productivities for different development stages of the species.

Table 8 - Average annual productivity of model 2

Period (years)	**Average productivity**		
	Guaraná (Barrel – 8kg)	**Cocoa (Bean/kg)**	**Coffee (Sack)**
1st to 5th	30	240	8
6th to 15th	50	602	11
16th to 20th	50	625	9
21th to 30th	50	625	11

Table 9 - Product prices - Model 2

Product	**Measure**	**Average Price (USD)**
Guaraná	**Barrel (8kg)**	29.55
Coffee	**Sack (60kg)**	80.11
Cocoa	**Bean/kg**	1.51

It is important to note the coffee price used here is the price of organic certified coffee, which is 15% higher than the regular one. In the sensitivity analysis we further explore the impact of price variation on the financial results.

The simplified cash flowed is presented in the following table:

Table 10 - Cash flow of Model 2 (US$)

Year	Gross Income	Tax on Sales (3.65%)	Costs & Investments	Cash Flow - before income tax	Tax on Income (3.08%)	Cashflow - after taxes
1	-	-	8,766.8	- 8,766.8	-	- 8,766.8
2	-	-	622.9	- 622.9	-	- 622.9
3	3,011.0	109.9	1,799.7	1,101.4	33.9	1,067.5
4	7,417.1	270.7	2,356.4	4,790.0	147.5	4,642.5
5	7,657.5	279.5	2,447.2	4,930.7	151.9	4,778.9
6	7,817.7	285.3	2,570.4	4,961.9	152.8	4,809.1
7	8,159.5	297.8	2,570.4	5,291.3	163.0	5,128.3
8	8,159.5	297.8	2,570.4	5,291.3	163.0	5,128.3
9	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
10	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
11	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
12	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
13	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
14	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
15	4,499.3	164.2	7,612.5	- 3,277.5	-	- 3,277.5
16	1,294.9	47.3	1,819.1	- 571.4	-	- 571.4
17	1,294.9	47.3	1,819.1	- 571.4	-	- 571.4
18	4,098.8	149.6	2,566.3	1,382.9	42.6	1,340.3
19	4,339.1	158.4	2,568.8	1,611.9	49.6	1,562.3
20	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
21	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
22	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
23	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
24	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
25	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
26	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
27	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
28	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
29	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3
30	4,499.3	164.2	2,570.4	1,764.6	54.4	1,710.3

The final financial indicators are presented in the table below. The investment for this area was around US$ 8,159, plus a second investment phase in year 15, yielding an IRR of 27%, and an NPV of R$10,959 The financial indicators show that the project is viable under the analyzed parameters. Finally, the inputs cover the initial costs in the fifth year, payback time also found in other projects of agroforestry systems (MENDES, 2016).

Table 11 - Financial indicators of Model 2

	-15%	Average	15%
Area (hectares)	3		
Investiment	$8159.06		
Discount Rate	10%		
IRR	20%	27%	33%
NPV	5,143.74	10,959.91	16,776.09
NPV/ha	1,714.58	3,653.30	5,592.03
Benefit/Cost ratio	1.24	1.46	1.68
Payback period (yr)	7	6	5

This model is feasible with all discount rates considered in the sensitivity analysis, as showed in the following table.

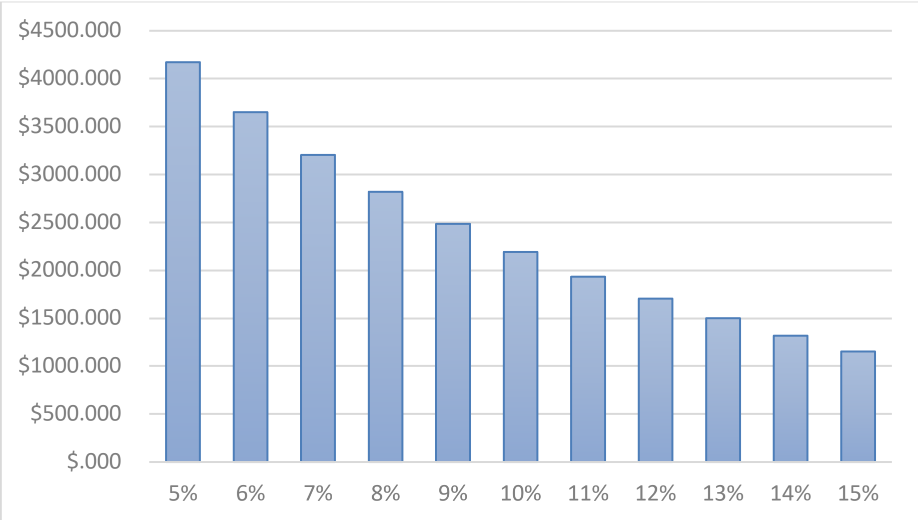

Figure 7 - Sensitivity Analysis - NPV per hectare vs Discount Rate - Model 2

Disclaimer: We visited a property with a similar model to model 2 in terms of the species of commercial interest and in the cultivation practices. However, this other area had separated plots, intercalating trees with the main cultivars. The guaraná spacing was 3 x 5 meters in an area of 0.5 ha, the cocoa 4 x 4 meters in 1 ha, and finally the 2 x 3 meters coffee in 3.5 ha. Among the structured models, it had the largest restoration area, 5.4 hectares.

The region presented a rugged relief in some parts, but did not prevent the use of the areas for planting. The cultivation presented high stratum species in adult phase, interspersed with those of commercial interest, providing an expressive shade of the area. From the ecological perspective of restoration, this model was the one that best served the needs of the ecosystem. The soil presented good constitution, organic matter added to it, a great diversity of lianas, herbs and native shrubs. However, the rugged relief on which the model was based significantly changed labor costs. Due to the low productivity in activities such as scouring and harvesting, labor costs were significant higher, reducing the economic performance of the model. This result highlights the importance of the topography and the particularities of each area for the feasibility of restoration projects. The simplified results are presented in the following table.

Table 12 - Financial indicators of Model 2B

FINANCIAL INDICATORS - Model 2B	
NPV	- 10.033
IRR	-8%
NPV/ha	- 1.858
Benefit/Cost ratio	0.8
Payback	-

Model 3: Coffee, cocoa, guaraná, açaí and banana

This is a 1.5 ha agroforestry system has the presence of species of low, medium and high stratum, planted in lines and between lines, according to the sketch below. Large-sized species fulfill the shading role for guaraná and coffee, and the açaí-de-claudia (*Euterpe oleracea*) performs the function of a wind barrier, in the margins of the system, besides being present between the lines of the system. The banana tree (*Musa spp.*) is present in the system in the first two years, in order to generate gains in this period, and gives rise to the açaí. In the elaboration of the model, the mortality of guaraná individuals in the field was considered, and their replacement by coffee trees. The guaraná and coffee spacing was 6 x 6 meters, the 3 x 3 meters banana, and 1 meter açai.

The soil of the plantation had a good constitution, and its coloration was dark, differing from the rest of the property. The diversity of individuals in the area was great, and many had commercial value. However, they were present in small numbers, which prevented inclusion in the model.

Due to the favorable topography, machines were used to prepare the soil. The highest costs associated with the implementation of the model were due to the enclosure and the seedlings. The highlight of the model is the tussock açaí, which presents a good productivity and a return in the first years of the project, reducing the investment's time of return. The area of the system is 1.5 ha.

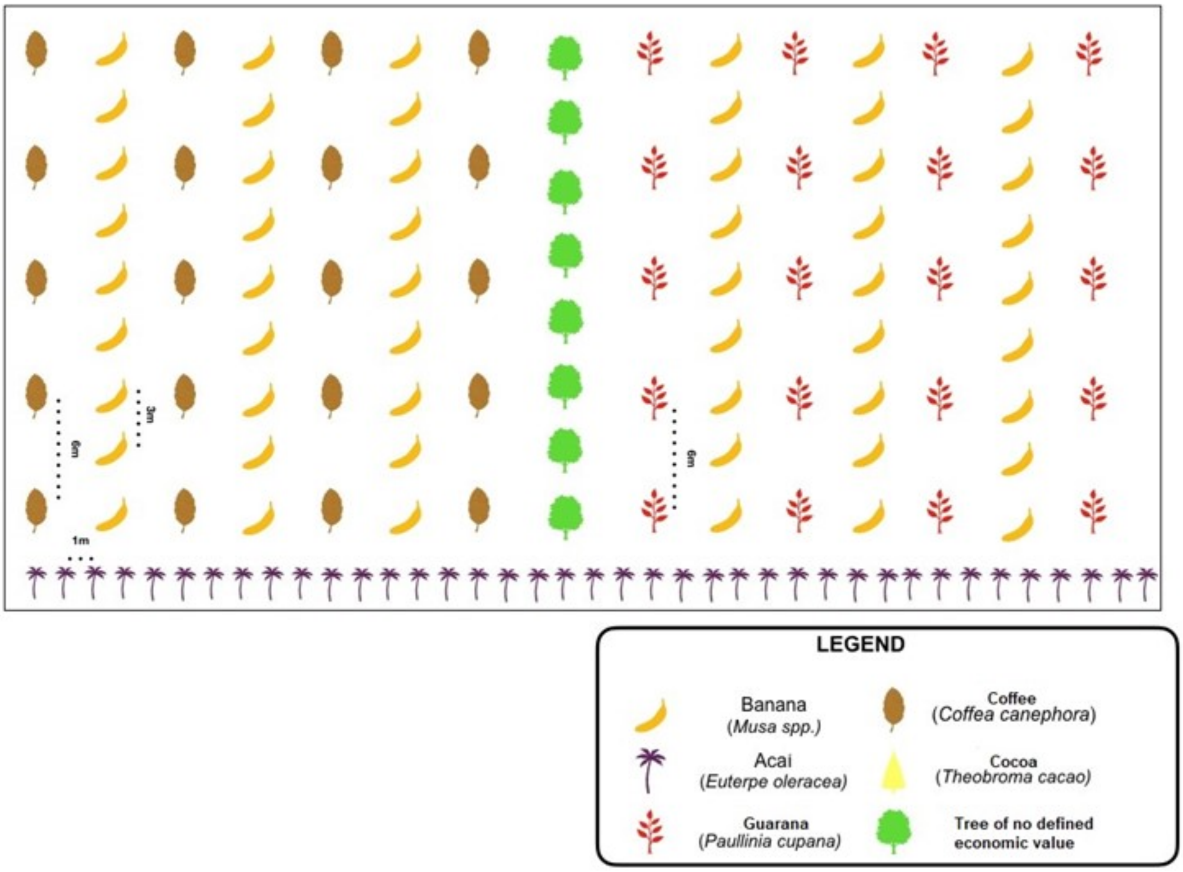

Figure 8 - Sketch of Model 3 - Coffee, cocoa, guaraná, açaí and banana

The highest costs of the model come from the fences installation for enclosure, which prevents the impact agent (cattle) to access the restored area. The private technical assistance was included in the costs, given that the standard local land owners do not have sufficient knowledge to implement the restoration process.

Table 13 - Parameters used on models for a standard 1ha restoration

Item	Unitary value (USD)
Technical Assistance - Recovery plan for degraded areas (PRAD)	414.36
Fence and labor	934.53
Limestone	31.76
Labour (daily)	22.09
Agricultural machine (hour)	46.96

Table 14 - Average annual productivity of model 3

Period (years)	Average productivity			
	Guaraná (Barrell – 8kg)	Coffee (Sack)	Açaí (Gallon – 20L)	Banana (kg)
1st to 5th	2	2	161	800
6th to 15th	3	3	226	-
16th to 20th	4	3	226	-
21th to 30th	4	3	240	-

The simplified cash flowed is presented in the following table:

Table 15 - Cash flow of Model 3

Year	Gross Income	Tax on Sales (3.65%)	Costs & Investments	Cash Flow - before income tax	Tax on Income (3.08%)	Cashflow - after taxes
1	-	-	4,832.6	- 4,832.6	-	- 4,832.6
2	884.0	32.3	699.8	151.9	4.7	147.2
3	442.0	16.1	981.6	- 555.7	-	- 555.7
4	1,480.4	54.0	1,360.6	65.7	2.0	63.7
5	2,166.5	79.1	926.9	1,160.6	35.7	1,124.8
6	2,575.9	94.0	926.9	1,555.0	47.9	1,507.1
7	2,575.9	94.0	1,449.0	1,032.9	31.8	1,001.1
8	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
9	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
10	2,575.9	94.0	1,551.2	930.7	28.7	902.0
11	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
12	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
13	2,575.9	94.0	1,551.2	930.7	28.7	902.0
14	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
15	2,575.9	94.0	1,266.7	1,215.2	37.4	1,177.8
16	2,495.8	91.1	1,551.2	853.5	26.3	827.2
17	2,495.8	91.1	1,117.5	1,287.2	39.6	1,247.6
18	2,495.8	91.1	1,117.5	1,287.2	39.6	1,247.6
19	2,535.8	92.6	1,551.2	892.1	27.5	864.6
20	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
21	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
22	2,575.9	94.0	1,551.2	930.7	28.7	902.0
23	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
24	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
25	2,575.9	94.0	1,551.2	930.7	28.7	902.0
26	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
27	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
28	2,575.9	94.0	1,551.2	930.7	28.7	902.0
29	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4
30	2,575.9	94.0	1,117.5	1,364.4	42.0	1,322.4

The final financial indicators are presented in the table below. The investment for this area was relatively low, around R$4,556, yielding an IRR of 15.05%. The payback time was 13 years, having a benefit/cost ratio of 1.26. The model fulfills the project's goal, and manages to cover costs in the 13th year of the project.

Table 16 - Financial indicators of Model 3

	-15%	Average	15%
Area (hectares)		1.5	
Investment		$4,556.45	
Discount Rate		10%	
IRR	10.56%	15.05%	19.01%
NPV	286.90	2,796.41	5,302.80
NPV/ha	191.27	1,864.27	3,535.20
Benefit/Cost ratio	1.07	1.26	1.45
Payback period (yr)	25	13	10

This model is viable with the discount rates tested, as showed in the following table.

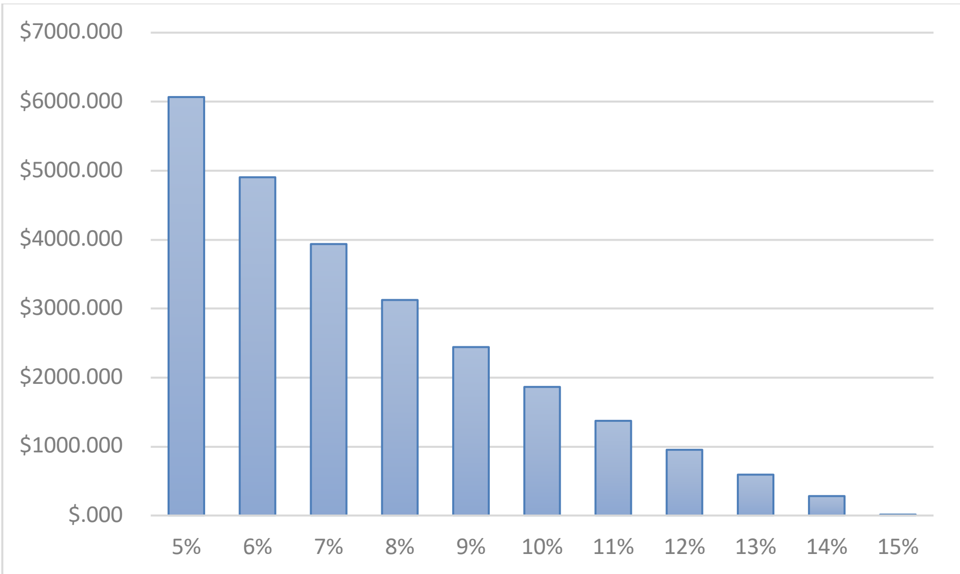

Figure 9 – Sensitivity Analysis - NPV per hectare vs Discount Rate – Model 3

Overall Results

For sake of comparison among different areas, we had the following NPV results per hectare:

Table 17 – Results comparison

	Products	Size	NPV / Hectare	IRR	Payback year
Model 1	Guaraná	1.0 ha	-US$ 1,068	5%	-
Model 2	Guaraná, Cocoa, Coffee	5.0 ha	US$ 3,653	27%	6
Model 3	Coffee, Guaraná, Cocoa, Banana, Açaí	1.5 ha	US$ 1,864	15%	13

The following tables present results of all three models assessed:

Table 18 – Overall comparison of results, Models 1, 2, 3

	-15%	Average	15%
Area (hectares)		1	
Investment		$3,233.43	
Discount Rate		10%	
IRR	-10.4%	5.0%	12.0%
NPV	-2,705	-1,068	569
NPV/ha	-2,705	-1,068	569
Benefit/Cost ratio	0.8	1.0	1.1
Payback period (yr)	dna	dna	18

	-15%	Average	15%
Area (hectares)		3	
Investment		$8159.06	
Discount Rate		10%	
IRR	20%	27%	33%
NPV	5,143	10,959	16,776
NPV/ha	1,714	3,653	5,592
Benefit/Cost ratio	1.24	1.46	1.68
Payback period (yr)	7	6	5

	-15%	Average	15%
Area (hectares)		1.5	
Investment		$4,556.45	
Discount Rate		10%	
IRR	10.56%	15.05%	19.01%
NPV	286	2,796	5,302
NPV/ha	191	1,864	3,535
Benefit/Cost ratio	1.07	1.26	1.45
Payback period (yr)	25	13	10

The economic value of the initiatives is derived comparing the scenarios with and without these initiatives. The *status quo* scenario is the simple compliance with the forest law using natural restoration techniques, which implies only the investment in fences to prevent cattle access to the area. On the other hand, the proposed project scenarios imply an additional level of investment and operational costs in order to generate additional income from agroforestry products.

Natural restoration has a cost around US$454 per hectare in the Amazon (Benini e Adeodato, 2017). Due to scale gains, the cost is higher in small areas (such as those assessed on the field). Therefore, the baseline scenario is not to have zero economic return, but to have a negative return per hectare to comply with the law.

Supply and Demand of Agroforestry Products

This section explores the markets for agroforestry products in Brazil. Depending on the supply expansion of some of these products, driven by restoration efforts, if there is no parallel expansion in the demand, the tendency is that this might generate downwards effects on prices, affecting the results of the enterprises. This study does not intend to make a thorough demand analysis, but it gathers elements to compare current market size with the potential expansion in the production of agroforestry products.

During the analysis and data collection in the field, several challenges and opportunities related to the demand and supply of the products were verified. Consultations with local merchants and producers showed a high price and demand for products derived from açaí, but a low production of these. This context is favorable to provide economic gains for models that involves the species. On the other hand, there is a limited market and relatively low prices for guaraná. This is due to the low number of buyers of the product, which often goes through middlemen on their way to the final buyer. Cacao also presented an unfavorable commercialization scenario, with low prices due to low regional demand. Although the sale of the almond adds value to the product, the gains per hectare with this product were not expressive. Finally, the coffee had a market price that was consistent with that practiced in other regions of the country, and its demand has been stable.

Coffee

Conilon coffee is the variety that may have a good productivity in southern Amazonas. It is produced in all regions of Brazil, except for the south region. The states with the highest production of conilon coffee in Brazil are Espírito Santo, Bahia and Rondônia – neighbour to Amazonas state. Espírito Santo state has the oldest and largest conilon coffee production in Brazil, with a production of 5,915 thousand bags, equivalent to 354,900 thousand tons in 2017. However, Rondônia, the third largest Brazilian production, had a production of 142,800 thousand tons. The graph shows the historical series of production of the three states with the highest production of conilon coffee:

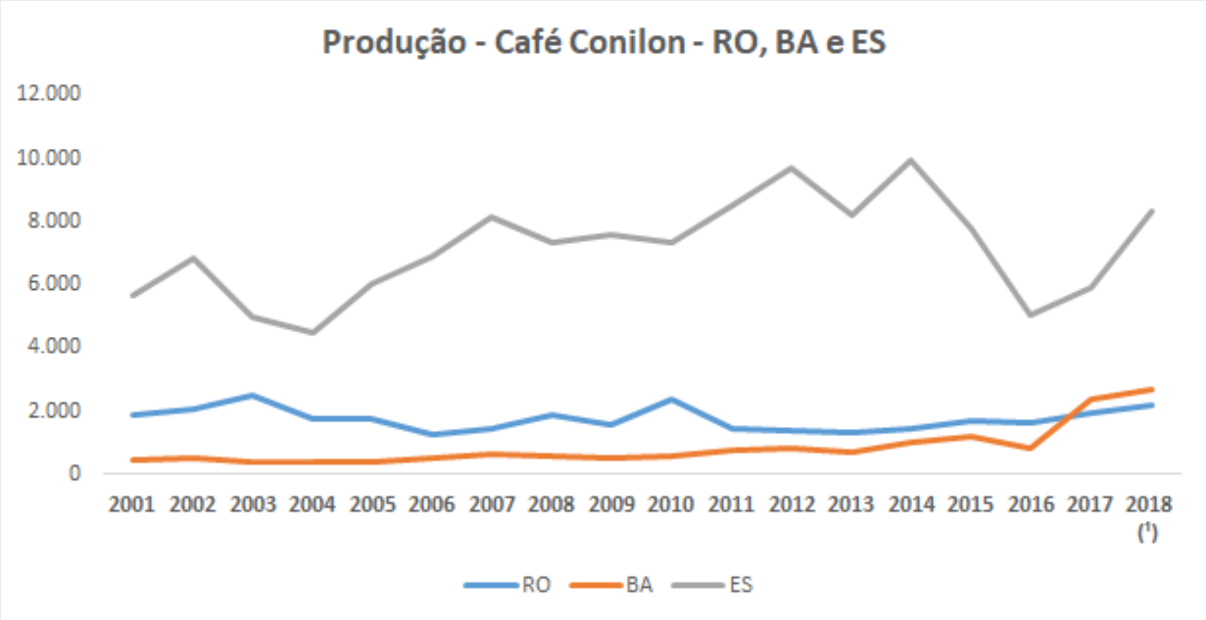

Figure 10 - Conilon coffee production in the states: Rondônia (RO), Bahia (BA) and Espirito Santo (ES)

(unit: thousands of 60kg sacks). Source: Conab, 2018.

Rondônia state´s production in comparison with Brazil´s one:

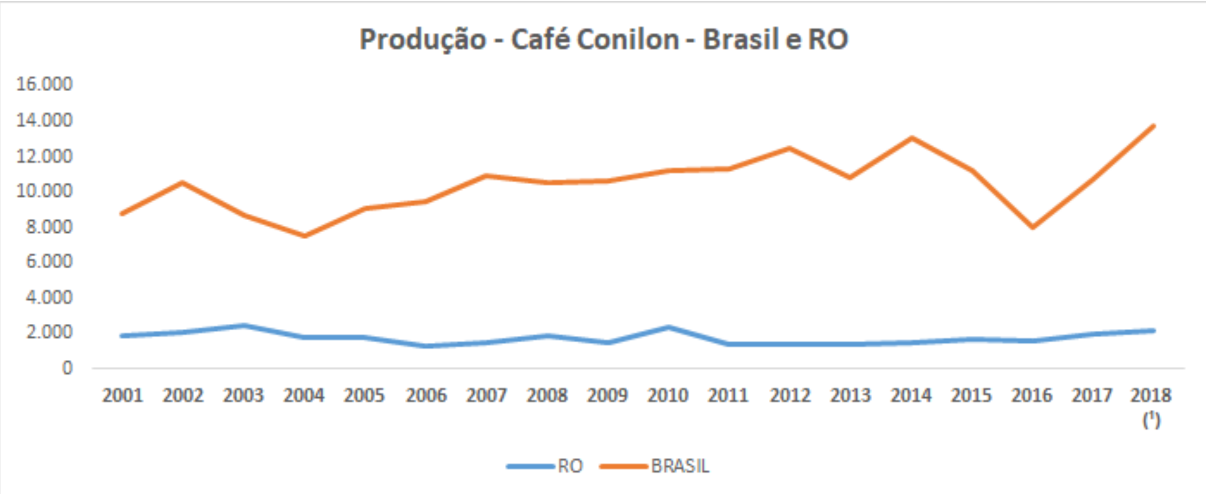

Figure 11 – Historical series of coffee conilon production in Brazil and the state of Rondônia (RO)

(unit: thousands of 60kg sacks). Source: Conab, 2018.

The state of Amazonas had a production of 7,500 bags in 2017, which is not very significant compared to other states, but it is the only state where monoculture does not prevail.

In the Amazon, there is one coffee brand that might be used as example for the region, the Apuí Agroflorestal Coffee (AM). Unlike other Conilon coffee production in Brazil, it is based on sustainable rural production, being the first coffee produced in a sustainable way in the Amazon, which represents the strengthening of the agroforestry coffee production chain. The Idesam is responsible for supporting the Coffee Project in Agroforestry through technical assistance and rural extension, which began in 2012 with funding from the Vale Fund, aiming at generating income, improving the quality of life in the field and reducing deforestation.

The main markets of Apuí Coffee are in Porto Velho and surrounding cities, Manaus, São Paulo, Rio de Janeiro and Brasilia (it has been growing for 1 year). Some of the main buyers / establishments are: Instituto Chão (SP), Armazém do Campo (SP), Mundo Verde (SP), Instituto Ata (SP), Unisafra (online), Patio Goumet (Manaus), Café do Musa, Green Hostel (various states), Friends of the Forest, Local Hostel (Manaus), Green Peace, Asproc, Nakau (chocolate factory), Slow Food basket, Tarberna Amazonia (RJ). São Paulo, today, is the market with the highest demand for Apuí Coffee. Local farmers sell an average of 7,200 kg to 7,800 kg per year (120 to 130 sacks)[6]. Each sack contains 60 kg and costs between R$ 290,00 and R$ 300,00 Brazilian reais, a price higher than the bag of common conilon coffee (between R$ 250,00 and 260,00 reais per sack). There is no distinction between two periods in the year because coffee is collected only once a year (between June and July). The "Chão de São Paulo Institute", which is a non-profit association, is now considered one of the largest buyers of Apuí coffee. Every 2 months, the Institute buys an average of 100kg in coffee packages.

The coffee of Apuí has been conquering strongly the market of Manaus and of other states of Brazil, like São Paulo, Rio de Janeiro and Brasília. The perspective of an increase in the Apuí coffee market is high, already for next year, as producers are in the final process to obtain organic certification of the product, which will add greater value to the production of family agriculture. Idesam and partnerships also seek to make possible the expansion of the project's areas of activity, as well as the number of producers involved through the training of multiplier producers and the maintenance of technical advice, expanding the internal market and seeking to conquer the foreign market.

We did an "price elasticity exercise", consulting experts on hypothetical market scenarios. Experts say that if the price were, for example, 20% lower, it would be financially feasible to buy the double of the current quantity, providing a lowest price to the consumer. If the price were to be 20% higher, middlemen would buy 50% less. The main factor for increasing the purchase of the product is having more demand.

Guaraná

Guaraná production in Brazil is around 45,000 kg a year. Despite being originated in the Amazon, guaraná has its largest production in the state of Bahia - the municipality of Taperoá is the largest producer of Guaraná in the country. The state of Bahia produced 2,694 tons in 2015, while in the state of Amazonas produced 662 tons in the same period.

[6] Idesam, Apuí Coffee Project, Coffee in Agroforestry for the strengthening of the low carbon economy - Results and Perspectives - 2016.

Figure 12 - Historical series of guaraná production in Brazil

Source: IBGE

In the state of Amazonas, guaraná is produced in the municipalities of Maués, Urucará, Borba, Presidente Figueiredo and Apuí. Most of the production is sold to big beverage companies (Ambev and Coca-Cola), and only a tiny part is sold to smaller industries.

The Guaraná price in Amazonas is, on average, R$ 17.00 per kilo and can reach up to R$ 22.00, depending on the diversification of the product in the year. But the price does not change frequently because, although there are guaraná productions in Bahia, there is a certain exclusivity and appreciation for being produced in the Amazon region, to have the indigenous way of preparing.

Experts state that the main bottleneck in guaraná production is production management. The cost of producing guaraná is high, as there are three management rounds during the year and there is the risk of losses due to diseases.

Açaí

Açaí is a traditional food that has gained a lot of new consumers in all regions in Brazil and in the world, being one of the main products of the Amazon. Its increasing cultivated area represents its importance in local fruticulture, and its socioeconomic relevance on the Amazonian region. The consumption of açaí berries is part of the social identity of the people and, in the harvest season, it is even more popular, because of the price drop, making it more attractive to consumers.

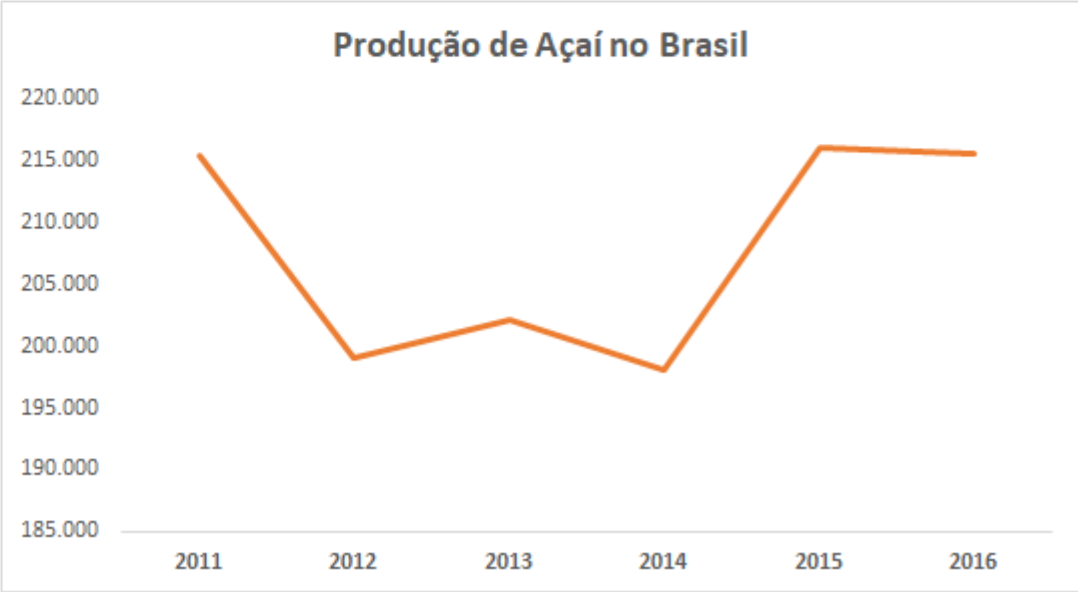

Figure 13 - Historical series of açaí production in Brazil

Source: IBGE

Most of the açaí pulp is extracted in floodplain areas of the Amazon River and supply the local, national and international consumption. The growth of the açaí market, on an international and national level, is worrying the local suppliers. However, the farmers, the local industries of medium and small-scale and the carrier companies benefits of the increase of açaí demand.

Due to its favourable location, the Amapá state has one of the biggest exporter industry (Sambazon). It exports only target the competition with the local market when the price of the sack (50 kg) drops by R$ 50,00, which equals to R$ 1,00 /Kg. In times of shortage (off-season) the market absorbs an increase of no more than R$ 200,00 per sack (R$ 4,00 per kg). The largest part of the industrialized and consumed açaí in the Amapá state (89%) is extracted in Pará state, meanwhile, 11% is produced in the state itself, in the Macapá, Santana, Mazgão (in the floodplains of the Amazon River), Amapá, Calçoene and Oiapoque (floodplains of the Atlantic coast) town. In the Laranjal do Jari town, the *Associação dos Trabalhadores Extrativistas de Açaí do Pará e do Amapá* (açaí extractors association of Amapá and Pará state), has permission to colect and extract all the production of açaí in the glens of permanent conservation areas (APPs) of the eucaliptus plantations of the Jari-Celulose company, with no cost.

In order to make the process of extraction profitable in distant areas, such as southern Amazonas, the local processing industries fixes a minimum price in the harvest season, which is sufficient to cover the cost of transport. This mechanism of regulation does not permit that the price drops excessively in periods of great offer of the product. The composition of the price of Açaí is connected to the location of the extraction area, the distance and the access. It means that the price paid to an extractor depends on the area he extracts. Furthermore, the selling price is determined by the marketing establishments.

There is an alternation of cycle regarding the production of açaí between the Pará and Amapá state, which leads to a synchrony of the harvest season and the off-season. While the state of Pará is in the increased offer period, Amapá is in its off-season, vice-versa.

According to experts, the processing industries adds about 155% above the cost value of the product, which can be justified by the specialized commerce of Açaí, which can involve, for example, the certification of the raw material.

Risks and Challenges for Economic Forest Restoration in Southern Amazonas

There are several risk factors associated with investments in forest restoration in the Amazon and these risks are related to the development agenda for the Amazon (TCU 2017), including the southern region of Amazonas state. This section presents issues related to the current legal framework, land tenure, public policies, labor and technical assistance.

Effectiveness of Legal Framework

Land tenure and **Land registration documents** is essential to guarantee long term incentives and also for the rural producer to access public resources for agricultural production. In the settlements of southern Amazonas, it is normal for rural producers to have no land documents. This has undoubtedly been - and possibly will continue to be - an obstacle to forest restoration in the Amazon.

Besides, the southern region of Amazonas is characterized by a series of **settlements** where most of the rural producers are concentrated and where the deforestation in the Amazon happens (Azevedo et al., 2016). Most rural producers in this region do not have **land registration documents**, which makes it difficult to access **public policies** to family farmers. Due to lack of land documentation, farmers that need to restore their land may be prevented from the access to the financial resources for such purposes. However, the land demarcation in the Amazon seems a problem far to be solved, and it is, therefore, important that the national strategy to support the rural producer remains disconnected from the land tenure conditions of the region.

Amnesty for environmental crimes

In 2008, Brazil published Decree No. 6,514 dealing with infractions, administrative sanctions and the federal administrative process for the determination of infractions to the environment (Brazil, 2008). This decree would apparently curb illegal deforestation and, in fact, from its publication until Lei 12.651 of 2012, deforestation in the Amazon was progressively reduced (PRODES, 2018). The Law of 2012 defined the illegal deforestation that took place before the 2008 Decree as a "consolidated rural area" and this generated a series of criticisms of the government before and after the amnesty (WWF-Brasil, 2011, Instituto Socioambiental, 2014 and Imaflora 2017). However, in 2018 the Federal Supreme Court (STF) decided to maintain the amnesty granted to landowners who deforested beyond what was allowed until July 22, 2008 (STF, 2018).

The amnesty of Law 12,651 lost 41 million hectares illegally deforested, most of it in the Amazon biome (IMAFLORA 2017). The same law that amnestied deforestation seeks to curb deforestation and oblige the debtor to regularize the vegetation deficit (Brazil, 2012). However, this amnesty backed by the Federal Supreme Court is a clear evidence of contradictions in the current Brazilian environmental agenda, thus providing an environment of doubts and uncertainties for farmers and agents that can mediate forest restoration efforts in Brazil.

As a consequence, landowners may not have enough incentives to comply with the law. Field activities promoted by CSF-Brazil (2018) showed that rural producers and environmental technicians question the real need to recover vegetation deficit. Indeed, some believe that it will be difficult for producers to restore their environmental liabilities - they will continue to deforest and for wait another legal amnesty. However, such a situation may lead to purely fictitious efforts and weak social engagement, especially in regions where culture, history and economics are based on deforestation and livestock farming, as in the south of the Amazon.

Deforestation and Public Policy

In the last three decades deforestation in the Amazon has been detected around 1 million hectares per year (PRODES 2018). During this period, the lowest annual rate was in 2012, but 2017 deforestation increased by 52%, totaling 694,700 hectares (PRODES 2018). The advance of deforestation combined with rising global temperatures and a weakening environmental policy in Brazil will drive forest restoration efforts to absolute failure, especially on Jair Bolsonaro's planned presidential agenda (Fearnside 2018). However, the Union Court of Accounts (2017) considers that the "risk associated with the insufficiency of public policies capable of containing deforestation in the Amazon is the loss of biodiversity and Brazil's failure to comply with treaties relating to the Environment and possibility of not meeting ODS target 15 - Protecting and restoring terrestrial ecosystems by 2030".

Disarticulation among agencies working on the region's development agenda

Public agencies that should act on the Amazon's development agenda are not properly engaged in the national and regional debate that involves the forest restoration in the Amazon, as well as the national agroecology policies and the National Plan to Strengthen the Extractive and Riverine Communities (SUDAM, 2018; SUFRAMA, 2018; MMA, 2018). In fact, the Brazilian Court of Audit of the Union (TCU) published in 2017 an audit survey with the purpose of producing a systemic diagnosis on the topic of development in the North Region of Brazil – Fisc North, and noted that the institutions of the region's development agenda act in a manner "disjointed and with overlapping actions and initiatives to combat the same problematic, which is why one should think of a crystalline definition of each institution's role in the regional development's process" (TCU 2017). This is why efforts should be allocated towards coordinating the role of governmental institutions in the process of local development, including the forest restoration agenda.

The agencies (superintendencies) for local development SUDAM and SUFRAMA are not properly engaged in the discussions that involve forest restoration in the Amazon, as well as national policies for the promotion of socio-biodiversity products and the national strengthening of extractive and riverine communities. Although created to act on the development agenda, such agencies need to be guided to participate in the discussions that are being promoted and centralized mainly by the Ministry of the Environment. In addition, these agencies have legal competence to be the main promoters of the forest restoration agenda in the Amazon.

Monitoring: Monitoring is an essential part of forest restoration (Brancalion et al., 2015). However, Brazil does not yet have a **forest restoration monitoring system** (MMA 2017). A monitoring system is part of the strategies of the National Plan for the Recovery of Native Vegetation (MMA, 2017). The areas under forest restoration in the Amazon are unknown, but an unpublished study conducted by the Brazilian Biodiversity Fund identified these areas in the Amazon. However, it is necessary to think and design a forest restoration monitoring system that is adapted to the conditions of the southern region of Amazonas and integrated to the national system for that purpose.

Market conditions and Technology

There are risks associated to the lack of practical and theoretical knowledge about large-scale and long-term forest restoration. For example, there are no precedents of forest restoration in the Amazon in an area of more than 50,000 hectares, which would represent 1% of the estimated 2030. As an effect, it can be considered that many essential elements are missing to restore the five million hectares expected by 2030, e.g. large-scale experience, labor, propagules (fruits and seeds), infrastructure, the delimitation of areas to be restored, among other essential factors. In addition, knowledge about the risks of climate change is lacking (Nobre et al., 2016).

There are few **nurseries** available in the southern Amazon region (IPEA 2015) and one of the main nurseries in the region is at risk due to a lack of income and may close at any time (CSF-Brazil 2018). There are also contradictions - for example, the owner of this nursery (Viveiro Santa Luzia), comments that the nursery was not included in the Forest Cities project (Dalcir Saatkamp - Personal Communication), carried out with public money, through the Institute of Conservation and Development Amazon Region, which seeks to consolidate a forest-based economy in Amazonas (Amazon Fund 2018). This would reinforce the observations of the Court of Auditors of the Union which points out that each institution ends up working in a disjointed way in the region (TCU 2017).

Transportation: Transport logistics are essential for the production flow that can emerge from forest restoration. However, the southern region of Amazonas is isolated from major consumer centers and main production routes in the northern region of Brazil, for example, from federal highway BR-163 (Santarém / PA to Cuiabá / MT). Thus, an offer from the forest restoration may find difficulties related to transportation and commercialization, because the transport sector in the Brazilian Amazon is less than the local demands, with low efficiency and operation in very precarious conditions. It is inferred, in this context, that the transportation system is essential to internalize and make feasible the development of this region and to take advantage of the opportunities of forest restoration.

Technical Assistance

The participation of the local people is essential to make environmental laws effective, and for this the legal situation should be clear to all citizen (Fearnside, 2000). This study notes that the legal framework for forest restoration in Brazil is defined by several laws (Brazil 1981, 1988, 1998, 2012, 2017), and there is regulation focus on the implementation of the “Degraded Area Recovery Plan” (Portuguese acronym, PRAD), required for the compliance with environmental legislation (IBAMA, 2011; ICMBio, 2014; CFBio, 2018). Despite the legal framework, rural producers often are either not *aware* of their obligations or do not understand what they need to do to comply with the law - and how they should do it. This indicates that technical and legal help should be provided or incentivized in order to undertake the recovery of degraded areas and related activities.

Today, rural producers lack of technical and legal knowledge about forest restoration, and many of them are uncertain about how to recover the vegetation deficit and economically take advantage of Legal Reserve (LR) areas in the future. Therefore, it is still necessary to understand how rural producers will be assisted in a technical, legal and financial way to recover vegetation deficit in the Amazon, whether via the State or via the private sector.

It is important to consider private technical assistance costs, considering that the State will not guarantee it widely. The forest restoration of five million hectares of Permanent Preservation Areas (PPA) and Legal Reserve (LR) in the Amazon until 2030 will require a large number of technical goods and services to be implemented (Instituto Escolhas, 2015; MMA 2017a), with an estimated investment of 20 billion Reais (Instituto Escolhas 2015). The rural family farmers represent the majority of the producers with deficit of PPA and/or LR in the Amazon (Imaflora 2017), most of them being cattle ranchers, inexperienced in forest restoration. These family farmers invest little in private technical assistance, and many, being settled by INCRA, do not access rural credits for lack of land documents (Gonçalves et al., 2015).

The consequence of an inefficient forest restoration system for rural producer assistance may be the failure to meet nationally announced targets (Brazil 2012, 2017a) and internationally (Brazil, 2017b). If technical assistance fails, areas that could be restored and used economically run the risk of remaining degraded and abandoned. Inefficient technical assistance can cause serious social problems due to scarcity and degradation of forests, as well as rural producers who are willing to postpone or fail to comply with their legal obligations.

The "Alliance for Restoration in the Amazon" is an initiative to integrate the forest restoration agenda in the Amazon, a voluntary group formed by institutions from different segments of society, including State, companies, organized civil society and research centers (MMA, 2017). The Alliance seeks to *qualify and expand the forest restoration scale in the Brazilian Amazon and promote the integration between different actions and the cooperation among multiple agents engaged in the theme.* The Ministry of the Environment is a partner of the initiative that has been working to provide financial resources for forest restoration with the GEF (Global Environment Facility) and the Amazon Fund (MMA, 2017). However, it seems relevant to take knowledge of the activities of this Alliance, thus to strengthen the articulations and roles of the institutions in this broad and multidisciplinary work agenda that is the forest restoration in the Amazon.

WWF-Brazil has been developing conservation projects in the region since 2005, and, currently the work agenda addresses aspects of the law on protection of native vegetation (Brazil 2012), focusing on the Rural Environmental Registry (Portuguese acronym, CAR) and forest restoration (WWF-Brazil 2016). WWF-Brazil has undertaken field experiments and studies to make feasible a project to act in the restoration of forest landscapes (IUCN and WRI 2014), within its agenda to support the implementation of the Forest Code in the south of Amazonas (WWF-Brazil 2016, 2017).

Table 19 - Main limiting and potentiating factors for the implementation of landscape forest restoration (FLR) in southern Amazonas, Amazon biome, Brazil

Strengths	Weaknesses	Opportunities	Threats
Real examples of successful forest restoration; Presence of forest fragments (natural sources of seeds).	Producers with no experience in forest restoration; Decapitalized or poorly motivated rural producers to restore their environmental liabilities; Producers with no investment experience in technology and technical advice for forest management; Uncertainties from rural producers on the possibilities of using products from the forest restoration; Producers without documentation of land; Rural producers with low educational level; Lack of labor to perform on a large scale; Lack of nurseries in the area; Declining wood sector; Lack of agroindustries to add values to the products of the forest restoration.	Well defined legal framework; Hundreds of millions of hectares for forest restoration by 2030; Amazon Fund and GEF intend to invest in forest restoration; Development of more in-depth studies; Development of a productive chain of forest restoration; Diversification of production of family farmers; Comply with the Law 12.651 (Forest Code) and the commitment of the Paris Agreement.	Poor law enforcement; Lack of experience on a large scale (greater than 10 thousand hectares); Federal Government (2019-2022) shows little interest in the environmental agenda; State and civil society organizations acting in a disjointed manner; Contradictions between environmental laws and political and judicial decisions; Climate change generates unknown risks; Deforestation and illegal fire; Lack of a forest restoration monitoring system; Logistic isolation and distance from consumer centers; Region with an economy focused on livestock.

Gap analysis and next steps for Forest Restoration in the southern region of Amazonas

Rural producers in the southern Amazon have few experiences with forest restoration. In fact, in Apuí, where field activities were carried out, the forest restoration cases found are aligned with the expectation of developing the extraction of non-timber products, but there is no clear scenario or plan to develop timber products extraction. Thus, because of the lack of biological and economic information of wood yields in conditions of forest restoration, it is difficult to simulate the future use of the wood species. However, it is important to point out that one of the main gaps in knowledge about forest restoration is the future of the use of wood species.

Rural producers in the region appear to be under-capitalized or under-motivated to restore their environmental liabilities. In general, there is a preference for investments in livestock, and forest restoration is treated almost exclusively as a legal obligation. Producers still do not visualize or practice forest restoration as a business opportunity, being uncertain about the possibilities of using the products resulting from this intervention. This set of factors is unfavorable to subsidize robust data on the future prospects of forest restoration in the area of study, mainly in the aspect of wood use.

There are forest restoration initiatives in the state of Rondonia, with field experiments, but without data that would simulate the same type of intervention in southern Amazonas. In fact, it seems that all logging that took place in the study region was made from native forests, and forest restoration experiments are incipient. It still seems that the timber sector is declining in the region of study, which can be a de-motivating factor for the timber trade.

The lack of land tenure documentation can be an obstacle for rural producers in the study region, because it is common practice to require these documents to access public resources in Brazil. It may be that the state understands this situation and facilitates access to credit for forest restoration, but this scenario is hypothetical and needs further study, so that it can understand the State's position regarding the lack of land documents.

Finally, Brazil does not have a large scale experience in forest restoration in the Amazon. Considering the period between 2020 and 2030, to meet the five million hectares planned for the Amazon, the amount of forest restoration per year would be 500 thousand hectares[7]. Undoubtedly, the lack of experience, knowledge, land documentation, skilled labour and nurseries in the region are a set of factors that can be considered as significant obstacles to the planned realization.

The current scenario is complex and there is no single or clear path for rural producers in the southern Amazon to participate in the Landscape Forest Restoration (RFL) project. The current scenario indicates the need for structuring investments so that forest restoration can be carried out in large tracts. The lack of experience of rural producers points to the need to popularize the knowledge derived from the experiments in the south of Amazonas and new studies. These studies should contemplate, at the same time, biological and economic factors of the use of the resources coming from the forest restoration.

[7] However, natural restoration figures are being assessed by the federal government, which will probably show that the human driven restoration efforts may not need to be as big as first thought to achieve this target.

The activities in the field allowed to observe that the local nursery, located in Apuí, is close to shut down its activities due to the lack of revenues. This demonstrates that even if there is a legal demand for the acquisition of seedlings and seeds, the entrepreneur who sought to generate subsidies for this demand is unmotivated and signaling difficulties to keep the activity running. Without nurseries there is nothing to be done to restore large tracts of degraded areas in the south of the Amazon. Thus, it can be concluded that the local nursery needs to be supported so that their enterprise does not fail. A failure of the local nursery would represent all the complexity and difficulties to implement private forestry restoration projects in the study area.

Conclusion

The study indicates the existence of restoration models with positive economic return in the south of the Amazon. These results can be used to incentivize landowners to comply with the forest law restoration requirements, generating financial returns, or at least reducing the compliance costs. The models considered different combinations of species: guaraná, cocoa, açaí, coffee, banana, and native species that help the ecological restoration process with no direct economic value.

The properties visited on the field had restoration areas ranging from 1 to 5.4 hectares, however the largest area included in the analysis had 3 hectares. The average investment required for them was US$3,290 per hectare, considering the installation of fences and provision of technical assistance to local landowners – cattle ranchers with no previous experience with forest restoration. These investments yielded internal rate of returns (IRR) that ranged from 5% to 27% - even though we found a model with negative returns due to peculiarities in its production system. Considering an average discount rate of 10%, the Models' Net Present Value (NPV) ranged from negative US$1,068 to positive US$10,863, or US$3,621 per hectare for a 30 years period. This is very good news for forest restoration initiatives, showing that, with the right investments and technical assistance, forest restoration might be a profitable activity in southern Amazonas.

All models consider only non-timber products and indicate that forest restoration can be economically sustainable, generating financial and environmental returns, with possibility of economic return and payback loans until 2030. Given the context, and considering that the Brazilian Forest Law gives farmers a 25 years period to restore and accomplish their environmental liabilities, silviculture and the extraction of non-timber forest products presents itself as an interesting alternative for the economic development of the region. Because of its cattle ranch vocation, there are not many initiatives and projects with this focus in the region. In addition, according to OLVEIRA & RIOS, 2014, there is a considerable variety of Amazonian species that occur naturally and have economic potential.

There are still many challenges for scaling up forest restoration projects, mostly related to law enforcement, provision of technical assistance, low interest rate loans, and maintaining nurseries that are able to supply seedlings and seeds in scale. Environmental legislation in Brazil is pressured by contingencies and contradictions that occur at various institutional and governmental levels, causing the legal framework to generate uncertainties that undermine the goals and the catering market. In Brazil it is normal that land documentation is required to finance agricultural activities with public resources. For forest restoration, in this scenario, financing will tend to benefit the large rural producers, a group that accumulates most vegetation deficits in the Amazon (Imaflora 2017). At the outset, it is important to consider that national efforts for forest restoration may be conducted in a way that generates few opportunities for traditional small farmers and land settlers, groups that are usually in need of land documentation.

The current scenario suggests that, in order to reach its goals by 2030, the State will also need involvement of private professionals and companies to provide capital, technical assistance to help mediate relations between landowners and environmental agencies responsible for forest restoration. For technical assistance to gain scale, it will be also necessary the State to have qualified segments of civil society providing assistance, seedlings, seeds, equipment and specialized labor for forest restoration.

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