“Forest Landscape Restoration Implementation:
Progress on the Ground”

Snapshot Analysis of Forest Landscape Restoration
Brazil

Final Report

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Acronyms List

ABC plan - *Plano Agricultura Baixo Carbono* (Low Carbon Agriculture Plan)

AF - agroforestry

AFS - Agricultural Family Schools

APP - Permanent Preservation Area

ATEC - Certified Technical Assistant

ATER - approved technical assistance institution

CAR - *Cadastro Ambiental Rural* (Rural Environment Registry)

COOEX - *Cooperativa dos Extrativistas da FLONA de Carajás* (Cooperative Extractors of FLONA Carajás)

DAP - Declaration of Aptitude to the rural credit PRONAF

DEFRA - British Government's Ministry of Agriculture, Food, Fisheries and Rural Affairs

DUs - Demonstration Units

EFA - *Escola Familia Agrícola* (School for Agricultural Families)

EMBRAPA - Brazilian Agricultural Research Corporation

FECAT - Family Agriculture Cooperatives of Southern Pará

FLR - Forest Landscape Restoration

GDP - Gross Domestic Product

GHG - greenhouse gas

HDI - Human Development Index

IABS - Brazilian Institute of Development and Sustainability

ICF - International Climate Fund

ICLFS - integrated crop-livestock-forestry systems

IDB - Inter-American Development Bank

INCRA - National Institute of Colonization and Agrarian Reform
IUCN – International Union for Conservation of Nature

LRs - Legal Reserves

LULC - Land Use and Land Cover

MAPA - Ministry of Agriculture, Livestock and Food Supply

MPEG - Museu Paraense Emílio Goeldi (Para's Emilio Goeldi Museum)

MST - the Landless Rural Workers' Movement

MU's - Multiplier Units

NGO – Non-Governmental Organisation

NTFP – Non-Timber Forest Product

PA - Settlement Projects

PAA - Food Purchase Programme

PAE - Agroextractive Settlement Projects

PDS - Sustainable Development Projects

PNAE - National School Feeding Programme

PPCDAm - Action Plan for the Prevention and Control of Deforestation in the Brazilian Amazon

PRA - Plans for environmental regularization

SD - Standard Deviation

UNIFESSPA - Federal University of South and Southeast of the State of Pará

UNFCCC - United Nations Framework Convention on Climate Change
EXECUTIVE SUMMARY

The Marabá landscape in Brazil’s Amazon state of Pará covers an area of 2.36 million hectares. It contains three municipalities: Marabá, Nova Ipixuna and Parauapebas. In this landscape during the 20th century, extraction areas (Castanhais) were transformed into large farmlands (latifundios) owned by oligarchic families, forests were heavily logged and progressively converted to pastures with support from government incentives. From the late 1970s onwards, part of these latifundios were claimed during the agrarian reform when settlements of farming families were established. Today, the landscape is a mosaic of agrarian reform settlements and large cattle ranching farms, with a large block of protected areas in its western portion. There are eight conservation units (two strictly protected areas, four sustainable use areas and two Indigenous Lands). The remaining areas of natural forest are mostly concentrated in these protected areas, approximately 284,693 ha in Indigenous Lands and 926,114 ha in conservation units (CUs), totalling 1,210,808 ha (part of the CUs are outside the region though).

The economy in the three municipalities is based on the extraction of natural resources (e.g. mining), as well as public services and the farming industry, with an emphasis on cattle ranching. There is a high concentration of land with family farming occupying 85% of the rural establishments (i.e. number of farms), but accounting for only 26% of the total area of agricultural land (74% is owned by medium and large farms).

Currently, the Marabá Region is in the most deforested area of the Amazon, located in the so-called arc-of-deforestation. Fifty years after the colonization period, a total of 904,201 ha of forest have been deforested and converted mainly (97.91%) into low productive pastures, of which, a large proportion has been abandoned after just a few years of use, resulting in regenerating forests (i.e. secondary forests) in these areas.

This report presents an assessment of three FLR projects developed in the Marabá Region: (1) PROSAF developed by the Institute of Forest Development and Biodiversity of the State of Pará (Ideflor-Bio) (2013–present); (2) Rural Sustentável (Sustainable Countryside) established by the Brazilian government through its Ministry of Agriculture and Livestock, in partnership with the Inter-American Development Bank (IDB) and funded by the British Government (2015–2018); (3) Juventude e Cooperativismo (Youth and Cooperativism) developed by the federation of local fruit cooperatives FECAT (2006–2008) funded by the Development & Citizenship programme of the federal oil company Petrobras. The report also briefly reviews some restoration work by the mining company VALE.

THE PROSAF PROGRAMME (2013-current)

PROSAF is a state-run programme, implemented by the Institute of Forest Development and Biodiversity of the State of Pará (Ideflor-Bio) since 2013 and developed essentially to carry out forest restoration on smallholders’ properties, mainly in agrarian reform settlements across Pará State. This is in response to an assessment in 2012 showing the high rate of forest loss in the state and related legislation requiring 80% forest cover on individual landholdings.

PROSAF was initiated in a favourable political context with the launch of the revised national native vegetation legislation and national and state policies to combat deforestation - the
Green Municipality programme and the Action Plan for the Prevention and Control of Deforestation in the Brazilian Amazon (PPCDAm).

Around 32 municipalities in Pará (out of 143) have received funding for forest restoration from the PROSAF programme, with an area of 1500 ha of agroforestry implemented across the state in 2017. The programme is focused on commercial agroforestry as a single strategy to address forest restoration. In general, agroforestry systems promoted are composed of four components: 1) varied agricultural short-lived staple crops (e.g. manioc, maize, beans and occasionally pumpkins, rice and many others); 2) semi-perennial fruit crops (e.g. banana and passion-fruit); 3) perennial fruit plants of high commercial value, such as the palm *Euterpe oleracea* “açaí” (currently the crop with the highest market demand), the tree *Theobroma grandiflorum* “cupuçu”, occasionally *T. cacao* “cocoa” and the palm “*Bactris gasipaes*” pupunha; and finally 4) forestry tree species of which only a few are easily commercialized, but some are particularly profitable, such as the Brazil-nut, which is a flagship species in the region and *Spondias mombin* (commonly known as *taperebá*) which is used for producing fruit pulp.

PROSAF has supported only a few farmers in each municipality, but is spread across the state of Pará and acts as a demonstration project which could be replicated more widely. It encourages multifunctional landscapes with a strong focus on improving livelihoods of Amazonian smallholders.

Although relatively recent, the project has already achieved positive results, such as an improvement in food security, small increases in tree cover, improvements in habitat quality at local scale, and an increase in the presence of several animal species, such as howler monkeys. Nevertheless, high resolution satellite images in one sample settlement indicated that forest cover in this settlement had decreased by 70% in the 2012-2018 period.

Many limitations and challenges were found with PROSAF, such as: a lack of interest by farmers to continue the programme’s activities; insufficient extension workers to provide technical assistance; insufficient agricultural inputs (e.g. fertilisers, lime, etc.); low production yields (associated with insufficient water and soil nutrients); asynchrony between the time of arrival of the agricultural inputs and machinery, and the time window to plant in the rainy season; problems with community nurseries; fires (resulting from land use practices); need for financial incentives and credit to improve and expand the agroforestry systems; and chronic infrastructure problems, such as poor transportation for agricultural produce due to lack of trafficable roads during the rainy season.

On the positive side, PROSAF benefits from skilled technical capacity and committed local technicians; it contributes to capacity building, increasing community engagement and increased environmental awareness.

**THE RURAL SUSTENTÁVEL PROJECT (2015-2018)**

The *Rural Sustentável* Project was a federal government initiative to encourage the adoption of sustainable agricultural and forestry practices by small and medium producers living in the Amazon and the Atlantic Forest biomes in Brazil. It covered 70 municipalities and its objectives were to: 1) improve land and forest management to promote rural development,
poverty reduction, biodiversity conservation and climate mitigation; and 2) contribute to the development of the Low Carbon Agriculture Plan (Plano Agricultura Baixo Carbono). The project used the following low carbon technologies: agroforestry, integrated crop-livestock-forestry systems (ICLFS), restoration of the productivity of degraded pastures, forest restoration in degraded pastures, commercial tree planting and management of native forests. It was structured around two distinct units: Demonstration Units (DUs) which were areas where one or more of the technologies encouraged by the project were already established and Multiplier Units (MUs) which were rural production areas where the project supported the new implementation of one or more of the technologies and environmentally-friendly activities. It provided technical assistance to rural producers for planning, implementation and monitoring of the MU. The project also supported the purchase of seedlings and inputs, as well as supporting capacity-building activities.

Although the project was too recent to generate significant income, most farmers interviewed were optimistic about the prospects and some reported improved diversity in their own food consumption. Additionally, farmers reported a return of fauna, a reduction in deforestation and that agroforestry was contributing to save locally threatened species, such as Brazil nut and mahogany.

Positive aspects of the project include: farmers’ autonomy to take decisions as direct recipients of money, access to technical assistance and the benefits of training on field days offered by the project, the opportunity to disseminate the technical and practical knowledge of the innovative producers. Innovations associated with the programme included the technical assistance model, financial rewards for field technicians and specific varieties of species including genetically improved varieties of cupuaçu and açaí. Farmers also mentioned organic fertilisation, the use of legumes to recover degraded areas, techniques for germinating seeds of forest species, the use of bees for pollination of fruit species and the dissemination of agroforestry systems.

Challenges related to delays in the arrival of materials (seedlings) and money; the fact that knowledge about the local context should have been given more value, as should have the views of local beneficiaries. Improved communication could have avoided delays in the schedule. Riparian areas should have been considered further for conservation and restoration.

THE JUVENTUDE E COOPERATIVISMO PROGRAMME (2011-2014)

The project was implemented between the years 2011 and 2014 in seven municipalities in Southern Pará, including Marabá, Parauapebas and Nova Ipixuna. It was implemented in cooperation with a broad network of public institutions, non-governmental organizations and grassroots family-based organizations.

The specific aims of the Juventude e Cooperativismo were to: i) implement fruticulture modules with native species of the region; ii) train young farmers in cooperativism and associativism and to integrate them into municipal cooperatives; iii) recover degraded areas; iv) expand the cooperatives’ marketing capacity. The target group for the project was young family farmers of the region.
Positive results were recorded with all respondents highlighting improved food security. Some farmers increased their revenue by 50%, while others had no income at all prior to participating in the programme and managed to generate an income thanks to the system. Most interviewees mentioned that they noticed changes in the amount of tree cover in the property, even if the areas were small and fragmented. Nonetheless, once again a visual inspection of high-resolution satellite images for a sample settlement indicated a decrease of 50% of primary vegetation from 2012 to 2018. Farmers reported an improvement in ecosystems, with the return of water springs and animals such as birds and monkeys, as well as improvements in soils and local microclimate.

Challenges related to the short-term nature of the project and discontinuation of funding. The lack of irrigation within the scope of the project was another problem identified by the farmers. For the manager, the economic return time of fruticulture when compared to soybeans was one of the bottlenecks for farmers. Additional challenges related to the profile of participating farmers, the selection of profitable species, irrigation, on site plant nurseries, increasing funding and project duration, increasing tree species

RESTORATION PROJECTS BY THE MINING COMPANY VALE

The multinational mining company, VALE S.A., has several mining projects operating in the region since the 1970s. It is responsible for almost 70% of the mineral extraction in the state of Pará, extracting iron, copper, manganese, nickel and gold.

VALE is legally obliged to restore after exploitation. It follows a diversity of reforestation strategies, implementing high diversity ecological restoration and exclusively using native species, as required by its environmental compensation agreement. There are three mechanisms through which VALE engages in restoration: 1. Through a third party (e.g. recently through the company Florestas Engenharia they restored 187 ha in the Marabá Region, with an area of around 30 to 50 ha planted annually), 2. With communities, and 3. Through its own staff (with for e.g. approximately 150 ha were restored in the 2016-2018 period).

COMMONALITIES, ACHIEVEMENTS AND LIMITATIONS ACROSS ALL PROJECTS

All the projects reviewed focused on agroforestry mainly for improving livelihoods of smallholders and all built on each other. They all achieved socioeconomic benefits, including improved food security and incomes. Diversification of production through agroforestry increased resilience and reduced the reliance on cattle ranching alone. The projects also appeared to increase tree cover in the rural properties, even though the area of forest is still very small and fragmented throughout the landscape and satellite images from sample sites seemed to show an increase in deforestation. In many cases, improvements were reported concerning habitat quality at local scale, improved micro climate, protecting water springs and improving soils, and the recovery of biodiversity.

The projects still have a limited spatial scale and the engagement of farmers has proven hard, resulting in a high rate of abandonment. Projects were deployed over very short
periods (3-4 years) and environmental objectives were considered secondary. Of the three main projects evaluated here, only PROSAF is on the way to being consolidated as a state policy.

OVERARCHING LESSONS

1. Policies and incentives are needed to encourage an increase in tree cover and tree diversity. Increases in tree diversity in the landscape are still very limited compared to their potential. There is a need to develop mechanisms to increase tree diversity to meet the twin goals of FLR.

2. The technical assistance model needs to be reviewed. Farmers need to be more independent in their ability to engage in FLR activities.

3. Fire prevention needs to be part of the FLR model in Marabá. It is absolutely necessary to include fire prevention in the reforestation programmes. Wildfires are a huge issue and easily destroy restoration projects, causing frustration or resistance to engage in programmes.

4. FLR pathways need to take droughts into account. There is a need to plan alternatives to deal with water shortages.

5. Conflicting expectations can hamper FLR progress. Farmers may join FLR projects with the aim to receive general support and technical assistance, while donors and project leaders may have different objectives and expectations.

6. FLR and restoration more generally, require a different timeframe to that proposed by most projects. Long term programmes are necessary to achieve the ambitious goals of FLR.

7. Spatial scales in FLR create significant challenges. The area covered by the projects in Marabá is very extensive and yet very few technicians and vehicles were deployed.

8. To limit abandonment rates, actions are necessary to motivate farmers to engage in FLR. Such actions need to be factored into projects right from the start so as not to lose their initial interest and enthusiasm.
PART I - Landscape Description

1. INTRODUCTION

The study landscape, (hereafter “Marabá Region”) corresponds to an area of 2.36 million hectares in Brazil’s Southeastern Amazonian state of Pará. It encompasses three municipalities: Marabá, Nova Ipixuna and Parauapebas (Figure 1). The estimated total population in this region is 494,462, distributed mainly in Marabá (55%) and Parauapebas (41%), with a small proportion in Nova Ipixuna (4%) (IBGE, 2019a).

Marabá was an important extractive centre during the 19th century, where minerals (mainly diamonds), caucho (Castilla ullei) and fruits of the Brazil nut tree (Bertholetia excelsa) were extracted (Neves & Schmitz, 2018). The region became the largest exporter of Brazil nuts during the first half of the 19th century. In the 20th century, the extraction areas (Castanhais) were transformed into large farmlands (latifundios) owned by oligarchic families, the forests were heavily logged and progressively converted to pastures after government incentives, culminating in the current landscape composition (Neves & Schmitz 2018). From the late 1970s onwards, part of these latifundios were claimed during the agrarian reform when settlements of farming families were established and became an important social component of the landscape (Assis, 2009) (Figure 1).

Today, the region is a mosaic of agrarian reform settlements and large cattle ranching farms, with a large block of protected areas in its western portion. T

There are eight conservation units for a total of more than 1.2 million ha:

- two strictly protected areas, i.e. areas where extraction of resources is prohibited and physical access is restricted (Biological Reserve of Tapirapé and National Park of Ferruginous Field);

- four sustainable use areas, i.e. areas with controlled resource extraction, (National Forest of Carajás, National Forest of Itacaunias, National Forest of Tapirapé-Aquiri and Environmental Protection Area of Igarapé-Gelado).

- two Indigenous Lands (Tuwa Apekuokawera e Xikrin of River Catete) (see Figure 1).
1.1. Biophysical Aspects

The vegetation in the Marabá Region is diverse, composed of several vegetation types, dominated by Terra Firme forests. In the municipalities of Marabá and Nova Ipixuna, sub-montane dense forest is predominant in areas of flat relief. In Parauapebas, vegetation typologies vary according to the variation in soil and relief, causing the occurrence of several sub-types, which include dense and open forests. In the Serra de Carajás, in Parauapebas, there are also some patches of meadows (Campos) and savannah (Cerrado), with the predominance of xerophytic vegetation. The region was also originally covered by extensive areas of riparian vegetation along the Tocantins, Itacaiúnas and other smaller rivers (IDESP, 2014).

The climate in this region is characterized by a transition from Aw to Am according to the classification of Köppen (Alvares et al., 2013), with a rainy period from December to April and a drier period from July to October, the cumulative annual precipitation is approximately 1900 mm for Marabá and for the other municipalities it is 1700 mm to 1800 mm (Fick and Hijmans, 2017). The regional topography presents a wide variation of altitude (~100–900 m), with the maximum altitudes found in the Carajás hills, in Parauapebas, varying between 800–900 m. In the Marabá Region, Red-Yellow Podzolic soils (clay texture) and the Dystrophic Red-Yellow Latosol (medium and clay texture) predominate, although
the rich ‘Terra Roxa’ (clay texture) is also found in the region (FAPESPA 2016, 2017 and 2017a).

### 1.2. Socio-political Description

Each of the three municipalities in the landscape has its own autonomous local government, with its own revenues and laws. However, these municipal-level governments form part of a hierarchy and are answerable to the state and the federal governments and also receive funds from these and other agencies.

Decentralization policies (i.e. moving decision making away from the federal level to states and municipalities) are increasingly common in Brazil, as exemplified by the policies to combat deforestation initiated in 2004 that created a hybrid governance arrangement between municipalities and the federal government. For example, the state programme “Green Municipality” in Pará which was launched in 2011, aimed to support measures to reduce deforestation and forest degradation, among other pro-sustainability actions, through pacts among different stakeholders in the municipality.

The Green Municipality programme emerged in response to an overarching federal policy launched in 2004, the “Action Plan for the Prevention and Control of Deforestation in the Brazilian Amazon” (PPCDAm) which has decentralized environmental governance to the level of municipalities. PPCDAm put forward the Green Arc Operation around 2009, aiming to provide sustainable alternatives for Amazonian populations, and the Environmental Registry of properties (CAR). This operation was novel as it focused on measures to foster conservation actions, rather than the typical command-and-control approach that was adopted in the heavily criticized previous Arc of Fire Operation. In the Green Arc, there were important actions that had a pioneering role for restoration activities, such as capacity building and the construction of community-based nurseries.

**BOX 1. Legal instruments to forest protection and restoration in Brazil**

Forest protection across Brazil is ruled by the national forest legislation (Federal Law 12.651). This law has a central role in regulating land-use and management on private properties across Brazil. Farmers must set aside 80% of every private property in the Amazon (known as Legal Reserves), as well as environmentally sensitive areas such as riparian zones and hilltops (APPs — Areas of Permanent Preservation). If the property has a forest deficit, i.e. it is covered by less forest area than legally required, compliance is achieved through reforestation or through compensation or offsetting by renting land elsewhere. The 80% limit is reduced to 50% if the property is located in zones of consolidated use, i.e. areas with long-term agricultural production by the Ecological Economic Zoning. As an example, if a
property in this special zone has 60% of forest, it is compliant to the law, but no further deforestation is allowed. Generally-speaking, the level of compliance has been extremely low, particularly in the Amazon region (Soares-Filho et al., 2014). The forest legislation was thoroughly revised in 2012 when many rules were changed; for example, incompliant smallholders in small properties were exempted from the obligation of restoration and areas of agroforestry could be counted towards their Legal Reserve requirement. The revised legislation established the general rules for farmers with vegetation deficits to comply through the creation of an internet-based system for environment registry of properties (CAR) and determining mandatory state plans for environmental regularization (PRA) for those farmers with a forest deficit. Following this, Pará state launched its restoration plan early in 2015 (Decree 1379/2015). Reforestation must be accomplished within 20 years, given that at least 10% of the area is restored every two years. A national plan for restoration and the national legislation were both launched in 2017. Since the forest legislation revision and subsequent acts, an increasing awareness and momentum for forest restoration began to take place in the country, including in the Amazon region.

The economy in the three municipalities is based on the extraction of natural resources (e.g. mining), as well as public services and the farming industry, with an emphasis on cattle ranching. The Gross Domestic Product (GDP) in the region for 2015 was 4.8 billion dollars, which was mainly from Parauapebas (60%), due to the mining activities of the Vale Company. The Human Development Index (HDI) is 0.715 for Parauapebas, 0.668 for Marabá and 0.581 for Nova Ipixuna; while the average HDI for Pará state is of 0.646 (FAPESPA, 2019).

Currently, the studied region has 91 settlement projects, which occupy a total area of 503,299 ha and are home to 9,247 farmer families (INCRA, 2019). These settlements were a result of strong battles fought by social movements and grassroots organizations with a long history in the region (Assis, 2009). Family farming prevails in the region, occupying 85% of the rural establishments (i.e. number of farms), with most of these being in agrarian reform settlements. Despite representing the vast majority of farms, family farms account for only 26% of the total area of agricultural land in this region, while 74% is owned by medium and large farms, illustrating the concentration of land (i.e. few people owning most of the land) still present in the region (IBGE, 2006).

Land reform settlements are created through a state-led redistribution programme aiming at granting land rights to smallholders by distributing available public lands to smallholders or redistributing large land-holdings that have been occupied by smallholders through land invasions (Pacheco, 2009). The settlers receive financial support to settle on the land, including housing, basic infrastructure (water and electricity, roads), credit access to agriculture production and technical assistance. Once the settlement is consolidated, the farmers receive their land titles and the settlement is finally considered autonomous and independent from INCRA- which might occur decades later (Alencar et al., 2016). Currently, there are 12 types of settlements that vary in terms of their purposes, settler profiles and land use. The Settlement Projects (PA, in Portuguese) are the most common ones which are
focused on agricultural production through land redistribution. From the 1990s new forms of settlements emerged prioritizing forest conservation and traditional populations, such as Agroextractive Settlement Projects (PAE) and Sustainable Development Projects (PDS) (Alencar et al. 2016).

The Marabá Region has a long history of social and environmental conflicts, marked by a high number of murders resulting from land conflicts in Brazil, many associated with the occupation of land claimed for the establishment of settlements (Hébette & Moreira 1996). Some cases have received much international attention: the largest mass killing in Brazilian history, named the Eldorado dos Carajás’s massacre¹, which was the mass killing by the police of nineteen landless farmers who were in a demonstration of the MST (the Landless Rural Workers’ Movement in Brazil) in 1996. Another case from the region that received great attention was the murder, in 2011, of a couple of agroextractive farmers living in the Praialta Piranheiras Agroextractive Settlement Project², located in Nova Ipixuna municipality. The couple had been fighting against deforestation, land occupation by illegal loggers and the expulsion of smallholder farmers.

In terms of infrastructure in the Marabá region, the federal roads BR 230/222 (Transamazon highway) and BR 155, along with the Carajás railroad provide the region with good overground transport. The Itacaiunas and the Tocantins rivers pass through the region and are used as transportation to the Vila do Conde Port, in Barcarena, which is the main export port of Pará state. Another essential component of the regional infrastructure is the Hydroelectric Dam of Tucuruí, the fourth largest hydroelectric power plant in Brazil, which supplies energy for 187,585 consumer units in the region distributed through a wide network in rural and urban areas. Production from this plant has intensified in recent years with the implementation of the “Electricity for All” Programme (“Programa Luz para Todos”, in Portuguese) (FAPESPA, 2019).

Regarding education, the region is home to the Federal University of South and Southeast of the State of Pará (UNIFESSPA), founded in 2013, and located in Marabá municipality. Together, the three municipalities have 50 state high schools, and 297 municipal government elementary schools. Of these schools, two have special education for people in rural areas: the “School for Agricultural Families” (from Portuguese “Escola Família Agrícola” — EFA) and the Federal Institute of Education. Both are located in the rural zone and apply alternance pedagogical methods to teach young children from farming families.

2. LAND COVER/USE AND LAND COVER/USE CHANGE

2.1. Occupation History

The recent occupation history of southeastern Pará is linked to the opening of highways in the late 1960s and early 1970s, and by the implementation of “major projects of national

¹ https://www.theguardian.com/environment/2013/apr/05/amazon-activist-murder-trial
interest”, such as the Great Carajás Mining Programme and the hydroelectric dam of Tucurui. These large projects attracted a migrant population, particularly from the states of northeastern Brazil; this colonization process attracted a large number of migrant smallholders, who live today in the Marabá Region (Hébette & Moreira, 1996). The Serra Pelada mining site, considered the world’s largest gold mine, also contributed significantly to the amount of migration to this area.

Currently, the Marabá Region is in the most deforested area of the Amazon, located in the so-called arc-of-deforestation. The remaining areas of natural forest are mostly concentrated in the protected areas, approximately 284,693 ha in Indigenous Lands and 926,114 ha in conservation units (CUs), totalling 1,210,808 ha (part of the CUs are outside the region though; Figure 1).

The deforestation dynamics of the region are closely related to its colonization and population dynamics resulting from large-scale projects in the Amazon. For example, almost ten thousand families were settled in the region by the federal government as part of several colonization projects. These families employed traditional slash-and-burn agricultural practices to produce crops or to establish pastures for cattle farming. Fifty years after the colonization period, a total of 904,201 ha (MAPBIOMAS, 2018) of forest have been deforested and converted mainly into low productive pastures, of which, a large proportion has been abandoned after just a few years of use, resulting in regenerating forests (i.e. secondary forests) in these areas.

2.2. Land Use and Land Cover (LULC)

LULC analysis through MAPBIOMAS indicates the Marabá Region has lost around 35.4% (773,132 ha) of its original forest cover across the last three decades (Figure 2). Most of the primary forest in the region was converted into pastures (97.91% of the deforested area), making this land use the main driver of deforestation in the region.
Data from the Terraclass Project (Almeida et al., 2016) show that pasture area in the region increased 112,224 ha in the 2004–2014 period (Table 1). Secondary forests (i.e. naturally regenerating forest from clear-cut areas) increased 71,849 ha in the same period (Table 1). Other land-uses represent much smaller areas in the Marabá Region: the mosaic of uses which includes roças (6,991 ha), plantation forestry (5,749 ha) and mining activities (4,002 ha). Therefore, pasture is by far the predominant land-use in the region. The municipality of Nova Ipixuna had more pasture than forested area by 2014 (Table 1), and Marabá municipality, if current trends persist, will soon also have more pasture than forest. In contrast, Parauapebas has more than 80% of its area still covered by forests, due to the presence of protected areas in the municipality, including the Carajás National Forest. This protected area (IUCN category VI) covers 411,948 ha, in which the mining company Vale extracts minerals. This Brazilian multinational company exploits mainly iron and nickel and the region is the largest producer of both minerals. In return, the company is responsible for supporting the protection of the conservation unit, which includes financial support for developing regional socioenvironmental projects under the supervision of the regional centre of the Chico Mendes Institute for Biodiversity Conservation (ICMBio).

Table 1 — LULC area (in ha) for the three analyzed municipalities for the Marabá Region from 2004 to 2014. Data are from the Terraclass Project.
### 2.3. Causes of Degradation

Around 1 million ha of forest in the Marabá Region have been converted, mainly, into pastures and secondary forests (Table 1). The transformation of this landscape is a result of the regional production systems, in which the forests, whether primary or secondary, are felled and burned in preparation for establishing pastures and planting crops. The conversion of forests causes high rates of landscape fragmentation, with forests being restricted to small fragments across the landscape. Primary forests have been restricted to protected areas in the western part of the region (Figure 2). The extant forests have been subjected to intensive logging since the 1980s, resulting in increasing susceptibility of forests to fires and further deforestation (Hébette, 2004). Therefore, even the small fragments that persist today have been highly degraded by fires, logging and hunting (Barlow et al., 2016).

#### 2.3.1. Agricultural and Forestry Production

Cattle ranching plays the most prominent socioeconomic role in the region, while other small animals (i.e. pigs, sheep, goats, poultry and fish) also play a role, mainly in small farms. The municipality of Marabá is the Brazilian municipality with the fifth highest number of cattle, the majority of which are raised on large farms, with a minority being raised on family farms. Family farms produce most of the staple foods (e.g. manioc, rice, corn, beans, fruit and vegetables) consumed in the region, as well as perennial crops and extractive products (e.g. cocoa, Pará’s nut, rubber, açaí and vegetable oils) (IBGE, 2019).

According to IBGE (2019b, 2019c, 2019d), The following trends in agricultural production were observed between 2009 and 2017 in the Marabá Region:

- **Temporary crops:** A significant increase in production (Figure 3A), with an increase in the main temporary crops (41%), such as corn, manioc and watermelon.
- **Perennial crops:** A slight increase in production (12%), e.g. passion fruit, papaya and açaí (Figure 3A).
- **Cattle:** An increase in the total number of cattle, reaching 1.26 million in 2017, and the expansion of the average herd sizes (Figure 3B). Regional milk production also increased by 35% (Figure 3C).
d) Other animals: Fish production increased by 291% during the period between 2013 and 2017. Other animals such as pigs, goats, sheep, chickens and bees are all raised in the region, but the production has much less prominence than cattle.

e) Timber extraction: There was a four-fold decrease in total timber extraction between 2009 and 2017 (Figure 3D), reflecting the depletion of sources of timber due to the decrease in primary forest areas and forest degradation.

f) Extraction of non-timber forest products: There was a substantial reduction in the regional production, mainly driven by a decline of Brazil nut production (Figure 3E). The 2017 IBGE data show non-timber forest products (NTFPs) have become rather negligible in the region. It is important to note, though, that the IBGE does not report several important NTFPs, including plant products such as cumaru (*Dipteryx odorata*), andiroba (*Carapa guianensis*) and copaiba (*Copaifera* sp), which are commonly found in the region's free trade fairs and markets. This decline may be partially related to the fact that the products are not officially declared, but also due to the lack of incentives, markets and, finally, the depletion of forest areas that were intensely deforested in the region.

![Figure 3](image)

**Figure 3** - Main agricultural and forestry production in the Marabá Region, with aggregated production in tonnes of temporary and perennial crops (A); cattle (number of heads) in the region (B); Milk production in thousands of litres (C); Timber extraction in m³ (D); and Brazilian nut production in t (E).

### 3. DESIRED FUTURE LANDSCAPES

As stated before, the Marabá region has lost around 1 million ha of its original forest cover, with the vast majority of the area converted to pastures (818,385 ha) and a considerable amount of productive areas subsequently abandoned and turning into secondary forests.
(217,987 ha; Almeida et al. (2016)). Part of the area counted as secondary forests are family farming plots in the fallow stage of the slash-and-burn agricultural system (roças).

At present, the vast proportion of pastures are degraded with very low productivity (<1 animal/ha), following the pattern seen in many parts of Brazil where productivity reaches only 32–34% of its potential (Strassburg et al., 2014). Recovery of the productive capacity of pastures is observed in a small proportion of areas across large and medium-sized farms. Although this is still confined to small areas in the region, it might increase in the future, considering the primary forest decline and legal restriction concerning further conversion of forest areas (Box 1).

The agricultural production in the region for most products has stabilized in recent years, despite an increase in 2017 relative to 2009 (Figure 3). Milk and farmed fish production are some of the exceptions. On the other hand, the forestry sector, including timber and NTFP production, has decreased. These data reflect the consolidated agricultural frontier, with decreasing area of primary forest.

The revision of the national forest legislation in 2012, showed a large deficit of forest (i.e. smaller area than required in the forest legislation) on private properties across the country, including across the Marabá Region (Soares-Filho et al., 2012). This political context has led to some initial steps towards forest restoration in the region and elsewhere (Box 1).

Some restoration projects have been developed in the region in the last decade, although not necessarily responding to demands for environmental compliance. They represent an increasing — yet modest — interest of stakeholders in the Marabá Region to reduce the dominance of pastures in family farming in favour of more diversified agroforestry systems. Local technicians and managers often recognize how difficult it is to change cultural patterns that are deeply ingrained in farmers’ minds3. However, there have been institutional incentives in the region towards agroforestry and diversification, including the harvesting of fruits and honey, as well as dairy farming and pisciculture. Incentives for agroforestry date back to the early 1980s, encouraged by alliances between grassroots movements, associations and the university in the recently occupied agrarian reform settlements. These initiatives have gained more momentum in recent years as some opportunities for financial support emerge.

Within this context, we present here an assessment of three FLR projects developed in the Marabá Region: (1) PROSAF developed by the Pará State Institute for Biodiversity (2013–present); (2) Rural Sustentável (Sustainable Countryside, free English translation) established by the Brazilian government through its Ministry of Agriculture and Livestock, in partnership with the Inter-American Development Bank (IDB) and funded by the British Government (2015–2018); (3) Juventude e Cooperativismo (Youth and Cooperativism, in English) developed by the federation of local fruit cooperatives FECAT (2006–2008) funded by the Development & Citizenship programme of the federal oil company Petrobras. Our analyses were focused on restoration projects implemented by family farmers living in agrarian reform settlements in the studied region (Table 2)

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### Table 2 - List and details of visited settlement projects.

<table>
<thead>
<tr>
<th>Name of the Settlement Project</th>
<th>Year of Creation</th>
<th>Nº of Families Living in the Settlement Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA 26 de março</td>
<td>2008</td>
<td>206</td>
</tr>
<tr>
<td>PA Piquiá</td>
<td>2002</td>
<td>70</td>
</tr>
<tr>
<td>PA Pimenteira</td>
<td>1998</td>
<td>135</td>
</tr>
<tr>
<td>PAE Praialta Piranheira</td>
<td>1997</td>
<td>330</td>
</tr>
<tr>
<td>PA Itacaiunas</td>
<td>1996</td>
<td>119</td>
</tr>
<tr>
<td>PA Murajuba</td>
<td>1999</td>
<td>87</td>
</tr>
<tr>
<td>PA Escada Alta</td>
<td>1998</td>
<td>96</td>
</tr>
<tr>
<td>PA Carajas/Tamboril</td>
<td>1988</td>
<td>234</td>
</tr>
</tbody>
</table>
PART II – Forest Landscape Restoration Initiatives

I. THE PROSAF PROGRAMME (2013-current)

1. Introduction

The PROSAF is a state-run programme, implemented by the Institute of Forest Development and Biodiversity of the State of Pará (Ideflor-Bio) since 2013. This initiative was developed to perform forest restoration on smallholders’ properties, mainly in agrarian reform settlements across Pará State. This project stemmed from previous pilot projects that were developed by Ideflor-Bio during 2011–2013.

Around 32 municipalities in Pará (out of 143) have received funding for forest restoration from the PROSAF programme, totalling an area of 1500 ha of agroforestry implemented across the state in 2017, according to the last publicly report available. The current report refers to three of these municipalities in a zone where Ideflor-Bio aggregates 12 municipalities, which is named the “Carajás sub-region”. According to official Ideflor-Bio documents describing the programme, the selection of municipalities was based on the presence of ongoing and past conservation and sustainability programmes — such as the national Green-Arc Programme (Programa Arco-Verde, in Portuguese) and the Green municipality state programme (Programas Municípios Verdes, in Portuguese) — as well as municipalities which have signed the zero deforestation agreement and those with lower Human Development Index scores.

The PROSAF programme has chosen agroforestry (AF) as a restoration strategy to address multiple objectives – social, economic and environmental (Figure 4a,b). Diversification of farming systems and increases in household incomes are among the main objectives, with additional objectives of supporting pathways to a forest-based economy and environmental compliance. In the initial stages of the programme, there was a strong focus on implementing collectively-run plant nurseries to be run by local farming communities to supply the necessary seedlings of native and exotic species for reforestation (Figure 4c). This focus seems to be decreasing over time, at least in the Marabá Region, where there is an increasing tendency to acquire seedlings from the public nursery in the city of Marabá (Figure 4d). The public nursery has increased its production from 200,000 seedlings to around 1 million seedlings a year resulting from a partnership between the municipal government and the mining company Vale as part of its socioenvironmental commitments.

The programme consists of replacing active or abandoned slash-and-burn agricultural plots (roças) and degraded pastures with agroforestry plots. To this end, the AFs are implemented using diverse native and/or exotic species of fruit-bearing or forestry trees together with staple food crops, such as manioc, maize and beans. The selection of fruit-bearing tree species is mainly based on their commercial value and potential for increasing household income, as well as feasibility to producing seedlings. Some efforts are reported in the official PROSAF documents to consider the viability of local markets and the aspirations of the farming communities.

PROSAF project documents published by Ideflor-Bio show the programme has multiple objectives — encompassing environmental, social and economic dimensions — and aims to: 1) contribute to the recovery of degraded areas on smallholders’ properties; 2) increase tree planting in commercial agroforestry systems; 3) promote forest restoration in private protected areas, as is mandatory in the national forest legislation — locally know as Legal Reserves (LRs) and Permanent Preservation Areas (APP), including water springs; 3) help capacity building of technicians and smallholders in techniques for seedling production and establishment of agroforestry systems; 4) expand the supply of seeds and seedlings of fruticulture plants and native forest species with good genetic and physiological qualities; 5) contribute to the improvement and expansion of technical assistance services in agroforestry and silvicultural practices, primarily of native species; 6) disseminate knowledge about native species, as well as plant arrangements of local and socioeconomic importance.
Many institutions, such as the municipal government, the Secretariat of Agriculture, the Environment Secretariat, universities, farmers’ syndicates and associations, are involved in the initiative, to varying extents depending on the municipality. For example, in 2017, an area of 600 hectares of agroforestry was established in the Carajás sub-region (Ideflor-Bio Annual Report\(^5\)) and 34 ha in the Marabá region (pers. comm.; Figure 5).

![Figure 5 - Distribution of restoration projects implemented by the PROSAF Programme across the landscape in the Marabá region.](https://ideflorbio.pa.gov.br/wp-content/uploads/2015/07/REL-GEST%C3%83O-2017-IDEFLOR-vers%C3%A3o-final.pdf)

While the PROSAF programme has been developed with only a handful of farmers in each target settlement and 1-ha of agroforestry per smallholder, the overarching objective seems to be encouraging farmers within the programme, their neighbours and others in the community to become involved in a transition towards more diversified and productive systems. Considering that it covers a large portion of Pará state, this programme is very likely the largest public restoration initiative in the region. Therefore, PROSAF relates well to the forest landscape restoration approach, as it aims to encourage multifunctional landscapes with a strong focus on improving livelihoods of Amazonian smallholders. Restoring ecological integrity seems to be more of a co-benefit with a secondary role in comparison with the socioeconomic objectives.

2. Implementation

2.1. A brief description of the sample used to understand the project

To analyse the PROSAF programme, 11 interviews were conducted as part of the FLR snapshot, which were combined with the existing knowledge by the researchers involved. The regional project manager was first interviewed, followed by ten farmers located in three different agrarian reform settlements in Marabá: 26 de Março, Escada Alta and the Agroextractive Project (PAE) Praialta-Piranheira (Figure 5). More interviews were conducted in the 26 de Março settlement due to its larger size and easier access. Farmers were, on average, 55.4 years old and originated mainly from different states of northeastern Brazil (n=8), with only two born in the Marabá region. Most farmers were men (n=8) and had mixed levels of formal education: three were illiterate, five had only elementary school education and two were graduated (both women, educators/instructors). The average property size was 42 hectares (SD=11.6) and the average time living in the current property was 12.7 years (SD=6.05). The average time living in the property is mostly influenced by the settlement 26 de Março that was created only in 2008.

2.2. Project stakeholders

The two main stakeholders of PROSAF are Ideflor-Bio, as the leading institution that created the programme and is responsible for implementing it, and the smallholders, who are the direct beneficiaries and who, in the vast majority of cases, are residents of agrarian reform settlements.

Ideflor-Bio is the Institute for Forest Development and Biodiversity of the State of Pará, which was created in 2007 (Pará state legislation 6.963/2007), with the purpose of managing public forests (for timber production) and Conservation Units, as well as to implement forest restoration. In its mandate, there is also the design of policies for the production and development of the forestry sector, the implementation of conservation policies, conservation and sustainable use of biodiversity, terrestrial and aquatic fauna and flora in the State of Pará. Since 2011, Ideflor-Bio has selected agroforestry systems as a tool for promoting the forestry sector in the region.

Many other stakeholders are involved in the PROSAF initiative with varying levels of engagement depending on each municipality’s unique context. Among the main stakeholders are the municipal governments through their agricultural and/or environment secretariats, the technical assistance and rural extension agency of the State of Pará (Emater), and the syndicates and local associations of smallholders. The municipal governments and Emater are key partners as they often suggest possible areas to participate in the programme, based on local demands and interest. Once a potential community is identified, these institutions work together with the farmers’ syndicates and associations to promote meetings within the selected communities and identify farmers who would be willing to engage in the project. Normally, up to 30 farmers are selected to be part of the
programme in each community. The farmers’ associations are key players, acting as intermediaries between Ideflor-Bio and individual farmers.

The municipal government plays a critical role in the programme as the main provider of seedlings to the communities. Although the production of its own seedlings was at the heart of the programme, with the establishment of small, collectively-run nurseries within the participating farming communities, recently most of the seedlings have come from a large public nursery led by the municipal government in the centre of the city of Marabá. This has been attributed to multiple implementation difficulties, such as lack of vehicles to transport seedlings and a lack of labour as the farmers have to reconcile many different activities already.

Additional support can be given by municipal governments, such as helping with the establishment of nurseries, supplying tractors for land preparation, offering transportation for the planting materials and occasionally helping with systems for irrigation. Research institutions such as the Brazilian Agricultural Research Agency - Embrapa - provide technical support by advising technicians, donating special seedlings, including genetically improved varieties of key plant species used in the region and species of forest trees.

A diversity of other institutions is also involved in capacity building activities that are continually developed throughout the programme. For example, the regional centre of Embrapa, local universities (Unifesspa — Federal University of South-eastern Pará) and the Federal Institute of Pará offer professional and technical courses. The municipality of Tomé-Açu, which is 420 km from Marabá, is a benchmark site for agroforestry systems in the region and farmers and institutions from this municipality are key players in the capacity building process in the wider PROSAF programme receiving groups for field days and discussions.

### 2.3. Technical design of restoration interventions

The PROSAF programme is focused on commercial agroforestry as a single strategy to address forest restoration, based on its capacity for diversifying and improving quantity and quality of food production, and especially its socioeconomic feasibility (PROSAF document). PROSAF adopts the following definition of agroforestry systems “land-use systems in which wood perennial plants are managed in association with herbs, shrubs, trees and agricultural crops in the same plot, in a spatial and temporal arrangement with high species diversity and interactions between the different components”.

Planting seedlings directly in open areas — abandoned roças or pastures, is the sole strategy used for forest restoration in PROSAF, although management of natural regeneration might occur occasionally. One farmer reported that, in addition to direct planting, the management of naturally regenerated specimens is practiced, especially resproutings of *Shizolobium amazonicum* (Paricá) and other species of interest (e.g. *Lecythis pisonis* “sapucaia”, *Spondias* sp. “cajá” or “taperebá”, *Handroanthus* sp. “ipê” and *Copaifera* sp. “copaiba”). It is clear though that this management strategy was adopted due to his personal interest and was not being incentivized by the programme.

Land preparation techniques were diverse and apparently varied with the context of each farmer, such as distance from the city and availability of his/her own financial resources to
implement additional techniques. Mechanization was the dominant form of land preparation, being applied by seven of ten farmers who used tractors for harrowing their land. Slash-and-burn was adopted by three of the interviewed farmers. Herbicides were used to eliminate the grasses from the previous pasture by two farmers. Soil analysis to guide fertilisation before planting was reported by only three of the ten farmers.

Species selection in the agroforestry plots was highly variable in terms of composition (including wood, herbaceous, agricultural and forest trees species). However, in general, the agroforestry systems were composed of four components: 1) varied agricultural short-lived staple crops (e.g. manioc, maize, beans and occasionally pumpkins, rice and many others); 2) semi-perennial fruit crops (e.g. banana and passion-fruit); 3) perennial fruit plants of high commercial value, such as the palm *Euterpe oleracea* “açai” (currently the crop with the highest market demand), the tree *Theobroma grandiflorum* “cupuaçu”, occasionally *T. cacao* “cocoa” and the palm “*Bactris gasipaes*” pupunha; and finally 4) forestry tree species of which only a few are easily commercialized, but some are particularly profitable, such as the Brazil-nut - a flagship species in the region - and *Spondias mombin* (commonly known as *taperebá*) which is used for producing fruit pulp. According to one of the interviewed farmers, he was able to earn R$900.00 (~220 US dollars) from a single Brazil nut tree during the previous harvesting season, selling each fruit for R$1.00 (~0.25 US dollars). The diversity of forest trees planted in the agroforestry plots were restricted to a few species: Brazil nut (*Bertholletia excelsa*), Brazilian or African mahogany (*Swiettenia* sp.), andiroba (*Carapa guianensis*), jatobá (*Hymenea* sp.), ipê (*Tabebuia* sp.), taperebá (*Spondias* sp.), cumaru (*Dipteryx odorata*). Moreover, there were only around a dozen individuals per hectare of agroforestry plot, in comparison to hundreds of perennial fruit trees of commercial value. While the semi-perennial species are planted between 3 and 6 metres apart, forest tree species are separated by 10 to 40 metres.

2.4. Enabling activities

The PROSAF programme was created in a national political context that strongly increased the demand for forest restoration in the country, particularly the revision in the national native vegetation legislation and national and state policies to combat deforestation - the Green Municipality programme and the Action Plan for the Prevention and Control of Deforestation in the Brazilian Amazon” (PPCDAm) (Box 1).

In the context of PROSAF, it is important to note the revised forest legislation has opened new opportunities for smallholders as it became legally acceptable to use agroforestry systems to comply with the law regarding restoring deforested areas. As stated in the PROSAF concept note, one of its key purposes is “to promote forest restoration in Legal Reserves and Permanent Preservation Areas”.

As mentioned previously, the large public nursery in the centre of the city of Marabá, which is operated by the municipal agricultural secretariat, offers fundamental support to PROSAF, and many other regional programmes/initiatives. This nursery was renovated and expanded in 2015. Its original capacity for producing around 200,000 seedlings a year was expanded to around 1 million seedlings a year. Such an expansion was possible due to an agreement signed between the mining company Vale and the municipal government, through the mediation of the Chico Mendes Institute for Biodiversity Conservation (ICMBio). ICMBio is
responsible for managing the Conservation Units in the region and establishes actions related to environmental compensation by Vale.

Finally, it is important to note that developing a programme with the spatial coverage of PROSAF is only possible given the existence of an institution such as Ideflor-Bio. The institute has technical, administrative and financial autonomy, including its own fund Fundeflor with financial resources provided by the state logging concessions and compensation by companies with environmental damaging activities, among others. Despite all of these positive aspects, however, the institutional infrastructure of Ideflor-Bio imposes limitations. According to the manager interviewed, the programme in the Carajás sub-region has only three technicians (one forest engineer and two agronomists) and only three vehicles for the 12 municipalities. The institutional budget is extremely limited: according to the 2017 annual institutional report, the budget of the programme in the whole of Pará state was approximately R$500,000 Brazilian Reals (~US$ 130,000).

3. Monitoring

PROSAF does not have a formal plan or specific financial resources for monitoring the beneficiaries of the programme. According to the farmers and manager interviewed, visits to the agroforestry plots are done by technicians, either from Ideflor-Bio or Emater, without a specific schedule, because of their limited infrastructure and resources. One of the farmers indicated he is often contacted prior to any visit so he can indicate his availability. During the visits, the technician collects qualitative data on the development and occasional problems faced by the farmer. The programme does not generate specific reports on the development of each area under restoration but rather aggregates simple data (e.g. planted area, number of farmers) for each sub-region, i.e. groups of municipalities that compose the annual institutional reports.

4. Outcomes/benefits

4.1. Local livelihoods improvements

The agroforestry plots implemented under PROSAF are relatively young (3–4 years), and, therefore, many of the potential benefits are yet to be realized. However, despite the short period since its implementation, six of ten farmers have already reported some financial gain from the short-lived crops. The main profit comes from the sale of bananas, with farmers reporting profits of R$1,100–2,000 (US$ 285-520) per month. Some also reported selling manioc flour, which can also generate around US$500 per month. Even the farmers who have not yet experienced an increase in profit, were very positive about the programme, describing their plans for the future production, in particular the processing of Euterpe oleracea fruits (“açaí”). Planting açaí palms has been the most promising production because of its high demand and prices.
Independent of making profits from agroforestry plots, all ten farmers reported improvements in terms of food security. Some emphasized that they had stopped buying many food stuffs from the market. The families had more access to staple foods, such as maize, manioc and beans, and increased their consumption of fresh fruits (e.g. bananas and açai) and horticulture products. Another point highlighted by one of the farmers was that the quality of their food had increased, as it had been produced without agrochemicals.

4.2. National benefits

National benefits were not identified by the interviewers. However, if this project gains scale in the region it will contribute to compliance to the national forest legislation, as well as the national policy for combating climate change through reducing forest loss and degradation.

4.3. Ecological benefits

Among the main ecological benefits perceived by the farmers is the fact that planting agroforestry systems is a more efficient use of land, as they no longer need to clear new areas of forest to establish roças or pastures. Some interviewees expressed that “Having 2.5 ha of bananas is enough to completely support the subsistence of my family”, and yet “I haven’t visited the back of my property for two years now, because it is not necessary anymore, I only work in my agroforestry plots closer to the house”; another said “the small patch of forest I have in my property will remain standing if the agroforestry works as promised”. Additionally, some of them believe that agroforestry helps somehow to conserve forests because “planting makes you not want to cut down the forest” and this gave them the sense that they were doing their bit to avoid deforestation.

Six out of the ten farmers reported an increase in tree cover in the property, although it did not increase forest cover so far. They perceive diverse improvements in habitat quality at local scale. Some cited the importance of trees in reducing air temperature, especially considering the increase in temperature and drought events in the region. One farmer reported "If it were not for the trees I am planting, I would be suffocated by this warming". Others highlighted the recovery of soils, including improvements in soil fertility, as well as an increase in water supply.

The contribution to biodiversity recovery was the most cited benefit associated with the new agroforestry sites by the farmers interviewed. They reported an increase in the presence of a variety of animals, particularly birds. A number of species are reappearing, such as howler monkeys (Alouatta sp.), deers (Cervus sp.), mutum (cf. Mitu tomentosum), jacus (Penelope sp.), and some species of dove, including the “pomba galega” reported by them as currently very rare.

Farmers also perceived the importance of the agroforestry plots to maintaining important native tree species, such as ipê (Handroanthus sp.) and copaiba (Copaifera sp.). Agroforestry has also been important to increasing the populations of two threatened tree species — Brazil nut (Bertholletia excelsa) and mahogany (Swietenia macrophylla) — which were among the most planted trees by the farmers interviewed. Farmers recognized the importance for the açaí palm Euterpe oleracea which they felt had become less common across the settlement area due to deforestation and reduction of humid areas.
In general, all people interviewed understood that the project contributes to reducing deforestation in the region. Despite all these perceived ecological benefits, though, we could not find evidence that forest cover is increasing in the region. High resolution satellite images of the PA 26 de Março, used as an example, indicated that forest cover in this settlement has drastically decreased by 70% in the 2012-2018 period (Figure 6; Table 3).

![Figure 6](image-url) - Comparison of forest cover between 2012 and 2018, based on classification of high resolution satellite images (2012: Rapideye image – 5 m; 2018: Planet image – 3 m) in the agrarian reform settlement PA 26 de Março, Marabá, Pará.

![Table 3](image-url) - Land use change estimated from high resolution satellite images classification of the 26 de março settlement project, in the Marabá municipality, Pará.

<table>
<thead>
<tr>
<th>Year/LULC</th>
<th>Primary Vegetation (Ha)</th>
<th>Secondary Vegetation (Ha)</th>
<th>Grassland (Ha)</th>
<th>Bare Soil and Others (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>4,203</td>
<td>1,612</td>
<td>2,716</td>
<td>1,727</td>
</tr>
<tr>
<td>2018</td>
<td>1,275</td>
<td>2,411</td>
<td>5,886</td>
<td>685</td>
</tr>
<tr>
<td>Variation (2018-2012)</td>
<td>-2,928</td>
<td>799</td>
<td>3,170</td>
<td>-1,042</td>
</tr>
</tbody>
</table>

5. Financing

Information regarding financing of activities could only be obtained for 2017, from a publicly-available annual report published by Ideflor-Bio. Unfortunately, the financial figures they make available are not separated by sub-region, so it is not possible to have the specific
budget for our study region, there is only a simple summary of the investment in restoration in comparison to other activities.

The financial resources for Ideflor-Bio come from its own Fundeflor Fund that collects money from concessions for timber exploitation in state forests and for environmental compensation by companies with environmental damaging activities. In 2017, the available budget was R$ 5,514,671.96 (~US dollars 1,330,000), which was spent by Ideflor on multiple activities besides forest restoration, including management of protected areas, monitoring of public forests, environmental education and support to indigenous and other traditional communities. The 2017 budget for the whole PROSAF programme was approximately R$500,000 Brazilian Reals (~ US$130,000), which was only one tenth of the institutional budget for that year. Information on spending separated by activity is not available in the report.

6. Communications

The PROSAF programme does not have a specific team or budget for communication of the initiative. However, there is an institutional communication sector in Belém, which occasionally publishes news on its own website regarding the programme. The regional coordinator reported only some interviews on the local radio. So far, the project has not been broadly disseminated in the region.

On the other hand, the programme invested much of its efforts in capacity building for agroforestry production among farmers and technicians, with inter-municipal and inter-settlement visits for exchange of information and knowledge about agricultural production and technologies. In general, farmers could cite a number of capacity building initiatives in which they had participated, which were seen as very positive. During the events, some compilation of informative material by Ideflor-Bio were made using different sources (e.g. Embrapa), but no booklets or other materials specific to the programme have been produced.

Despite a continuous process of capacity building, there have been no reports of events for the systematic discussion of lessons learned so far.

7. Lessons Learned

The different people involved in the programme expressed many limitations and challenges in the development of PROSAF. The programme manager and even some farmers pointed out a lack of interest by the farmers as an important issue to maintain the project activities. According to the programme manager, frequently out of a group of 30 interested farmers in a selected settlement, only 10 or so will continue with the programme. One farmer who coordinates a communal nursery which is shared among 10 families also complained about the lack of commitment of his partners in the care of the seedlings. Despite this, nine of the ten farmers believed that, in general, responsibilities were clearly defined among the group. They shared the belief that it is very important for the farmer to have a certain profile to be
able to change from mainstream land-uses to agroforestry, which often represents much more work to the family with a limited labour force to reconcile a number of activities in the rural property. One of the farmers suggested the necessity of having signed agreements between Ideflor-Bio and the farmers to reduce these problems. Many interviewees thought part of the issue would be solved if the selection of farmers to be included in the programme was more rigorous.

From a management perspective, improving the infrastructural and financial situation of the institution is a fundamental step to the programme’s success. This includes substantially increasing the number of technicians in the team and increasing their capacity to acquire agricultural inputs (e.g. fertilisers, lime, etc.), as well as their ability to transport them to rural areas. It is important to note that in Brazilian governmental institutions, the problem is often greater than limited financial resources, and involves excessive bureaucracy in the purchase process.

The farmers expressed concerns regarding a number of technical aspects; some have reported very low production yields, which was associated with insufficient water and soil nutrients. Water shortage and recurrent droughts have been perceived as a very real limitation in the region, which has been linked to deforestation rates by some research. Thus, irrigation is among the most frequent interest of the farmers, but it is rarely possible due to the high prices associated with the practice.

Another common complaint the farmers have is the asynchrony between the time of arrival of the agricultural inputs and machinery (e.g. tractors, fertilisers and seedlings) and the time window to plant in the rainy season. Given the limited financial resources and infrastructure, the products very often arrive too late, thus impairing the activities. Therefore, a more careful planning, overcoming of the institutional limitations cited above, as well as more financial resources are necessary to improve the success of the programme.

Technical assistance is also an issue in the programme given the limited number of Ideflor-Bio technicians to attend a large region with dozens of municipalities. Hiring more technicians would greatly improve the capacity of the programme. On the other hand, it is also fundamental for partner institutions to be more committed and engaged with the programme (although key institutions like Emater that provides technical assistance, is also operating at the limit of its capacity).

The manager also reflected on the importance of rethinking the role of the community nurseries in the programme. Once being at the heart of PROSAF, the collective nurseries seem to face many problems, from the lack of commitment from farmers, scarcity of water, to inability to transport seedlings from the nurseries to the properties.

An important problem the communities are facing is the occurrence of fires in the settlements resulting from land use practices, which seriously threaten the agroforestry plots established by the programme. All the farmers interviewed in the settlement 26 de Março reported losses from the fires in recent years. One farmer had his agroforestry plot burned twice. A couple of farmers had lost their entire systems, leading to interruption of monitoring by Ideflor-Bio and severe frustration by the farmers. Therefore, it is fundamental to develop a fire management programme in parallel with PROSAF, with collective
agreements to avoid fires escaping to agroforestry areas to improve the success of the programme.

There are a number of relevant issues, beyond the properties, that could greatly help boost the programme. They are related to financial incentives and credit to improve and expand the agroforestry systems implemented with Ideflor-Bio support. Furthermore, it is important to design concerted plans with other institutions to assist with the commercialization of agroforestry production. Good examples in Brazil are the recent initiatives, such as the Food Purchase Programme (PAA) and the National School Feeding Program (PNAE), both national policies which incentivize the purchase of products from the family farms by institutional markets, like hospitals, etc. Some of the farmers interviewed here were benefiting from these programmes by selling bananas and other products to the local market and schools; but, these benefits need to be strengthened and gain scale within PROSAF. Finally, some chronic infrastructural problems persist in the region, such as poor transportation for agricultural produce due to lack of trafficable roads during the rainy season.

Despite a myriad of challenges facing PROSAF, its participants could highlight many positive aspects of the programme. The existence of skilled technical capacity in the region, the commitment of local technicians and capacity building were identified as strong points of the programme. In relation to technical capacity for agroforestry, the region is very likely in a more favourable condition in comparison to the majority of areas in the Amazon. We attribute this to a long history of grassroots movements since the 1970s in the region, with pioneer projects involving tree planting over three decades ago. The participants highlighted some aspects they considered innovative in the region: many of them considered the adoption of agroforestry itself, in a region completely dominated by pastures, as the first example of local innovation. In addition, some management techniques started to be used with the arrival of the programme, such as grafting of some fruit species and the use of new genetically improved plant varieties (e.g. *Theobroma grandiflorum* cupuaçu and *Euterpe oleracea* açaí), and even the use of herbicides to eliminate grasses. They also considered the implementation of movable nurseries, which, if not successful in a given community, can be moved to another, as an important local innovation.

Some interviewees highlighted some social benefits brought about by the programme, including increasing community engagement, a tendency towards more collective actions in farmers’ associations and improved environmental conservation. According to the farmers, the programme is still in the very early stages, but environmental awareness has increasing due to farmers’ concerns with increasing warming and water scarcity.

However, in reality, we could not find a strong environmental motivation in the discourses of PROSAF participants. For example, the contribution of the programme to compliance with forest legislation as stated in the programme objectives, was only mentioned by one farmer. It was clear that the social and economic purposes are the main motives for participation, particularly diversifying production, generating income for poor communities and helping to divert smallholders from cattle ranching. Despite environmental concerns not being part of the primary motives for participating in the programme, all of farmers recognized and valued the contributions of the programme to reducing deforestation and identified other environmental local benefits.
Moreover, we observed a lack of interest and plans to commercialize products from the forestry tree species planted in the agroforestry systems, both timber and non-timber species, except for a few fruit species commonly commercialized in the region (e.g. cupuçu, cocoa and brazil-nut). These species, together with the açai, are the most important species in the agroforestry areas.

Most of the farmers stated that they did not have any plans for using the forestry species but some reported having them for diverse purposes other than commercialization, such as aesthetical (n=3) or medicinal values (n=2). One of the farmers reported planting *Handroanthus* sp. (ipê) for aesthetic purposes only, as the species produces massive flowers. Others expressed thoughts like “I want to have the trees here decorating my property for the rest of my life”, “… I plant forestry tree species on my property to contribute to environment conservation”, “I have never considered using the timber species planted here as I don’t want to cut them down”, “I plan to use the timber species in the future, but for producing my own pieces of furniture”. “I will leave the brazil-nut and mahogany trees to my grand-children, they surely will know what to do with them”. Three out of the ten farmers interviewed had not yet managed to plant any trees in their agroforestry system.

Despite the positive discourses, we interpret that, with few exceptions, forestry species planted in the agroforestry are still strongly disregarded by the farmers, likely being planted only for compliance with the PROSAF requirements. We believe this stems from the farmers’ culture, their lack of familiarity with silvicultural products and especially, the lack of demand for these products and the lack of impetus for their commercialization.

In this context, there is a clear barrier to the wider adoption of forestry species in the agroforestry systems in the region; and even more so for the implementation of more biodiverse systems which would contribute more to ecosystem services. Concerted efforts are needed to develop new product supply chains and markets based on forestry species to incentivize agroforestry systems that are able to deliver more environmental benefits.
II. THE RURAL SUSTENTÁVEL PROJECT (2015-2018)

1. Introduction

The Rural Sustentável Project (Rural Sustainability Project, free English translation) was a federal government initiative aiming to encourage the adoption of sustainable agricultural and forestry practices by small and medium producers living in the Amazon and the Atlantic Forest biomes in Brazil. The project, encompassing 70 Brazilian municipalities, consisted of financially rewarding farmers and technicians that implemented or intended to implement low-carbon agroforestry systems, as well as to incentivize the protection of native vegetation. Successfully implemented areas were used as a basis to promote training courses and discussions about sustainable systems and farm management with groups of regional farmers.

This project was conducted by the Ministry of Agriculture, Livestock and Food Supply (MAPA) in partnership with the Inter-American Development Bank (BID). It was funded by the International Climate Fund of the British Government’s Ministry of Agriculture, Food, Fisheries and Rural Affairs (DEFRA) and the BID acted as executor and resource manager. Implementation was carried out by the Brazilian Institute of Development and Sustainability (IABS) between 2015 and 2018 in the states of Pará, Rondônia and Mato Grosso (Amazonian states), as well as the Atlantic forest areas of the states of Bahia, Minas Gerais, Paraná and Rio Grande Sul. A total of R$ 70 million (Brazilian Reals – ~USD 16.5 million) of investments were destined to directly benefit rural producers.

The objectives of the Rural Sustentável Project were to: 1) improve land and forest management to promote rural development, poverty reduction, biodiversity conservation and climate mitigation; and 2) promote the implementation of a large-scale project intended to contribute to the development of the Low Carbon Agriculture Plan (Plano Agricultura Baixo Carbono, in Portuguese, the ABC Plan) through the promotion of technology deployment in rural properties. The project used the following low carbon technologies: agroforestry, integrated crop-livestock-forestry systems (ICLFS), restoration of the productivity of degraded pastures (named in the project “recovery of degraded areas with pastures”, acronym RAD-P), forest restoration in degraded pastures (which was called in the project “recovery of degraded areas with forests, acronym RAD-F), commercial tree planting and management of native forests.

The project was structured around two distinct units: first, the Demonstration Units (DUs) which were areas where one or more of the technologies encouraged by the project were already established. The DUs served as a reference to guide the rural producers with specific knowledge of the techniques and activities disseminated during the field days promoted by

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6http://www.ruralsustentavel.org/en
the project. Second, the Multiplier Units (MUs) which were rural production areas where the project supported the new implementation of one or more of the technologies and environmentally-friendly activities. The project provided technical assistance to the rural producers for planning, implementation and monitoring of the MU. The payment was made to rural producers who reached the proposed objectives. The project also supported the purchase of seedlings and inputs. It also supported capacity-building activities for participating producers and agents providing technical assistance. To publicize the project, field days were held at the DUs and involved rural producers, technicians and other interested parties. During these field days, success stories were presented, and participants were trained in low carbon technologies and encouraged to disseminate sustainable production and conservation practices.

In the DUs, reward systems were offered to the producers on a per hectare basis. Farmers could implement up to four hectares of the sustainable systems, such as agroforestry, for which they were paid R$ 5,220.00 per hectare (~ 1,270.00 US dollars). Concerning the reward for technicians, the total amount could reach R$ 7,308.00 (~ 1,780.00 US dollars) received in two instalments. The first was received when the technical proposal was approved and the second following the delivery of the final report. In addition to these rewards, for each field day attended, producers who were the owners of the DU received R$ 1,048.00 and technicians received R$ 348.00 (~ 255.00 and 85.00 US dollars, respectively).

In the case of MUs, the value of the rewards paid to producers by the Rural Sustentável Project varied according to the technology adopted: i) for low-carbon technologies with a forestry component the value received was of R$ 1,500.00/ha; ii) For RAD-P, R$ 500.00/ha were given; and iii) for forest conservation areas, R$ 1,000.00/ha were paid. The amount paid to the technician was R$ 6,000.00/MU. This payment was divided into two instalments, the first of R$ 3,000.00 was paid once the technology to be implemented was presented and approved by the managers, and second instalment of R$ 3,000.00 was paid following or during the implementation of the low carbon technology. Additional requirements were that the forest conservation area must have been delimited (if applicable), a final report must have been approved, and the producer must have presented a valid Rural Environment Registry (from Portuguese Cadastro Ambiental Rural - CAR) for his/her area.

In the state of Pará, the Rural Sustentável Project was implemented in eight municipalities. In the Marabá Region - the focus of this investigation - only the Marabá municipality was in the project scope. In Marabá, six DUs were implemented, all of which were agroforestry system/ICLFS-based, totalling 21 ha. A total of 89 MUs were established, from which RAD-P, agroforestry systems and RAD-F were the most common. A total of 83 field days were carried out in the municipality of Marabá, and agroforestry systems were the most frequently discussed theme (Rural Sustentável 2019b).
2. Implementation

2.1. A brief description of the sample used to understand the project

For the assessment of the Rural Sustentável programme, we performed 10 interviews, including managers (n=2), technicians (n=3) and farmers (n=5). First, we interviewed one of the regional project managers in Belém to gain a broad overview of the project. Then, we interviewed another manager, the technicians and the farmers in the Marabá region. The farmers were resident in three different agrarian reform settlements in Marabá: Escada Alta (n=2), Piquiá (n=1) and the recently established settlement Itacaiúnas (n=2). Farmers were, on average, 60.8 years old (SD=6.68) and originated mainly from northeastern Brazil (n=3); the remaining two were from Marabá and another region of Pará state. Two of the interviews were conducted with both the husband and wife of the property, while the remaining three were conducted with male respondents only. Their formal education was mainly to elementary school level (n=4 farmers), except for one farmer who was only educated to basic level. The median property size was 41 hectares, with the largest being a 185-ha property. The average time living at the current property was 31.33 years (SD=6.11) in Escada Alta and Piquiá. Farmers in Itacaiúnas settled only seven years ago.

2.2. Project stakeholders

Rural Sustentável is a technical cooperative programme under the execution and financial administration of the Inter-American Development Bank (IDB), whose beneficiary is the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA) with the technical and institutional coordination of its Social Mobility, Rural Producer and Cooperatives Secretary. The programme was funded by the United Kingdom, through the International Climate Fund (ICF) of the Department for Environmental, Food and Rural Affairs (DEFRA).

The Brazilian NGO Institute of Development and Sustainability (IABS) was responsible for the execution of the programme including administrative and logistical operations. This institution was selected only two years after the start of the programme through a competitive bid launched by IDB. The preparation phase of the programme started in 2013, through consultants hired by the IDB that were involved in engagement of local institutions and potential partners. This preparatory phase involved a long series of meetings and training courses for local technicians.

The programme execution and implementation team was composed of professionals from the IDB and IABS. Local teams, composed of field supervisors and communication advisors, were designated in each state to support the execution and operationalization of administrative and logistical activities. According to the programme documents “Field supervisors are IABS professionals responsible for supporting and supervising the execution and disseminating information about the Project during field days within the participating municipalities”, while local communication advisors are IABS professionals “responsible for supporting the deployment, direction and registration of Project actions within [each participating] state”. In producing this report, we interviewed one field supervisor and one communication professional.
According to the programme, small and medium rural producers, as well as certified technicians (ATECs) were the beneficiaries of the initiative. The programme targeted a large range of producers, based on income and property size. Farmers that could apply for projects were divided into three categories: Type IA — Property area greater than 4 and up to 15 fiscal modules and gross annual farm income of up to R$1,760,000 (around US $ 5,200); Type IB — Property area equal or less than four fiscal modules and gross annual farm income equal to or less than R$360,000 (around US $ 94,200); Type II — Property area equal to or less than four fiscal modules and gross annual farm income equal to or less than R$20,000 (around US $ 5,200). The size of a fiscal module in the Marabá region is 70 ha, meaning that farmers with property areas as large as 1,050 ha could participate in the programme. In this assessment we only had access to smaller producers (28–185 ha) because smallholders are the majority of beneficiaries.

Technicians affiliated with institutions were important stakeholders, as rural producers interested in being beneficiaries of the programme had to do so through a Certified Technical Assistant (ATEC) in his/her municipality, who was affiliated with an approved technical assistance institution (ATER). The technician was responsible for providing technical assistance to the rural producers and supporting the activities implemented in the selected DUs or MUs. On the other hand, the ATEC institution had to ensure activities were implemented successfully and in accordance with the proposed plan regarding low carbon technologies. For this, the ATER institutions had to sign a Technical Cooperation Agreement with an eligible rural producer to collectively prepare and submit a funding proposal and guide the implementation of the proposed activities once approved. Different ATERs were selected in the region, including ATER Emater, a governmental institution, and other private institutions.

Finally, the Brazilian Agricultural Research Corporation (Embrapa) gave technical support to the programme endorsing the sustainable practices and approving the proposals. The Brazilian Bank (Banco do Brasil) contributed with the distribution of the non-reimbursable financial incentives to farmers and payments to technicians.

2.3. Technical design of restoration interventions

In general, the technical design of the restoration interventions followed a similar pattern as the ones described in the PROSAF programme, as three of the five interviewed farmers received financial compensation for Demonstrative Units, meaning that their agroforestry plots were already established with the support of other projects.

The five farmers interviewed planted in open areas, except two that managed natural regeneration along with planting in open areas. All farmers, except one, used tractors and fertilisers. The programme made some donation of seedlings and fertilisers for free to farmers that were implementing MUs.

7 Tax module is a unit of measure used in Brazil that is fixed for each municipality, taking into account factor such as type of predominant land use in the municipality and the corresponding income
All the projects involved agroforestry, with the three DUs varying in terms of species diversity, with higher, intermediate and lower tree species richness. The one with the highest number of forestry species, had not only the highly commercial species cupuaçu (*Theobroma grandiflorum*) and açai (*Euterpe oleracea*), but also a diverse set of other native tree species (andiroba (*Carapa guianensis*), bacuri (*Platonia insignis*), pequi (*Caryocar Brasiliense*), Brazil-nut (*Bertholletia excelsa*), among many others). This DU is owned by an innovative farmer who has participated in several different projects regarding sustainable production in the last decades. The farmer Mr. Sebastião (aka Tião do Cupuaçu) is a pioneer in the cultivation of açai in the region and collaborates with Embrapa research in the cultivation of genetically improved varieties of cupuaçu. The DU with intermediate tree species richness is composed of banana and passion-fruit as semi-perennial components, as well as fruit plants highly commercialized in the region (açai, cupuaçu taperebá/cajá (*Spondias mombin*), acerola (*Malpighia emarginata*), guava (*Psidium guajava*)), and forestry species (ipê, sapucaia and Brazil-nut). On the other hand, the DU with lower species richness had açai and cocoa, together with African mahogany.

For the two MUs (i.e. newly implemented systems), one had mainly açai with some plants of ipê and jatobá that the farmer acquired from the public nursery. The other had banana, açai and cupuaçu, together with Brazil nut and mahogany. These MUs were established in a newly occupied settlement (~2012) covered almost completely by pastures, which is more distant from Marabá city in comparison to the others that were analysed. This makes access to inputs, such as seedlings, more difficult. One of the farmers with very positive results reported that he collects seedlings in the nearby forests to transplant to his agroforestry. For the farmers that applied to recover the production capacity of their pastures, it was mandatory in addition to set aside one hectare of forest (primary or secondary) to be protected. We visited two such farmers, who showed us areas of young, unfenced secondary forests that were defined as forest reserves with the support of the partner technicians. Natural regeneration was also successfully used by a farmer to restore a 30-m wide riparian area on his property.

### 2.4. Enabling activities

The *Rural Sustentável* programme aimed to address key barriers that led to the low participation of farmers in the Brazilian governmental plan for Low Carbon Agriculture, known as the ABC Plan and the low levels of uptake of the ABC Programme credit scheme. The project was designed to enable access to information, technical assistance, rural credit and financial incentives, as well as to increase farmers’ motivation to develop sustainable agricultural practices (Newton et al., 2016). The ABC Plan, therefore, was at the core of the activities of the *Rural Sustentável* Programme.

The ABC Plan was launched by the Brazilian government in 2010, along with a new line of low-interest rural credit (the ABC Programme). This line of credit was intended to fund the implementation of low carbon agricultural practices to contribute to climate change mitigation and adaptation through reducing greenhouse gas (GHG) emissions and/or by sequestering carbon. A number of targets were included, such as reducing by 80% deforestation in the Amazon, recovery of degraded pastures and the adoption of agroforestry — including integrated crop-livestock-forests (ICLF) and tree plantations.
Following the publication of The National Policy on Climate Change in 2009, the National Policy for ICLF was launched in 2013. Aligned to this, Embrapa coordinated a network for the promotion of ICLF in the country and has given important technical support to this end. During the 15th Conference of the Parties (COP15) of the United Nations Framework Convention on Climate Change (UNFCCC), the Brazilian government pledged to reduce national greenhouse gas emissions by 36.1–38.9% by 2020, a reduction of 1 billion tonnes of CO2 eq. To achieve this, national targets include reclaiming 15 million hectares of degraded pastures and establishing 5 million hectares of ICLFS. The agriculture and land use sectors have an important role in this commitment as the sector accounts for more than 60% of Brazil’s annual GHG emissions (MCTI, 2016).

Finally, it is important to note that the Rural Sustentável Programme was built upon many former projects that were developed in the region, using established systems as model systems (Demonstration units or DUs) to showcase the sustainable technologies during field day events. Even the Multiplying Units areas yet to implement sustainable technologies supported by the project depended upon existing local technical assistance to support farmers with planning, implementing and guiding the development of MUs.

In operational terms, reporting of all the activities involved in the project - such as registration, submitting a project proposal and nominating a technician to submit reports - had to be completed on an online platform. Therefore, the participants needed satisfactory internet access to be able to participate, which can be difficult in rural areas of Marabá.

3. Monitoring

The project report does not describe any specific financial resources for the monitoring of implemented activities. However, among the roles attributed to technicians and field supervisors, was the duty to report the progress of the projects to the IABS representatives in the headquarters in Brasília, submitting reports using the IABS digital platform with information such as number of events and attendees. This monitoring was performed only for MUs and followed just six months after implementation. There was no monitoring beyond the duration of the project. Proponents of each MU were obliged to indicate how many visits would be made at the time of submission of the project proposal on the IABS platform. For each of these visits, a report was to be submitted on the platform with photos indicating that onsite activities had occurred. Evaluation sheets had to be submitted via the IABS platform for all field day events.

The technicians were mainly responsible for the on-site monitoring, and the reports were sent to IABS headquarters via the online platform. After the approval of the final report, technicians received the second, and final, payment, and they were no longer responsible for monitoring. The BID carried out random field audits to see if the project was done according to the reports sent.

Among the indicators observed in these on-site reports were: the instructions covered in training, the number of events in the region, the number of participants and the resources used. The reports were written in forms developed by IABS and analysed by the Regional Committee of the Rural Sustentável Project. These data were taken to meetings with the
managers based in Brasília. At these meetings, the weaknesses of the project were identified, and accordingly, modifications in its structure could be made. Among the changes made, one local project manager cited a budget increase for field days.

4. Outcomes/benefits

4.1. Local livelihoods improvements

Farmers that implemented Multiplying Units (MUs) had not yet generated any income from the new systems, as the projects were too young (1-2 years old), but they were optimistic about profits from the forthcoming açai harvests. One farmer has reported an increase in the diversity of food he ate, such as banana and pupunha (the palm Bactris gasipaes), another reported the production of beans, maize and açai for his family consumption. He also reported experimenting with using the excess cupuaçu seeds as feed for fish farming.

Farmers with Demonstration Units (DUs), recognized that the financial support from Rural Sustentável helped to consolidate their agroforestry systems and increase production. Two of them currently have around 17 ha of agroforestry. One farmer pointed out that the programme not only helped to increase the family income, but also to improve money flow in the region due to the field days. The financial support was not only given to the farmers, but to a number of technical assistants as well. An elderly farmer informed us that he used the financial support of the programme to pay for labour as he could not work in the field anymore due to health problems, as well as to purchase fertiliser.

The farmer with the most diverse agroforestry system reported earning some income from the following forestry species: fruits of brazil nut and bacuri, as well as the seed-oil of andiroba. One of the interviewed farmers invested the money from the programme in machinery for processing fruit, and he received a prize from Rural Sustentável for this achievement in a national competition within the category “income generation and employment”. Increasing verticalization of production (e.g., processing fruits to sell pulps) is the main plan for the near future for these innovative farmers.

Such consolidation of agroforestry sometimes helped to expand education and provided opportunities for cultural change. For example, the daughter of one of the farmers started studying an undergraduate course on agroindustry in Marabá to help toward the family plans to verticalize production (mainly pulp from açai and other fruits). A farmer likened his agroforestry to “good books that someone will come to study one day”. And another said he believed that “agroforestry had brought back the culture of planting, as before it was only pasture”.

Farmers in the recently occupied agrarian reform settlement PA Itacaiúnas saw additional benefits from projects like Rural Sustentável in terms of underpinning land tenure. As the area is lacking the basic land documents and titles (they only have registrations under the Rural Environmental Registry scheme, or CAR, in Portuguese), and they still feel insecure about being removed from the land. Therefore, they believe projects like the Rural Sustentável help to give more assurance of their rights on the land. But, even one farmer who had been living in an agrarian reform settlement since its foundation 30 years ago,
shared the belief that planting agroforestry systems is important to show that farmers use the land sustainably and have a right to do so.

4.2. National benefits

The *Rural Sustentável* Programme aimed to give support to the Brazilian plans for reducing carbon emission from agriculture and mitigating climate change. Therefore, the actions supported by the programme help to accomplish the national targets in the ABC Plan (2010-2020), which include rehabilitating 15 million hectares of degraded pastures, increasing 4 million hectares of integrated systems (agroforestry and ICLF), expanding 3 million hectares of trees and reducing greenhouse gas emissions by 160 million tonnes of CO$_2$ equivalent annually, before 2020 (Brazil, 2012).

4.3. Ecological benefits

All farmers reported that agroforestry increased tree cover, except one that had a recently implemented MU. But even with a young agroforestry system in the new settlement Itacaiúnas, a farmer said that “when the family arrived there was only pasture, now it is possible to see some trees”.

The farmer with the oldest (around 30 years) and most diversified agroforestry, selected as a DU for the *Rural Sustentável* Project, was proud that his agroforestry became a benchmark site in the region, and that it was visited by many different projects and independent farmers. In a 185-ha property, the farmer had around 75 ha of agroforestry at the time of writing this report, which is a remarkably large area in the region, and he highlighted that the native species he had planted in this area were sequestering carbon and attracting birds and monkeys. The return of fauna (deers, agouti) was highlighted by three farmers and improvements in thermal comfort were mentioned by two farmers. One of the farmers remembered when he arrived in 1993 in the Escada Alta settlement that was covered by forests with a rich fauna, these animals, such as monkeys and birds, had disappeared, but are now coming back to the area. Only one farmer reported not noticing any change in habitat.

All farmers, except one, reported that agroforestry was contributing to save locally threatened species, with Brazil nut and mahogany being the most often cited; the native tree species ipê and cedro (*Cedrela odorata*) were also cited. *C. odorata* is classified by IUCN as vulnerable, as well as some species of *Handroanthus*. The following fauna species were mentioned: red and green macaw (*Ara chloropterus*) and mutum (cf. *Mitu tomentosum*). Although they have been classified as least concern species by IUCN, there is a local perception that their populations are decreasing.

All five farmers agreed that the project and others like it had contributed to reducing deforestation. According to them “productive forests and agroforestry decrease the necessity of clearing virgin [primary] forests” and also that “agroforestry not only generates income, but also helps increase forest cover, which is what the world wants”.

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5. Financing

A total of R$ 13,624,592.82 (~US$ 3,265,500) was allocated to the stakeholders in the state of Pará. The distribution of funds was as follows: R$ 1,030,915.20 (~US$ 247,060) for DUs, R$ 11,173,698 (~US$ 2,677,760) for MUs, R$ 344,080 (~US$ 82,400) for field days, R$ 252,439.62 (~US$ 60,480) for payment of seedlings and agricultural inputs, and R$ 823,460.00 for field day logistics (Rural Sustentável, 2019b).

Of these cited resources, an amount was spent on staff training (technicians and farmers). All the interviewees mentioned that they were given the opportunity to participate in these events. In addition to the field days, widely mentioned by farmers, some training courses/events were provided to the technicians. These included courses/events such as: i) the implementation of the ILPF technique; ii) training in the Rural Environmental Registry (CAR); iii) environmental monitoring; and (iv) discussions on low carbon agriculture. However, the total cost of offering these courses/events was not mentioned in any of the reports (Rural Sustentável, 2019b).

6. Communications

The project report does not mention communication, or whether there were specific resources for this. However, all the interviewed farmers mentioned that they believed the project was well publicized during its implementation. One of the farmers, a leader in his community during the implementation of the Rural Sustentável Project in the area, said that it was one of his commitments to the programme to disclose the occurrence of all events for all members of his community. There were invitations, which could be printed using the IABS platform, for the dissemination of field days and training courses.

Both the farmers and the technicians mentioned that the primary means of communication used were social media and disclosures on the IABS digital platform. The technicians and managers declared that there had been reports on TV and radio, in which field days and success stories in the region were reported. Another means of communication was the production of videos, which were made available on the IABS platform, showing project success stories. Finally, there was also direct communications with the technicians, to mobilize them for the field days, which was done mainly by email newsletters.

7. Lessons Learned

Only two out of the five farmers highlighted lessons learned from the Rural Sustentável Project. These were the importance of having autonomy to take decisions as direct recipients of money, access to technical assistance and the benefits of training on field days offered by the project. The lack of clarity regarding lessons learned might result from the nature of the project, as its conception was very distinct from others in the region as the rules and decisions were made far away from the region meaning a reduced local power. In
addition, there was a short time to implement actions (less than two years), following a long process of local discussion at the beginning and some interruptions.

The most positive view of the project was that of the farmer Mr. ‘Tião do Cupuaçu’, who stated that the combination of different projects like Rural Sustentável reinforced his vision that “he will cultivate trees for the rest of his life to guarantee income and wellbeing on his property.”

Technicians and managers highlighted the opportunity to disseminate the technical and practical knowledge of the innovative producers in the DUs. On the other hand, they also highlighted the fact that knowledge about the local context should have been given more value, as well as more openness to consider the views of local beneficiaries. This results from the fact that the project was managed by an institution based in Brasilia, and even with some local staff (only two) and the team efforts, attending to local aspirations can be challenging. They also claimed more attention should have been given to internal communication of the project to avoid delays in the schedule.

When asked about what worked and what did not work in the programme, the farmers showed a high degree of satisfaction in general. For six respondents, everything that was promised worked and the remaining four mentioned important points that worked. Regarding what did not work, they indicated delays in the arrival of materials (seedlings) and money, as well as the non-approval of other projects they wished to implement.

For technicians and managers, the overall design and scope of the goals, the dissemination of technologies in the DUs, the payment of rewards and the economic benefits to the producers, worked well. In their view, the main problems identified were the difficulties found in the programme portal (website), the delay in contracting the executor institution (IABS) which caused delays to project plans (it was mentioned that the project was delayed by around one year) and the arrival of financial resources only after the agricultural calendar.

Nine of the 10 respondents believed there were innovations associated with the programme, mainly in the technical assistance model and financial rewards for field technicians. There were also technological innovations, notably the partnership with EMBRAPA to cultivate genetically improved varieties of cupuaçu and açaí. They also mentioned organic fertilisation, the use of legumes to recover degraded areas, techniques for germinating seeds of forest species, the use of bees for pollination of fruit species and the dissemination of agroforestry systems/ICLF in a region with a strong livestock tradition.

On what could be done differently, if the programme were implemented again, the main observation is related to the MUs. The implementation of MUs was extremely weakened because they were implemented very quickly and in the last months of the project schedule. For those interviewed, this could have caused adverse consequences for the project. The correct execution of the programme should have been better divided, prioritizing the DUs and training in the first two years, and the last three years focused on the implementation of the MUs. Moreover, some shortcomings in the programme portal would need to be addressed, and delays in payments should be avoided. In the view of the respondents, the selection of producers should centre on those with a profile more in line with the needs of the programme and it should have been more inclusive of young people and women. There
were some complaints regarding private companies providing technical assistance that came from other municipalities in the region to apply for projects, but with low local knowledge and commitment.

The riparian areas (areas of permanent protection in Brazil) should have been considered further for conservation and restoration. Finally, in terms of species selection, the açaí palm, typical of areas with high water availability, should be avoided in unsuitable areas and it would be important to include more fruit species and non-timber forest products in the implemented agroforestry systems.
III. THE JUVENTUDE E COOPERATIVISMO PROGRAMME (2011-2014)

1. Introduction

The Juventude e Cooperativismo programme (Youth and Cooperativism, in English) had the main aim of promoting the engagement of young rural farmers (<32 years old) in agroforestry. These agroforestry systems aimed at producing fruits to strengthen a set of associated cooperatives. The initiative was developed by the Federation of Family Agriculture Cooperatives of Southern Pará (hereafter FECAT), a private organization that works in the Marabá Region and that is composed of seven other cooperatives from southern Pará. The project received financial support from the Petrobras Development and Citizenship Programme. Petrobras is Brazil's largest state-owned mixed-energy producer. The project received a total amount of R$ 1,345,000 (~US$ 321,540) and was implemented between the years of 2011 and 2014 in seven municipalities in Southern Pará, including Marabá, Parauapebas and Nova Ipixuna. The spatial distribution of this restoration project in the Marabá Region is shown in Figure 7.

The specific aims of the Juventude e Cooperativismo were to: i) implement fruticulture modules with native species of the region; ii) train young farmers in cooperativism and associativism and to integrate them into municipal cooperatives; iii) recover degraded areas; iv) expand the cooperatives’ marketing capacity. The target group for the project was young smallholders, preferably alumni of the Agricultural Family Schools (hereafter AFS\(^8\)) of the region.

\(^8\) AFSs are schools frequented by children of smallholders who adopt the pedagogy model of alternation in which students attend school for 15 days and in the other 15 days return to their parents' lots to develop learning in everyday practice. The management of AFSs is shared between the association of parents of students and the municipal and state public authorities, and the school curriculum is geared to the rural reality of the region.
Figure 7 - Distribution of restoration projects implemented by the Juventude e Cooperativismo Programme in the Marabá region.

The project was implemented in cooperation with a broad network of public institutions, non-governmental organizations and grassroots family-based organizations. The technical/administrative team of the project consisted of two agronomists, five agricultural technicians, an administrator and an industrial chemist. This team provided technical assistance to 100 young farmers who planted approximately 87 hectares of agroforestry in the region, including timber and fruit species (Table 4).

Table 4 - Main plant species planted in agroforestry systems as part of the “Juventude e Cooperativismo” Project.

<table>
<thead>
<tr>
<th>TEMPORARY CROPS/VEGETABLES</th>
<th>PERMANENT CROPS</th>
<th>FOREST SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manioc</td>
<td>Cupuaçu</td>
<td>Castanheira</td>
</tr>
<tr>
<td>Beans</td>
<td>Açai</td>
<td>Andiroba</td>
</tr>
<tr>
<td>Corn</td>
<td>Banana</td>
<td>Cajá</td>
</tr>
<tr>
<td>Rice</td>
<td>Lemon</td>
<td>Mahogany</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Graviola</td>
<td>African Mahogany</td>
</tr>
<tr>
<td>Coriander</td>
<td>Pineapple</td>
<td>Angelim</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Passion Fruit</td>
<td>Jatobá</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Acerola</td>
<td>Ipê</td>
</tr>
<tr>
<td>Maxixe</td>
<td>Papaya</td>
<td>Copalba</td>
</tr>
<tr>
<td>Okra</td>
<td>Guava</td>
<td>Bacuri</td>
</tr>
<tr>
<td>Paprika</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>Eggplant</td>
<td>Cashew</td>
<td></td>
</tr>
</tbody>
</table>
In addition to supporting the implementation of the productive modules, these young farmers were trained through field days, training courses, property management and entrepreneurship workshops, seminars and meetings, and municipal assemblies. In the operational logic of the project, all the products from the agroforestry systems were absorbed by the municipal cooperatives or by FECAT. These cooperatives were responsible for processing the products and carrying out their commercialization. The primary market of these cooperatives was dedicated to supplying municipal school meals, through resources of the National School Meal Programme (hereafter PNAE) and supermarkets in the region.

In this sense, the focus of the project was income generation for young smallholders through the cultivation of fruit species in agroforestry systems. This production was sold by FECAT, strengthening the network of cooperatives linked to FECAT. Furthermore, there was also an environmental conservation dimension by promoting agroecological practices, environmental awareness and forest conservation. Thus, there was a connection with the Bonn Challenge as the project aimed at capacity building (Figure 8) and to directly implement the environmental recovery of degraded areas and disseminate this approach in the southeastern region of Pará.

![Figure 8 - Training on cupuaçu management by EMBRAPA researcher.](image)

2. Implementation

2.1. A brief description of the sample used to understand the project

For the analysis of the Juventude e Cooperativismo programme, nine interviews were carried out. Two of these interviews were with managers of the project, one was with a technician, and six were with young smallholders. These young farmers lived, at the time of the project, in the following agrarian reform settlements: PA Pimenteira (São João do Araguaia), PA Carajás Tamboril (Marabá), and PA Murajuba (Marabá) and in the Paulo Fontes e CEDERE I colonization areas in Parauapebas. The average age of interviewees was 32 years old, among them, 83% were born in the Marabá Region, and one was born in the state of Maranhão.
(Brazilian northeast). Most of the interviewees were male (n = 5), with a high degree of formal education, four were university graduates and two had partly completed a university degree. The average size of the establishment was 43 hectares (standard deviation = 13), and the average residence time was 21 years (standard deviation = 11).

### 2.2. Project stakeholders

The main actors involved in the project were, on the one hand, FECAT, which was the project's executing agency, and which also received, processed and commercialized the products of the productive modules and, on the other hand, the young smallholders who were the beneficiaries of the projects. These young smallholders were also the recipients of the training and implementers of the agroforestry systems.

FECAT was established in 2003, involving in its framework agricultural cooperatives of seven municipalities of the Marabá Region, among them are the three included in this FLR assessment. The main objective of FECAT is to "promote the development of family farming based on preservation and coexistence with local agrobiodiversity, sustained through the union of associated cooperatives and political representation in defence of their social, welfare and economic interests, enabling the development of marketing for products derived from family farming, guiding and integrating their activities as well as facilitating the reciprocal use of services". The history of FECAT is directly related to the agrarian reform and the struggles of the rural workers’ unions movement in the southeast and south regions of Pará. The strengthening of rural cooperativism arose from the need of farmers to promote and consolidate production in the areas of land conquered by the agrarian reform and aimed to develop sustainable family agriculture in the region in the absence of appropriate governmental policies. Other stakeholders are involved in the project, with different levels of engagement that change from municipality to municipality (Table 5).
<table>
<thead>
<tr>
<th>STAKEHOLDER</th>
<th>TYPE OF CONTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal University of Pará (UFPA/LASAT)</td>
<td>Technical support, mainly in the municipalities and in the systematization of data.</td>
</tr>
<tr>
<td>Institute for the Protection and Development of Amazon (IPEDA)</td>
<td>Contribution to the discussion of technical subjects related to the environment.</td>
</tr>
<tr>
<td>Technical Assistance and Environmental Advice Company (AgroAtins)</td>
<td>Discussion of technical subjects related to the project.</td>
</tr>
<tr>
<td>Rural Labour Unions from Marabá, Nova Ipixuna, Eldorado dos Carajás, São João do Araguaia, Itupiranga and São Domingos do Araguaia and FETAGRI Pará</td>
<td>Support for mobilization, dissemination and selection of beneficiaries.</td>
</tr>
<tr>
<td>Municipal Secretary of Agriculture of Marabá (SEAGRI)</td>
<td>Supply of seedlings and transport using pumps for irrigation.</td>
</tr>
<tr>
<td>National Institute of Colonization and Agrarian Reform (INCRA)</td>
<td>Provision of technical information, logistical support to the project and the implementation of seedling nurseries.</td>
</tr>
<tr>
<td>Company of Technical Assistance and Rural Extension (EMATER - Pará)</td>
<td>Support in discussion regarding the implementation of the modules and the regularization of the youth through the issuance of the Declaration of Aptitude to the rural credit PRONAF (DAP).</td>
</tr>
<tr>
<td>City Halls of Parauapebas, Eldorado dos Carajás, Nova Ipixuna, São João do Araguaia and Itupiranga</td>
<td>Purchase of family agriculture products for school meals, support with land preparation and installation of irrigation systems.</td>
</tr>
<tr>
<td>Municipal Cooperatives of Family Farmers</td>
<td>Participation in all phases of the project execution and support in the acquisition of the products in the lot and commercialization in school meals.</td>
</tr>
<tr>
<td>Brazilian Agricultural Research Corporation (EMBRAPA)</td>
<td>Implantation of nurseries of seedlings, seed donation and technical support with the production of seedlings and training courses.</td>
</tr>
<tr>
<td>Forest Development Institute of the State of Pará (IDEFLOR Bio)</td>
<td>Support for the implementation of seedling nurseries and strengthening of seedlings.</td>
</tr>
<tr>
<td>Agricultural Family School (AFS/FATA from Marabá)</td>
<td>Support in the mobilization and selection of young people of the project and the construction of the production groups in each municipality.</td>
</tr>
<tr>
<td>Federal Institute of Science and Technology (IFPA Rural Campus)</td>
<td>Technical support for the systematization of data, discussion and articulation regarding the chain of fruit growing in the region.</td>
</tr>
<tr>
<td>Brazilian Service to Support Micro and Small Enterprises (SEBRAE)</td>
<td>Support with the technical activities carried out in the municipalities of Parauapebas, Marabá and Eldorado dos Carajás.</td>
</tr>
<tr>
<td>Cooperative of Technical Assistance Services (CoopServiços)</td>
<td>Support with technical activities and young farmers training.</td>
</tr>
</tbody>
</table>

### 2.3. Technical design of restoration interventions

The technical design of the project prioritized the implementation of productive modules of approximately one hectare per young project participant. These productive units had different combinations of permanent crops, prioritizing fruit species, temporary crops/vegetables and forest species. No manual/guide with technical guidelines was formally used, and the recommendations were built based on the dialogue between the field technical team (two agronomists and five agricultural technicians) and the knowledge of the
young people who, because they came from AFS, already had a reasonably good understanding of the technologies adopted. All modules were arranged in deforested areas that were covered by secondary vegetation and resulting from the abandonment of old agricultural areas or degraded pastures.

![Figure 9 - Implementation of the productive modules by the smallholders during the Juventude e Cooperativismo Project.](image)

The preparation of the area was made in two different ways, with mechanization using tractor, ploughs and grates (50%), as well as with the use of slash-and-burn in areas of secondary forests (33%). One of the farmers did not inform us how he prepared his land. After the preparation of the area, seedlings of permanent crops and forest species were planted and temporary crops and vegetables were cultivated between the lines (species in Table 4) - Figure 9. The spacing of permanent crops ranged from 5x3m to 6x6m, and among the forest species the spacing was 20x20m. Only one of the interviewed farmers reported having planted forest species. This reduced interest in native forest species was shown in the document records of FECAT, in which it was noted that the project had distributed a total of 1030 seedlings of forestry species belonging to seven species in the whole region (Brazil nut, andiroba and mahogany had the highest number of plants), against more than 200,000 of crops, demonstrating the bias towards agricultural production.

2.4. Enabling activities

FECAT’s actions are directly related to public policies aimed at promoting the development of the family agriculture segment. During the execution of the Juventude e Cooperativismo Project, FECAT was active in several discussion forums, such as the National Network of Cooperatives of UNICAFES and the Cooperatives without Borders Network, besides the several projects and processes developed with the support of programmes and policies of the federal government. In this way, the project was conceived to promote access of young people to the policies aimed at them.

The main public policies that the Juventude e Cooperativismo project was, directly and indirectly, involved in during its execution were:

a) National School Lunch Programme (PNAE): to expand the marketing of FECAT products for school meals; to contribute to the young farmers' access to the school
meals market based on the national Law nº 11,947/2009, which establishes that 30% of the school meals should come from family farms.

b) National Policy of Rural Territories (PRONAT): through actions and projects, to strengthen the fruit production in Southern Pará.

c) Programme for the Promotion of Gender Equality, Race and Ethnicity (PPIGRE): action to promote the participation of women and young people in organizations and decision-making forums.

d) Meso-region Development Programme (PROMESO): for projects to strengthen the fruit production chain of the Bico do Papagaio sub-region.

e) Food Acquisition Programme (CONAB’s PAA): by encouraging family farming, including actions related to the distribution of agricultural products to food insecure people and the formation of strategic stocks, through instruments that favour structuring and development of family farming.

f) National credit Programme for the Strengthening of Family Agriculture (PRONAF): promoting access of young people to financing through the youth PRONAF modality.

In addition to these programmes, the project integrated public policies related to education and production, as in the case of rural schools, where the Juventude e Cooperativismo project, in partnership with the IFPA rural campus of Marabá, acted in follow-up activities and academic extension in the agricultural lots of students and the results were used as examples in the classroom. The municipality of Parauapebas used the Juventude e Cooperativismo model to create a municipal programme of investment in fruticulture. In this programme, other smallholders, not participating in the Juventude e Cooperativismo project, also attended, and, as a result, partnerships with government entities and companies, such as EMPRAPA and IDEFLOR, were forged. Therefore, this was a project to strengthen fruit production and the implementation of agroforestry systems.

3. Monitoring

The project document provided by FECAT for this investigation did not present specific information dedicated to on-site supervision. However, there was the payment of technicians, who had in the description of their functions, to monitor the agroforestry systems during their implementation period. According to the Juventude e Cooperativismo field technicians, there was a formal monitoring protocol. This document was based on the information collected in the field and was sent electronically to Petrobrás, including photos of the locality. The project technicians were responsible for drafting this report, as per their functions in their employment contract. The information in the report was collected only during the project execution period, and a partial and a final report was submitted to Petrobrás. The data collected was related to the number of young people in the settlement, total area planted and managed, income obtained with the project implementation and information on product sales. None of the respondents mentioned whether the changes were made during the project because of the findings of the partial report. The interviewed technician proved to be the only interviewee that knew of this report, however the secretariat of FECAT delivered some blank versions of this document.
4. Outcomes/benefits

4.1. Local livelihoods improvements

Only one of the interviewees (a farmer) mentioned that there was no financial benefit from agroforestry implementation. However, this individual had an irrigation problem on his plots that caused the mortality of his entire plantation. On the other hand, many positive outcomes of establishing agroforestry systems were highlighted by the farmers, with increased income being mentioned in all but the one case mentioned above, because of the diversification of production. Some farmers increased their revenue by 50%, while others had no income at all prior to participating in the programme and managed to generate an income based on the establishment of the system. It was mentioned that thanks to this project, some farmers excelled in fruit production in the region. All respondents identified the impact on food safety as positive, with the following sentence repeated in some interviews: "before the project, we had to buy all our food." The non-forest products were considered mainly in the form of fruits and Brazil nut; andiroba and taperebá/cajá were also mentioned. Forest species were not commonly thought of in this project as a form of income acquisition.

A few sociocultural benefits from the project were mentioned by the farmers. Some indicated that they would not have remained in the field if this opportunity had not been offered. In terms of land rights, the project gave them a sense of belonging, something that was repeated by one of the project managers and by several farmers.

The managers interviewed mentioned that after this project, some new cooperatives were created. The processing and marketing of fruit pulps, candy and the sale to PNAE were the value chains and benefit-sharing scheme most mentioned by them, and the strengthening of FECAT was one of the main highlights.

4.2. National benefits

In general, the interviewees did not associate the project to national benefits. However, a project manager mentioned that there was an international repercussion of the project, and some people came from outside the country to find out how the project was encouraging young people to stay in rural areas.

4.3. Ecological benefits

Most interviewees mentioned that they noticed changes in the amount of tree cover in the property, even if the areas were small and fragmented. A visual inspection in high-resolution satellite imagens for the settlement Carajás-Tamboril, the settlement with the highest number of beneficiaries of the project (n=5), showed no evidence that forest cover has increased in the last years. The classification made with the high resolution satellite images of the PA Carajás Tamboril indicated a decrease of 50% of primary vegetation from 2012 to 2018 (Figure 10; Table 6).
Figure 10 - Comparison of forest cover between 2012, Rapieye image, and 2018, Planet image in the agrarian reform settlement PA Carajás Tamboril, Marabá, Pará.

Table 6 - LULC areas estimated from high resolution satellite images classification of the Carajás Tamboril settlement project.

<table>
<thead>
<tr>
<th>Year/LULC</th>
<th>Primary Vegetation (Ha)</th>
<th>Secondary Vegetation (Ha)</th>
<th>Grassland (Ha)</th>
<th>Bare Soil and Others (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>4,654</td>
<td>2,254</td>
<td>6,416</td>
<td>585</td>
</tr>
<tr>
<td>2018</td>
<td>2,464</td>
<td>3,546</td>
<td>7,037</td>
<td>862</td>
</tr>
<tr>
<td>Variation (2018-2012)</td>
<td>-2,190</td>
<td>1,292</td>
<td>621</td>
<td>277</td>
</tr>
</tbody>
</table>

Learning about restoration allowed some of them to expand this knowledge to other areas within their property, allowing even the natural regeneration of some areas. However, no technique was used to measure these restoration contributions. Another important point that was stated by farmers, technicians and managers was that there was an improvement in the quality of ecosystems. Water springs were seen in areas where they had ceased to exist, animals such as birds and monkeys returned, soil characteristics and the local microclimate improved.

Most farmers, except two, declared that the project helped increase the population of endangered species. They mentioned mainly the Brazil-nut tree and mahogany, but also jatobá and andiroba.

Although environmental issues were a secondary focus of the project (after socioeconomic objectives), they recognized reduction of deforestation as an indirect effect. According to
interviewees, this reduction resulted from an increasing awareness of the value of forests and the knowledge that it is possible to grow agricultural produce and yet still have high degrees of tree cover on their properties. Another important point mentioned was that farmers were re-learning how to plant forest species.

5. Financing

According to the documents provided by FECAT, the total amount invested in the project was R$ 1,344,907.68 (~US$321,772) (of which Petrobras covered R$ 1,212,907.68 (~US$ 290,217), and R$ 132,000 (~US$ 31,584) was contributed by FECAT). There was a schedule of disbursement of the money invested, separated into two years, which was in instalments of R$ 242,581.54 (~US$ 58,050) and R$ 121,290.77 (~US$ 29,025) per month. The use of the financial resources was subdivided into fixed costs, payment of personnel, social charges, acquisition of materials, transportation, food, travel and promotion of events for farmers. The amount invested in training was R$ 22,900 (~US$ 5,480) in the first year and R$ 14,000 (~US$ 3,350) in the second year. Indirectly, in terms of training, there was the payment of the technical team, which totalled R $ 86,400 (~US$ 20,670) per year, this was also the only resource in terms of monitoring and data analysis. Concerning the investment in control, management and data storage, a total of R$ 18,526 (~US$ 4,432) in the first year and R$ 9,050 (~US$ 2,165) in the second year, were attributed to the acquisition of office materials.

6. Communications

There was a formal programme for communication of the project. However, there was no specific team assigned to the production of materials, and it was the managers and technicians who were responsible for this, as stated by the interviewed technician. In the first year, R$ 22,900 (~US$ 5,480) was spent on the printing of material, and in the second year, R$ 14,000 (~US$ 3,350) was disbursed to produce the project’s DVD. Other communications products includes: publicity booklets, communications on social media, radio and television interviews, billboards in the participating towns and, finally, a DVD about the Juventude e Cooperativismo project experience. These materials contained information regarding the project objectives and general explanations about them. Four of the six farmers interviewed believed the project was well publicized for their neighbourhood. These farmers mentioned mainly word-of-mouth and the importance of open events so that everyone would know what was happening and could learn about reforestation (even without being involved in the project).

7. Lessons Learned

All respondents stated that there was a specific process for learning lessons. The occurrence of several events and meetings, almost every month, in which the farmers could present
their results in the field were mentioned. There was also a series of field training days in which farmers could see and assimilate productive techniques.

In the reports, field experience and technical support were the most frequently mentioned good practices of the project. The farmers also mentioned that having a cooperative working to commercialize their goods/produce was a great help. Participation in field days was an essential tool for farmers since they were able to learn by doing. The interviewed technician also reported that the project helped to maintain young farmers close to their relatives as they had the opportunity to stay in rural areas and work on the land. In the view of the project manager, everything worked properly when the selected farmer had a vocation for fruticulture. Another important point mentioned by him was that the Juventude e Cooperativismo Project was one of the reasons for the existence of a specific credit line for the planting of açaí in the region of Marabá.

Among the reports of what did not work with this project, it was noted that many young farmers wished that the investments had lasted longer, which would have helped them stay in the field longer. The lack of resources after the second year caused the discontinuity of some projects, thus failing after a few years of implementation. The lack of irrigation within the scope of the project was another problem identified by the farmers (although some municipal governments offered irrigation systems for farmers, that was not part of the initial project). For the manager, the economic return time of fruticulture when compared to soybeans was one of the bottlenecks for farmers.

For the farmers, all knowledge about forest restoration was new. The production with agroforestry systems was an innovation for many families. The farmers welcomed the possibility of generating income with several annual crops and later with the fruticulture. For others, who had access to irrigation equipment, the installation of an irrigation system into the agricultural production process was one of the innovations of the project. There was also the development of actions that were not previously carried out by farmers in the region, such as the control of the “vassoura de bruxa” disease and the inoculation of mycorrhizal fungi to increase the plant’s resilience during the dry season.

Regarding what could be done differently, the most frequently mentioned action was the selection criterion of the farmers (i.e. the selection of people with an affinity with agroforestry). Secondly, improvements could be made regarding the selection of more profitable species (i.e. fruits with good market value or forest species with which farmers can earn income whether with seedlings or nuts). Supply of irrigation equipment was also mentioned as a possible way to improve the programme. They also mentioned the creation of on-site plant nurseries as an alternative to reduce farmers' withdrawal of the project and to ensure that planting was carried out in the appropriate periods. The acquisition of more investment funds, an increase in the area per rural property and the number of years of technical assistance were mentioned as other ways to improve the project’s success. The projects run by the Juventude e Cooperativismo programme are a form of dissemination of agroforestry models, thus, the programme may well have been more successful if the projects had been more evenly spread across the target region. Thus, a higher number of farmers would have been made aware of the possibilities of agroforestry.
This project was reported as one of the first experiences with agroforestry in the Marabá Region. The strengthening of cooperatives was believed to play a critical role in the continuity of such proposals. The construction of supply chains, such as the processing and marketing of fruit pulps and chocolates, is another instrument which needs to be addressed to improve the efficacy of agroforestry systems in the region. A major obstacle in terms of deforestation prevention was the perception of most farmers that forest species will not give them any economic returns. For the agroforestry experiment to be carried out successfully, raising awareness about the importance of forest species is fundamental. Accordingly, it would be important to include forestry species that can give financial returns to the producer.

The climatic issue, such as coping with droughts for agricultural production, was strongly emphasized by farmers. A solution proposed by some partner municipalities of the Juventude e Cooperativismo project, was the supply of irrigation equipment, which had excellent results and was spoken very highly of by the interviewees. On the other hand, investments are necessary to point out species that are more resilient to drought. This restoration experience brings a vibrant field of knowledge to the next projects. Therefore, it is necessary to think of all aspects of the field before implementing an agroforestry system.

The project manager of the Juventude e Cooperativismo stated that he had positive expectations for the future, and he believed that the farmers need to conserve forests, even in an unfavourable political context. It is possible to advance in restoration actions, but it is necessary for institutions to show farmers the necessity of restoration and the consequences of forest degradation (i.e. decrease in water supply, rainfall, warmer and drier microclimate). The manager also pointed out that the farmers in the region are learning, they are recovering on their own, and that they no longer want to clear-cut their land, they want to recover the forest.

An inherent legacy of this project is the maintenance of agroforestry systems on the properties. Although many young participants had given up a few years after the conclusion of the project, many parents had assimilated the ideas and continued investing in agroforestry. Many young farmers reported some resistance against the adoption of agroforestry from their parents at the beginning of the project. But, had successfully adopted agroforestry technique despite their parents’ initial reservations. Subsequent projects have a much better chance of being successful due to the lessons learned during the Juventude e Cooperativismo programme. The very short period of funding has been the main and most critical limitation for the success of the Juventude e Cooperativismo project. It is necessary to invest more efforts in a much longer-term project to encourage the adoption of agroforestry systems by young people in rural areas.
IV. RESTORATION PROJECTS BY THE MINING COMPANY VALE

The multinational mining company, VALE S.A., is a chief stakeholder in the Marabá Region. This company has several mining projects operating in the region since the 1970s. It is responsible for almost 70% of the mineral extraction in the state of Pará, extracting iron, copper, manganese, nickel and gold. In the Marabá Region, it is responsible for almost all the 4,000 ha of the mining area.

VALE has the legal obligation to compensate for its environmental liabilities, through social support procedures and environmental preservation. These liabilities are related to the vegetation extraction, intrinsic to their mineral activity, and other direct and indirect impacts related to their mining activity in the region. Social and environmental compensation is typically carried out by restoring the forest. Among these reforestation activities, several are developed on the land of smallholders. Below are some examples that illustrate the forest restoration of these areas by VALE.

One of the forms of restoration is done by contracting a third-party company to carry out restoration activities. These activities may take place in private areas acquired by VALE or in environmental protection areas, which are managed in cooperation with the Chico Mendes Institute of Biodiversity (ICMBio from Portuguese Instituto Chico Mendes de Biodiversidade).

The Florestas Engenharia company is one of the third-party firms contracted by VALE. This company is responsible for carrying out a project focused on reforestation using Brazil nut trees, a species currently protected by law in Brazil, as it is threatened with extinction, and is typical of the Carajás Conservation Unit Mosaic (Figure 1).

According to the interviewed technician from Florestas Enegenharia, in the last few years, they restored 187 ha in the Marabá Region, with an area of around 30 to 50 ha planted annually. The recovered areas are from abandoned pastures, in which, besides Brazilian nut trees, around 50 to 125 native forest species are planted, including some endangered species such as Mogno, Itaúba, Angelim and Acapu. Seedlings are initially planted with a spacing of 4x4 m. The preparation of the area is made according to the following steps: i) mechanical weeding with tractor; ii) application of herbicide/chemical weeding after regrowth of vegetation; iii) digging holes (manual or mechanized); iv) liming and fertilisation, when necessary; v) planting of seedlings; vi) maintaining area with herbicide use with an average frequency of three months during the first year; vii) annual firebreaks to prevent and contain accidental fires in reforested areas.

The project implemented by Florestas Engenharia benefits from scientific coordination by the Para’s Emilio Goeldi Museum (MPEG from Portuguese Museu Paraense Emílio Goeldi), in partnership with local and regional education institutions (UFRA, UNIFESSPA and UFOPA). The contracted company performs the monitoring of the plots and reports high survival rates of planted trees as well as satisfactory growth. Since seeds remain attached to Brazil nut seedlings, seed predation is a challenge faced by technical teams in the Marabá Region, tapirs (Tapirus terrestris) are the most common seed predators. The control of grass is considered one of the keys to the success of reforestation. According to the interviewed
technician, the use of herbicide is necessary until an efficient alternative technique for controlling this invader is developed.

Another strategy adopted by VALE is to support forest restoration in partnership with communities around its area of operation. One example is a project in partnership with the Cooperative Extractors of FLONA Carajás (COOEX, from Portuguese *Cooperativa dos Extrativistas da FLONA de Carajás*), in Parauapebas. In this project, VALE supports the income generation of COOEX members who collect seeds of native species within the conservation unit, which are destined for VALE forest nurseries and other institutions in the region. In 2017, VALE acquired 2,062 kg of forest seedlings from COOEX. In the same year, VALE’s forest nursery produced 204,885 plant seedlings of 125 different native species of the Marabá Region. These plant seedlings were used in their reforestation project, but also for the restoration of permanent preservation areas and other reforestation initiatives and agroforestry systems developed in partnership with communities and settlements in the region.

Lastly, there are restoration initiatives implemented by VALE's staff, including restoration areas of Permanent Protection Areas on properties surrounding the mosaic of protected areas. According to reports by VALE employees, approximately 150 ha were restored in the 2016-2018 period, and there is a plan to restore 125 ha between 2019-2022.

In conclusion, VALE is reported as an essential stakeholder for forest restoration initiatives in the Marabá Region. The mining company follows a diversity of reforestation strategies, it is, however, different to the other projects evaluated here in that it implements high diversity ecological restoration and exclusively uses native species, as required by their environmental compensation agreement.
PART III - Final Considerations

1. SYNTHESIS OF OUTCOMES

Our study revealed that the different projects presented in this document have a high overlap, even if one of them did not coincide in time with the others. The different projects built upon each other through the same purposes (i.e. agroforestry mainly for improving livelihoods of smallholders) and operational basis, sharing participants, technical assistants, as well as planting the same species and using the suppliers of seedlings.

All the projects delivered socioeconomic benefits, although to varying degrees, helping to increase family incomes and strengthening social networks within the communities. The most remarkable benefit was the contribution of the projects to increased food security and a more diversified diets for the participating families. These families are benefiting from access to greater diversities and quantities of food and are increasingly consuming more fresh fruits. Diversification of production through agroforestry increased resilience, promoting a change from a former focus on cattle ranching alone. Many farmers shared the aspiration to verticalize production, producing fruit pulps, mainly the highly valued fruits of the native palm açai, although only a few have realized this.

In general, the projects helped to increase tree cover in the rural properties, even though the area of forest is still very small and fragmented throughout the landscape. There were some improvements in habitat quality at local scale, such as alleviating heat, protecting water springs and improving soils. But the highest perceived contribution from the projects is the recovery of biodiversity, including the return of wild animals and conserving tree species that are vulnerable to extinction.

Despite the general perception that the projects contribute to a more efficient use of land and reduce deforestation, no evidence was found for increasing land cover in the region. In fact, one of the settlements used as a case study lost 70% of forest during the period of development of the PROSAF project.

2. CHALLENGES

The projects still have a limited spatial scale and changing this reality poses significant challenges. First, the number of farmers that are able to be involved in the projects is limited, as this is restricted by funding and poor institutional infrastructure. Second, the area available in each property is restricted by the relatively small size of the properties and labour shortages. Farmers have to reconcile a number of activities on their properties and there are only a few family members to help with the high workloads, as families nowadays are smaller and younger members leave the properties to live in urban areas. Third, the engagement of farmers has proven hard, resulting in a high rate of abandonment due to a myriad of problems. Project managers often recognize that it is key to select motivated and skilled farmers, but in practice this is not an easy task to accomplish. FLR, and agroforestry,
in particular, are innovations in the region, given the dominance of cattle pastures. It is largely accepted that innovation is done in niches and very often requires a long time and large efforts to be successful at large scales.

The studied projects were developed over very short periods (3-4 years). While we understand this is inherent to the nature of the projects, this reality is incompatible with the nature of cultivating tree systems such as agroforestry and nurturing innovation. For example, during the Rural Sustentável project most of the designated time was used for setting the necessary conditions for the project to initiate properly and then little time was left to implement the restoration activities. When the project finally began implementation, the funds were cut from Amazônia (and the Atlantic Forest) and moved elsewhere to other Brazilian biomes. If the projects had had longer durations, there would have been a better chance of gathering more useful information to help drive future innovation on FLR. This information could then have been used to guide restoration policies able to effect change at the scales expected by FLR initiatives. It is, however, unquestionable that these projects have left a legacy in the region that can be used to help develop further policies.

FLR projects have, in principle, multiple purposes (social, economic and environmental) and all the projects evaluated here did indeed have these explicitly defined. On the other hand, what we observed on the ground is that environmental objectives had only a secondary role well behind the socioeconomic objectives. The situation of social vulnerability of those communities living in agrarian reform settlements with few opportunities to improve livelihoods was surely a strong driving force for this. The problem is that few native species have an established market to help improve livelihoods. There are few exceptions, one of which is the açaí palm that has a large market nationally and internationally leading to the highest interest from the farmers. Thus, promoting different types of economic and non-economic incentives to strengthen the environmental benefits of these projects is an important challenge to be tackled. This includes increasing tree density and richness, which can be challenging because native species can be slow growing, and farmers are more interested in immediate returns. [The projects being developed by the mining company are very distinct as they have a very high plant diversity. On the other hand, they have a more limited scale in the region. Specific arrangements could be made to encourage higher tree diversity systems in smallholder areas supported by VALE].

The development of markets for the products currently produced by farmers, particularly trees, is key. Some very promising public policies were designed to incentivize the purchase of food products from smallholders for school meals, which proved to be successful, but the initiative has been weakened in recent months.

There are a number of common barriers that impede the development of different projects in the region, including FLR initiatives, particularly the chronic problems with technical assistance, as the agencies are underfunded and have much fewer staff than is necessary for such huge areas, as in the Marabá region, where there are more than 9,000 smallholders. One potential solution can be capacity building so that farmers can be more autonomous in maintaining and developing their plantations. This will entail well-considered strategies as the level of formal education among the participants is often very low. Another difficulty for land management is the control of invasive plants, a serious issue in the Amazon region, which often requires the use of agrochemicals that are not only undesirable
environmentally, but also expensive. Additionally, having seedlings readily available in the wet season for planting can pose difficulties in terms of transportation, as rural properties are sometimes long distances from nurseries and roads are often in poor condition. It might increase feasibility of projects if nurseries are as close as possible to the planting areas. On the other hand, managing collective nurseries proved to be very challenging. Again, solutions have to be designed to help farmers increase their autonomy to produce the seedlings on their own properties and reduce the burden of transportation.

Finally, there are two major risks in the implementation of FLR in the region. Droughts are becoming more frequent in the region, which is marked by significant seasonality in rainfall. Technicians and farmers have high expectation for installing irrigation systems, but these are very expensive and the higher demand for water can also impose environmental risks of depleting water bodies if FLR increases in scale. Fires represent a serious threat to the agroforestry systems in the region as they are becoming even more frequent during the dry season when they are used to clear agricultural areas and can often escape and spread throughout the wider landscape. This is another example of a chronic problem but that can be even more challenging to FLR. The solution involves developing management techniques, fire breaks and collective arrangements to avoid fires escaping.

In summary, although there are plenty of opportunities for FLR in the region, it also faces huge challenges that need to be tackled to realize its full potential. Among the three main projects evaluated here, only PROSAF is on the way to being consolidated as a state policy. But even PROSAF is vulnerable to political will and no guarantees exist that future governments will maintain it. The other two projects finished without any perspective of continuity. Despite this, these projects left an important legacy of technical knowledge and especially models that will inspire farmers and will certainly be useful to future FLR programmes.

3. OVERARCHING LESSONS

1. Policies and incentives are needed to encourage an increase in tree cover and tree diversity. Increases in tree diversity in the landscape are still very limited compared to their potential. There is a need to develop mechanisms to increase tree diversity to meet the twin goals of FLR. Smallholders are mainly interested in cattle ranching in the region. In general, their interest in FLR and reforestation is essentially generated by a lack of support for farming. Technical assistance is insufficient and so farmers are keen to receive any available assistance, which is very likely their main reason for joining the projects. The projects have sought to divert farmers’ interest from cattle to more diversified and tree-based systems. The reality on the ground is that the proportion of trees and diversity of trees is much lower than in the projects initially proposed. Trees are not at the heart of farmers’ interests.

2. The technical assistance model needs to be reviewed. Farmers need to be more independent in their ability to engage in FLR activities. Projects are frequently under-funded and technical assistance is more limited than farmers had hoped. They often did not know when to expect technical assistance, and yet are reliant on technical assistance. While
farmers do receive training, the type of training is insufficient. This study shows that one positive aspect of the projects is capacity building, with many field days included for training. However, the model may need to change to improve performance. Farmers may need more structured and regular courses.

3. Fire prevention needs to be part of the FLR model in Marabá. It is absolutely necessary to include fire prevention in the reforestation programmes. Wildfires are a huge issue and easily destroy restoration projects, causing frustration or resistance to engage in programmes. People who participated and were affected by fire, were frustrated feeling that the project had abandoned them. Fearing annual fires, some farmers simply did not want to engage in restoration seeing it as a futile effort. Preventing and combatting fires has to be included within reforestation programmes.

4. FLR pathways need to take droughts into account. There is a need to plan alternatives to deal with water shortages. Increasing irrigation is not the solution, but rather FLR needs to be considered part of the solution through species selection and species mixing in the landscape. Some interesting models that combine social and ecological goals, like the Rural Sustentável project were not given a chance due to their short duration.

5. Conflicting expectations can hamper FLR progress. Farmers may join FLR projects with the aim to receive general support and technical assistance, while donors and project leaders may have different objectives and expectations. It is important to recognise these different objectives and somehow be able to change them so that all those involved can share at least some objectives, otherwise they will be disappointed by progress and less likely to engage in future projects or abandon the project before its completion. Farmers on the ground are often alone and technical assistance is very important to them, but their main objective is increasing productivity rather than restoring forests. Yet, many farmers interviewed did acknowledge, to their surprise, that they could see the value of trees as providers of shade, additional food, recreation etc.

6. FLR and restoration more generally, require a different timeframe to that proposed by most projects. Long term programmes are necessary to achieve the ambitious goals of FLR. Current projects and programmes are very short and do not match the time scale necessary for forest restoration. Forest restoration requires time, while farmers are more interested in short term benefits and donors also tend to fund short term projects. Reaching ambitious objectives under FLR requires a much longer time, to engage stakeholders, achieve visible results, monitor and adapt landscape change as well as to learn how to improve, modify and adapt land and forest management to reach both socio-economic and ecological goals. Designing a network of model systems can help substantially. Efforts have to be made to allow the projects to be able to evolve into larger programmes and direct public policies.

7. Spatial scales in FLR create significant challenges. The area covered by the projects in Marabá is very extensive and yet very few technicians and vehicles were deployed. As a result, only small-scale changes can be achieved on the ground at the level of municipalities, which does not reflect the ambitions of FLR.

8. To limit abandonment rates, actions are necessary to motivate farmers to engage in FLR. Such actions need to be factored into projects right from the start so as not to lose their initial interest and enthusiasm. Some projects saw high drop out rates because of the lack
of motivation. If farmers are unable to see immediate benefits to them and their families, they move onto other activities and leave the projects.

References


