CENTRE FOR SUSTAINABILITY STUDIES AT THE
GETULIO VARGAS FOUNDATION (GVces / FGV-EAESP)

Financing forest recovery

First edition – February 2017

FEBRABAN
Brazilian Federation of Banks

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FGV EAESP
CENTRO DE ESTUDOS EM SUSTENTABILIDADE

FEBRABAN
Brazilian Federation of Banks

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Preface

FEBRABAN and GVces formed a partnership, which is now in its third cycle of activities, in order to analyse the possible options for leveraging the transition to a Green Economy in Brazil, via resources intermediated by the National Financial Sector (SFN). As a result of the first year of this partnership, a book was published in April of 2015 with the results of three complementary studies on the subject: the volume of allocated resources by the Financial Sector of the Green Economy, the institutional and regulatory framework for the National Financial Sector, and the relation between finance and sustainability in two sectors of the economy and two topics: agribusiness, renewable energy, biodiversity, and cities. In the second cycle of this partnership, during 2015, a further three studies were developed. The first was a discussion of the opportunities and limitations of the development of a Green Bonds market in Brazil, following international experiences. Another study addressed the opportunities and limitations of configuring Environmental Reserve Quotas (CRAs) as securities, and lastly, the third study consisted of an improvement of the methodology and quantification of the volume of resources intermediated by the National Financial Sector for the Green Economy and in sectors whose activities potentially cause socio-environmental impact.

During the third period of cooperation between FEBRABAN and GVces, in 2016, another three studies were produced. The first one seeks to make proposals for the action of the National Financial System in the agendas of sustainable buildings and energy efficiency. The second study is about the risks and opportunities of financial operations in sectors with intensive use of natural capital. The third study is on the identification of viable financing models for forest 'recomposition' – term used in this report as a synonym for recovery - as set forth in the New Forest Code (Law No. 12,651, May 25th, 2012).

This report presents this last study, which aims to analyse the economic and financial viability of selected models for the financing of forest recomposition in Brazil. The scope of the study covers the states of São Paulo, Paraná, and Mato Grosso, and the production of livestock, sugarcane, and soy. It additionally looks at the focus of family farming on polyculture systems.

In order to attain the proposed objective, economic-financial models were built to evaluate the impact of forest recomposition on the cash flow of its operations, considering their respective profitability. As a basis for these calculations it was decided that only forest recomposition activity without economic ends be considered, i.e. not accounting for any additional revenue.

The results of the models were discussed during 2016 with the Working Group (WG) held by FEBRABAN on this project and with other stakeholders involved in the subject.

The research was carried out through: i) a bibliographic review, particularly reports on environmental compliance of rural properties, legal frameworks, and financial instruments; ii) interviews with national and international participants of the forest recomposition market; iii) a financial modelling exercise based on Agrianual e Agripecuária[1] data for the identification of the financial product most adequate to the client profile and viable for financial institutions; iv) reflections with members of the FEBRABAN Working Group (WG) organized for this project and of the Sectorial Commissions on Social Responsibility and Sustainability, Rural Credit, and BNDES Affairs; and v) internal reflections of the GVces team.

This report is divided as follows: the first chapter provides the context of the study. The second chapter presents the basic concepts related to the subject. The third chapter presents the legal framework which impacts forest compliance activity at the federal level as well as the state level for the three chosen states. The fourth chapter presents the available finance mechanisms in Brazil for these activities. The fifth chapter discusses financial models and their assumptions. In the sixth chapter, the Monte Carlo simulations are presented. In the seventh chapter, the results obtained from the base-case and Monte Carlo modelling are presented. The eighth chapter is an analysis of the results obtained. In the ninth chapter, proposals are made for broadening the performance of the financial sector in financing the activities cited. Lastly, the tenth chapter consists of the final conclusions of report.

[1] Reports produced by Informa Economics IEG | FNP which has been active for 25 years in consulting in Agribusiness in Brazil.

1. Context

The New Forest Code (NFC), established by Law No. 12,651 of 25 May 2012 (Brasil, 2012) forms the legal basis for establishing criteria for the use and occupation of the soil of rural properties in Brazil, with a direct impact on the agricultural sector. Agribusiness is a key sector for the Brazilian economy, representing 21.46% of GDP[2] and 46.2% of Brazilian exports in 2015.[3] Agricultural activity in the country occupies approximately 30% of the national territory.[4]

The NFC is the basis for forest recomposition projects to occur on a large scale, as it defines forests and other forms of native vegetation as goods of common interest to all inhabitants of the country, exercising property rights within the limits established by the legislation. Important innovations of the NFC are the Rural Environmental Registry (CAR) and the Environmental Regulation Program (PRA), which aim to organize the process of environmental regulation.

As well as the NFC Brazil undertook, as part of its Nationally Determined Contribution (NDC) under the Paris Agreement,[5] the goal of restoring and reforesting 12 million hectares of forests by 2030. The completion of the process of registering rural producers through the Rural Environmental Registry (CAR) will indicate with greater precision the potential area on which environmental regularization will be required via the effective implementation of the NFC, thus enabling the goal established in the Brazilian NDC.

However, the NDC, as well as the mechanisms for implementing the NFC, particularly the PRA, require resources for financing the recomposition of the environmental liability that needs to be recovered. In order to meet the goal established by the NDC regarding forest recomposition, an investment of up to R$52 billion is estimated necessary, up to 2030.[6]

Therefore, although solutions exist, the costs of forest recomposition are not negligible. While the opportunity costs of avoiding greenhouse gas emissions (GHG) from deforestation are relatively low, forest recovery costs can be high, especially for small and medium-sized rural producers.[7] This is a challenge for society, especially for the landowners who will have to comply. This is because, according to the current economic model, forest recomposition in deforested areas may reduce the operational areas of rural properties as well as elevating costs without necessarily increasing revenue.

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[2] (CEPEA, 2016)
[3] (MAPA, 2016)
[4] (IBGE, 2006)
[5] The Paris Agreement was signed by 195 countries in December 2015, during the 21st Conference of the Parties to the UNFCCC (United Nations Framework Convention on Climate Change). Its objective is to limit global warming by up to 2°C, with efforts to not exceed 1.5°C by the end of this century, through legally binding contributions from all parties to the convention. The agreement was ratified by the Brazilian government in September 2016, which, taking 2005 as its base year, made a commitment to reduce is greenhouse gas emissions (GHG) by 37% by 2025 and 43% by 2030.
[6] (Kishinami & Watanabe Jr, 2016)
[7] (Soares-Filho, 2013)

On the other hand, it is known that agricultural activity depends heavily on natural resources and ecosystem services. Forest recomposition, as well as contributing towards the reduction of GHG emissions, also contributes to the provision of these services. These, in turn, contribute to maintaining the productive capacity of the land in the long term, through the services of climate regulation, control of soil erosion and nutrient loss, pollination, and water provision. Increasingly, there are noticeable productive benefits associated with ecosystem services which contribute positively to the medium and long-term economic value of regularized rural properties.

The economic value of rural properties is to be understood as the present value of cash flows generated over time. Thus mathematically, economic value can be expressed by the Net Present Value of the projection of cash flows of the property brought to present value by means of a discount rate. Mathematically, this can be written as:

Equation 1 – Calculation of Net Present Value:

$$VPL = \sum_{t=1}^{N} \frac{FCF_t}{(1+k)^t} - I_0$$

Source: Copeland, Weston, Shastri, 2005.

Where NPV is Net Present Value, NCFt is the net cash flow in time period t, I_0 is the initial cash outlay, k is the firm's weighted average cost of capital, and N is the number of years in the project.[8] However, future cash flows depend on the productive capacity of the property, which, as we know, correlates with the benefits provided by ecosystems.

From the perspective of the financial sector, the environmental non-regularization of rural properties represents a greater risk to its agribusiness portfolio. This is because the pressure on natural resources and ecosystem services can generate negative impacts on operations, decreasing profitability and consequently a reduction in payment capacity, depreciation of collateral and guarantees, and the possibility of incurring environmental fines for non-compliance, and non-access to international buyers' markets.

As such, the increase of capital flows destined to large scale forest recomposition in Brazil is a win-win relationship for both sides, the financial sector and the productive sector. The public sector is unable to finance the full amount needed, which implies the need for greater involvement from the financial sector in the subject. The challenge is to find the facilitators and the conditions to make the operation feasible for both the rural producer and the entrepreneur as well as the financial sector, contributing to the promotion of a model of agricultural production in Brazil in line with the principles of sustainability.

[8] (Copeland, Weston, & Shastri, 20015)

2. Important concepts when reading this study

It is important to mention that there are conceptual differences in the terms commonly used in the activity of recovering vegetation that has been deforested or degraded, either through manmade activity or a natural phenomenon. Restoration and recovery, for example, are different concepts and should not be used as synonyms.

Law No. 9,985 of 2000, which establishes the National System of Units of Conservation (SNUC), defines the terms as:

✓ **Restoration is the restitution of an ecosystem or degraded wild population as close as possible to its original condition;**

✓ **Recovery is the restitution of an ecosystem or degraded wild population to a non degraded condition, which may be different to its original condition.**

The term **restoration** is commonly found in the international literature, as for example, in the fundamental concepts adopted by the Society for Ecological Restoration (SER)[9] – a beacon in the field of restoration – and in articles in The Global Partnership on Forest and Landscape Restoration.[10] As in the definition provided by the SNUC law, the SER defines restoration as the process of returning an ecosystem to its historical trajectory.

The NFC, in dealing with areas consolidated in the Permanent Preservation Areas (Section II) and the Legal Reserve Areas (Section III), uses the term **recomposition**, a term not covered by the SNUC law. Nor does Article 3 of the NFC define the term **recomposition**.

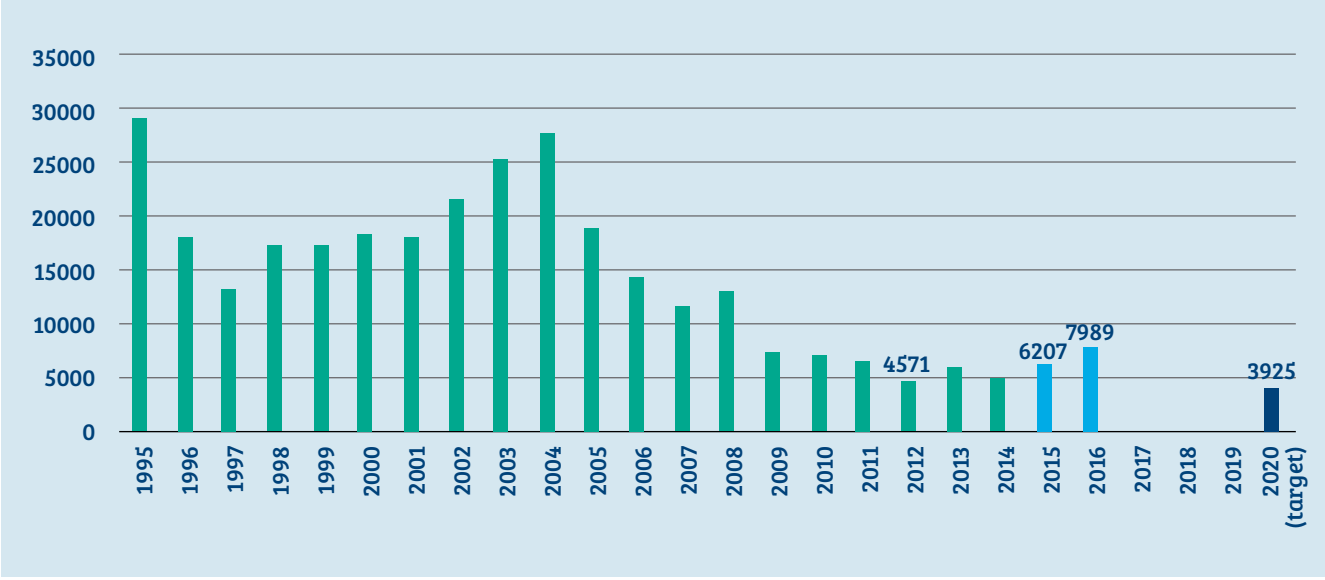
In the absence of a definition of the term 'recomposition' by the NCF, it has been assumed, for the purpose of this study, that **recovery** and **recomposition** are synonyms. Such a definition is important because there are implications regarding the costs assumed in financial modelling. Restoration processes can take longer and be costlier than recovery processes, as their objective is the restitution of an ecosystem or wild population to its original state.

[9] (SER - Society for Ecological Restoration, 2004)
[10] (The Global Partnership on Forest and Landscape Restoration)

Thus, in line with the presented definitions, forest recomposition, the object of this study, is an activity which has the objective of initiating or accelerating the recovery of a forest ecosystem which has been altered. In the Brazilian agricultural sector, the main environmental situations to which forest recomposition is applicable would be those under Permanent Preservation Areas (APPs), ecological corridors (normally occupying connections between APPs and Legal Reserves), areas used for agriculture with low aptitude, degraded pastures, already altered native forests (secondary forests) that make up the Legal Reserve of the rural properties, and areas of remnants suppressed irregularly.

Brazil has historically high rates of deforestation, mainly during the 90s and early 2000s. Figure 1 shows the consolidated annual deforestation rates in the Legal Amazon since 1995. As can be observed, between 2001 and 2012 there was a 70% drop in the annual rate of deforestation of the Brazilian Amazon[11], which began increasing again between 2014 and 2016: from 2014 to 2015, there was a 24% increase,[12] and from 2015 to 2016, a 29% increase.[13] For comparison, the deforestation reduction target for 2020 is still lower than the lowest historical value in the year 2012.

Figure 1 – Consolidated rates of annual deforestation in the Legal Amazon, 1995 to 2016 (km²)



Source: (INPE - Instituto de Pesquisas Espaciais, 2016)

In other biomes, high rates of deforestation in relation to the total area of the biome can also be observed, which by July 2008 were as follows: 75.88% of the Atlantic Forest,[14] 53.98% of the Pampa,[15] 47.84% of the Cerrado,[16] 45.39% of the Caatinga,[17] and 15.18% of the Pantanal.[18] These rates highlight the importance of forest recomposition.

[11] (Reddington, et al., 2015)
[12] (CCST/INPE, 2016)
[13] (Chiaretti, 2016)
[14] (PMDBBS, c2016c)
[15] (PMDBBS, c2016d)
[16] (PMDBBS, c2016b)
[17] (PMDBBS, c2016a)
[18] (PMDBBS, c2016e)

There are several ways of carrying out forest recomposition, which starts with the natural regeneration of vegetation and then intensifies, with human intervention, until it reaches a total plantation of native species. Determining the most adequate method of forest recomposition requires that some aspects be analysed, among them the state of conservation of the soil, the existence and abundance of the necessary conditions for the natural regeneration of vegetation, the richness of the species, and the location of these areas in relation to the remaining native forests. Based on the analysis of these factors, the best method of forest recomposition can be chosen. The main methods are:

- ✓ **Natural regeneration of vegetation: before implementing any type of forest recomposition action the existence of factors of degradation should first be identified and isolated so that, should the conditions be favourable, natural regeneration of the vegetation may occur. If they are not isolated, many of the efforts carried out before or during forest recovery may be lost through the continuity of these factors of degradation. Once these factors are isolated, the native vegetation has a better chance of developing, which in turn increases the efficiency of recomposition and reduces associated costs. Some of the more traditional forms of isolating target areas for forest recovery include the use of fences and/or firebreaks.***

- ✓ **Enrichment planting: should be carried out when there is a need to increase the diversity of the species in the area to be restored. To this end, seedlings or seeds of regional species are introduced, based on the biodiversity of a less modified vegetation in a similar biome.**

- ✓ **High-density planting: in areas where natural generation does not occur satisfactorily, seedlings of initial species of ecological succession are planted, which provide conditions for the development of end-stage species through shading.****

- ✓ **Total Plantation: when there is low potential for the natural regeneration of an area, total planting of seedlings is performed, combining species in the initial and final stages of succession, characterizing the different ecological groups of the natural process.*****

* (NBL and TNC, 2013)
** Adapted from (Brancalion et al., 2009)
*** Adapted from (Brancalion et al., 2009)

Regardless of the method used, an ecosystem is understood to have recovered when it has enough biotic and abiotic resources[19] to continue its development and sustain itself structurally and functionally without human intervention.

The cost of forest recomposition depends on several factors, presented in Table 1.

Table 1 – Factors which affect the costs of recomposition projects

Recomposition technique(s) adopted	Costs vary depending on the techniques adopted and their proportion in relation to others, where a combination of methods is used. The choice of techniques depends on local conditions, the quality, and the speed desired for vegetation cover. Total plantation is the most expensive technique, as it requires the highest intervention in the area.
Scale	Recomposition in large areas may allow for economies of scale, such as reducing input costs and other necessary resources.
Access to the area to be recovered	Greater distance from urban and rural centres affects the transport costs of inputs and personnel.
Topography	Areas with steeper slopes make recovery more difficult and reduce the use of machinery and equipment.
Capacity of the production chain in the region	Availability of business, technical, human, and seedling resources in quantity and quality in the region.
Hiring of labour	The need to hire external labour and wage level and legal framework on tax, social security and health and safety issues.
Investment in machinery and equipment	Project costs often include investments in machinery and equipment, which may explain significant variations between project costs.
Quality of recomposition and identification and mitigation of risks	Recomposition activity may result in vegetation cover with different characteristics in relation to factors such as diversity of species, height, crown area, and genetic origin. The impacts associated with events that are detrimental to recomposition (fire, rain, droughts, floods) require higher expenses for area recovery.

Source: Adapted from (Costa, 2016).

[19] Biotic resources: live organisms of an ecosystem; Abiotic resources: physical and chemical aspects of the environment (e.g. temperature, light, salinity, soil composition, water).

3. Legal basis

This chapter presents the main legal basis which determines the necessary limits and forms of forest recomposition in Brazil, which guide the performance of the productive sector.

Federal Law

The two main legal bases that govern forest formations in the country are the National System of Conservation Units (SNUC) and the Forest Code, the latter being especially relevant in the context of forest recomposition.

National System of Conservation Units (SNUC)

Federal Law No. 9,985 of 2000 established the National System of Conservation Units (SNUC). The SNUC divides Conservation Units (UCs) into two groups: Integral Protection Units and Sustainable Use Units (Law No. 9,985/2000, Article 7, items I and II). The first group is aimed at preserving nature, with only indirect use of its resources being allowed. The second group aims to make nature conservation compatible with the sustainable use of a portion of its natural resources (Law No. 9,985/2000, article 7, paragraphs 1 and 2).

The SNUC establishes that development projects which cause significant environmental impact must compensate for them, earmarking at least 0.5% of the value of the enterprise for the creation or management of Integral Protection Units, with revenue collected by the competent environmental agency. The larger the degree of the project's impact, the larger the percentage required by the competent environmental authority. In areas of tropical forests, for example, the proportion can exceed 6%.[20]

Forest Code

The Forest Code, established by Law No. 4,771 of 15th September, 1965 and later amended[21] by Law No. 12,651 of 25th May, 2012 (NFC), provides for the protection of native vegetation by defining, among private rural lands, categories of areas which are suitable for production and those which must be preserved.

Areas which must be conserved with their natural vegetation are subdivided into two categories: Permanent Preservation Areas (APP) and Legal Reserves (RL). If there has been a suppression of vegetation located in an APP or in the case of a rural property with a RL area inferior in extension to that established by the law, the land owner is obliged to recover the vegetation adopting the following alternatives, singularly or in conjunction:

[20] (ten Kate, Bishop, & Bayon, 2004)
[21] In Annex 2, the main changes between the old and the new Forest Code are described.

I – Recover vegetation;

II – Permit the natural regeneration of the vegetation; and/or

III – Compensate (allowed only with RL, not APP).

In order to do so, registration with the Rural Environmental Registry (CAR) is first required, and subsequently adherence to the Environmental Regulation Program (PRA). Created under the National System of Information on the Environment (SINIMA), the Rural Environmental Registry (CAR) is a "public electronic registry of national scope, which is obligatory for all rural property, with the aim of integrating environmental information of rural properties and possessions, forming a database for environmental and economic control, monitoring, and planning, and fighting deforestation" (Law No. 12,651/2012, Article 29).

The CAR includes data of the owner, rural owner, or the person directly responsible for the rural property; the georeferenced plan of the perimeter of the property, and the areas of social interest and of public utility; information on the location of remnants of native vegetation, consolidated areas, APPs, Restricted Use Areas (AUR), and RLs.

After the postponement of the deadline by Law No. 13,335/2016, rural properties have until 31st December 2017 to register with the CAR, with a possible extension until December 2018, at the discretion of the Executive Branch. Despite there not being a formal notification for not registering with the CAR, rural land owners or settlers who have not registered by this date will no longer be able to obtain bank financing as well as losing the benefits provided by the law, e.g. recognition of areas consolidated in the APPs and RLs, and the possibility of computation of the APP in the calculation of the RL area. Non-registration also prevents the rural landowner or settler from joining the PRA, as it is a prerequisite (Law No. 12,651/2012, Article 59, paragraph 2).

Adherence to the Environmental Regularization Program (PRA) is the next stage after registering a rural property or settlement with the CAR and its approval or validation by this environmental agency, and is part of the process of environmental regularization. Formal adherence to the PRA includes the signing of a Term of Commitment, which involves a Project for the Recomposition of Degraded and Changed Areas (PRADA), an instrument for planning recomposition actions containing methodologies, a chronogram, and inputs. As from signing with the PRA, sanctions arising from infractions related to the irregular suppression of vegetation in APPs, RLs, and AURs committed before 22nd July 2008 are suspended. In turn, vegetation recovery must be completed in 20 years, with a minimum of 1/10th of the area being restored per every two years, with APPs to be given priority at the beginning of the process.

Permanent Preservation Areas (APPs)

Permanent Preservation Areas are defined by Law No. 12,651/2012 as a "protected area, covered or not by native vegetation, with the environmental function of preserving water resources, landscape, geological stability and biodiversity, facilitating the gene flow of flora and fauna, protecting the soil, and ensuring the well-being of human populations" (Article 3, item II).

In APPs, "the continuity of agrosilvopastoral activity, ecotourism, and rural tourism in consolidated rural areas is authorised exclusively, until 22nd July 2008" (Law No. 12.651 / 2012, Article 61-A), i.e. economic use is not permitted.

Article 4 of the Forest Code defines APPs, in rural or urban zones, as: the banks of any natural watercourse (with ranges of bands from 30m to 500m, varying proportionally with the width of the course); the surroundings of springs (50m); the surroundings of lakes, natural lakes, and artificial reservoirs (variable sizes); on steep slopes over 45°; the tops of hills; areas of altitude above 1,800m; areas of sandbanks, mangroves, fringes of tablelands or plateaus, and vereda ecosystems. In the case of properties with consolidated areas in APPs, Article 61 indicates the minimum width which must be restored, as seen in Figure 2.

Figure 2 – Recomposition of Permanent Preservation Areas established by the Forest Code

Rural Property Area in Fiscal Modules	Minimum band to be restored			
	Water-courses	Perennial springheads	Veredas Eco-systems	Natural lakes and ponds
Up to 1 Fiscal Module	5 m	15 m	30 m	5 m
1 to 2 Fiscal Modules	8 m	15 m	30 m	8 m
2 to 4 Fiscal Modules	15 m	15 m	30 m	15 m

Rural Property Area in Fiscal Modules	Minimum band to be restored		
	Perennial spring-heads	Veredas Eco-systems	Natural lakes and ponds
More than 4 Fiscal Modules	15 m	50 m	30 m

Water courses	Band to be restored			
Length of Water-courses	Até 10 m	De 10,1 até 60 m	De 60,1 até 200 m	Acima de 200 m
4 to 10 Fiscal Modules	20 m	30 m	Length of Water-courses/2	100 m
Over 10 Fiscal Modules	30 m	30 m	Length of Water-courses/2	100 m

Source: (Embrapa, 2016)

The recomposition of these can be carried out, alone or jointly, through four methods: "conduction of natural regeneration of native species"; "planting of native species"; "planting of native species combined with the conduction of natural regeneration of native species"; and for small farms and family farming, the "intercropping of woody, perennial, or long-cycle species, exotic with native regional occurrence, of up to 50% (...) of the total area to be replanted" (Law No. 12,651/2012, Article 61-A, paragraph 13, items I to IV).

Legal Reserve (RL)

A Legal Reserve is defined by Law No. 12,651/2012 as:

> **"Area located in the interior of a property or rural property (...) with the purpose of ensuring the sustainable economic use of the natural resources of the rural property, assisting the conservation and rehabilitation of ecological processes and promoting the conservation of biodiversity, as well as the shelter and protection of wildlife and native flora " (Article 3, item III).**

As mentioned in the definition, the Legal Reserve includes the possibility of economic exploitation through sustainable management, which must "not de-characterize the vegetation cover nor harm the conservation of the area's native vegetation"; "ensure the maintenance of the diversity of species"; and "to manage exotic species with the adoption of measures which favour the regeneration of native species" (Law No. 12,651/2012, Article 22, items I, II and III).

Article 12 of the New Forest Code establishes that all rural properties must maintain an area with native vegetation cover, with the minimum percentages in relation to the area of each property described in Table 2.

Table 2 – Minimum percentages of Legal Reserve area established by the Forest Code

Region	Physiognomy or class	Percentage
Legal Amazon	Forest Area	80%
	Cerrado Area	35%
	Fields	20%
	Municipalities with 50% in CUs	50%
	Municipalities with ZEE	50%
Other regions of the country		20%

Source: Elaborated by Authors, based on Law No. 12,651/2012, Article 12, items I and II.

According to article 15, it is also permitted to compute the APP into the calculation of the RL percentage of the property, as long as it does not involve the conversion of new areas to alternative land use, that the area is conserved or in the process of recovery, and that the property is registered with the Rural Environmental Registry (CAR).

If recomposition is chosen of the three alternatives for the regularization of RL areas, it must be completed in up to 20 years. Recomposition may involve intercalating native[22] with exotic species[23] or fruit trees in an agroforestry system, provided that the planting of exotic species is combined with native species of regional occurrence, and provided that the area restored with exotic species does not exceed 50% of the total area to be recovered (Law No. 12,651/2012, Article 66, paragraphs 2 and 3).

Compensation may occur in four ways (Law No. 12,651/2012, Article 66, paragraph 5, items I to IV):

- ✓ **Acquisition of Environmental Reserve Quota (CRA);**
- ✓ **Leasing an area under environmental easement or Legal Reserve;**
- ✓ **Donation to the public authority of the area located inside the Conservation Unit of public domain pending land regularization; or**
- ✓ **Registration of another area equivalent to or exceeding the Legal Reserve, on a property of the same ownership or acquired on a third-party property, with established native vegetation, in regeneration or recovery, provided it is located in the same biome.**

Environmental Reserve Quota (CRA) as a mechanism for recovering liabilities from a Legal Reserve

The NFC stipulates that the Federal Government may institute a program for the support and encouragement of preservation[24] and recovery of the environment, with several categories and lines of action, among them (Law No. 12,651/2012, Article 41, items I, II and III) :

[22] Natural species of the ecosystem.
[23] Unnatural species of the ecosystem, which can be introduced naturally or through human action, and may or may not be harmful to the ecosystem.
[24] Maintenance activity of APPs and RLs are eligible for payments or incentives for environmental services, and are considered as additional for the purposes of certified GHG emission reductions markets (Law No. 12,651/2012, Article 41, paragraph 4).

- ✓ **Payment for Environmental Services (PES), such as for example, water conservation and climate regulation. PES may or may not have financial retribution, being primarily aimed at family farming with the objective of creating a market of environmental services;**

- ✓ **Compensation for environmental conservation measures, such as for example: obtaining agricultural credit with lower interest rates, contracting agricultural insurance under better-than-market conditions, allocating resources from water use charges for the recovery of APPs and RLs, exemption from taxes for the main input and equipment, credit lines for attending voluntary preservation initiatives, sustainable forest management, or recovery of degraded areas; and**

- ✓ **Incentives for the commercialization, innovation, and acceleration of actions for the recovery, conservation, and sustainable use of forests, such as the allocation of resources for research.**

In addition to the categories mentioned, an important mechanism stipulated by the NFC is the Environmental Reserve Quota (CRA), a "registered bond representative of an area with native vegetation, either existent or in the process of recovery" (Law No. 12,651/2012, Article 44), with four types of area which can guarantee a CRA:

- ✓ **Under a system of environmental easement;**

- ✓ **Exceeding Legal Reserve;**

- ✓ **Classified as Private Reserve of Natural Heritage (RPPN); or**

- ✓ **In properties within Conservation Units.**

Each CRA corresponds to 1 (one) hectare of "an area with native vegetation or secondary vegetation in any stage of regeneration or recovery" or "of areas of recomposition through reforestation with native species" (Law No. 12,651/2012, Article 46, items I and II).

The CRA of a property can be used to compensate for the deficit of a Legal Reserve of another, provided that it is equivalent in area and is situated in the same biome and preferably the same state. If not in the same state, compensation should occur in areas identified as priorities by the Union or the states (Law No. 12,651/2012, Article 66, paragraph 6, items I to III).

The issuance of CRA is not regulated, and must be requested by the land owner after the property is registered with the Rural Environmental Registry (CAR).

State Law

As the scope of this report focuses on the states of São Paulo, Paraná, and Mato Grosso, the particularities of the legislation of these regions is presented below.

Regulation of CAR and PRA in the states of São Paulo, Paraná and Mato Grosso

Regarding the regulation of PRAs, the Union has established only general norms, with it being up to the States to provide the details through specific norms, which is due to the existence of territorial, climatic, historical, cultural, economic and social particularities (Law No. 12,651/2012, Article 59, paragraph 1). Taking these particularities into account, Table 3 shows a comparison between some aspects of PRA regulations of the states mentioned above.

Table 3 – Comparison between the regulations of the Environmental Regularization Program (PRA) of São Paulo, Paraná and Mato Grosso

	São Paulo	Paraná	Mato Grosso
Laws/ Decrees/ State Resolutions	• Law No. 15,684/2015; • Decree No. 61,792/2016; • Joint Resolution 1/2016 SMA / SAA; • On 01/06/2016, PRA legislation of São Paulo was suspended due to a judicial injunction and depends on the judgment to resolve the conflict (see ADI of the State Law that established the PRA-SP - process No. 2100850- 72.2016.8.26.000).	• Law 18,295/2014; • Decree No. 2,711/2015.	• State Decree No. 420/2016.
Deadline for joining the PRA	1 year from the specific SMA resolution (to be published).	Does not state a deadline for compulsory membership of the PRA.	Deadline for compulsory membership on 05/02/2017.
Environmental agency responsible	• State Environment Office – SMA*: i. Environmental Company of the State of São Paulo – CETESB ii. Coordinating Body of Biodiversity and Natural Resources - CBRN iii. Coordinating Body of Environmental Inspection - CFA • Secretariat of Agriculture and Supply - SAA	Environmental Institute of Paraná- IAP	Mato Grosso State Environmental Office– SEMA/MT

	São Paulo	Paraná	Mato Grosso
Scope (covers deforestation occurring before and after 2008)	• Only areas deforested before 22nd July, 2008 may join the PRA; • Deforested areas after 22nd July, 2008 cannot be regularized based on the PRA (SMA is still discussing whether there will be a specific Commitment Term for these cases).	• Only areas converted up until 22nd July 2008 may join the PRA; • There is no possibility of joining the PRA for areas deforested after 22/07/2008.	• Only areas converted up until 22nd July 2008 may join the PRA; • There is no mention of the possibility of joining the PRA for areas deforested after 22/07/2008, nor are other forms of regularization mentioned.
CAR (Rural Environmental Registry)	Deadline for registration is 31/12/2017	Deadline for registration is 31/12/2017	Deadline for registration is 31/12/2017
PRADA (Project for the Recomposition of Degraded and Altered Areas)	• 12-month deadline for environmental agency evaluation; • Does not propose a model for PRADA; • 90-day deadline for rectification of PRADA; • 20-day deadline for administrative appeal, if PRADA is denied.	• Does not provide for PRADA evaluation period in the environmental body; • Does not propose a model for PRADA; • No deadline for rectification of PRADA.	• Does not provide for PRADA evaluation period in the environmental body; • Does not propose a model for PRADA; • No deadline for rectification of PRADA.

* The SMA and SAA are responsible for the homologation of PRADA and CAR analysis in the following way: i. CETESB for properties which have or are undergoing environmental licensing; ii. CFA for properties with a regularization of infraction notice; iii. CBRN for other properties with more than 4MF; iv. SAA for properties with less than 4MF. For properties with less than 4MF, competence is exclusive to SAA, as is approval of institution of Legal Reserve. For the monitoring of regularization, the Computerized Support System for Ecological Restoration (SARE) was created whose function, among several others, is to monitor approved PRADAs. The System stipulates that the owner must feed the registry in periods as yet to be defined, so that restoration activity can be monitored by the environmental agency until the end of their compliance (Resolution SMA 32/2014).

Source: (Lima & Munhoz, 2016)

Formal adhesion to the PRA contemplates the signing of a Commitment Term containing, at the minimum, the commitment to maintain or recover degraded or altered areas in APPs, RLs, and Restricted Use Areas of the rural property, or to compensate RL areas.[25] In the PRAs of the three states analysed, the Commitment Term guarantees the concession of benefits of consolidated areas, being an instrument which suspends fines and environmental crimes provided that the producer is regularized (conversion of fines into environmental services). São Paulo established a 90-day deadline for signing of the Term from the homologation of PRADA by the environmental agency, Mato Grosso established a 60-day deadline, and Paraná does not state a deadline.

[25] (Embrapa, 2016)

Table 4 and Table 5 present the main points regarding RLs and their suitability for each of the three states.

Table 4 – Information on Legal Reserves contained in the Environmental Regulation Programs (PRAs) of São Paulo, Paraná and Mato Grosso

LEGAL RESERVE (RL)
São Paulo
✓ Period for landholding regularization: up to 20 years (1/10th of the area every 2 years);
✓ Does not stipulate a minimum number of species for recomposition (specific resolution may address this in the future);
✓ Allows non-consecutive planting of up to 50% exotic species with 50% native species;
✓ The Law allows for the economic exploitation of RL via the Sustainable Forest Management Plan (PMFS), but the Resolution does not mention possibilities of exploitation;
✓ Exemption of RL recomposition, due to the recognition of deforested areas according to the law of that time, will be recognized by the Secretariat of Agriculture and Supply (SAA) according to the following percentages: i. During the period from 23/01/1934 to 15/09/1965 the producer should maintain 25% of the existing forests; ii. During the period from 15/09/1965 to 18/07/1989 the producer should maintain 20% of the area of each property with forest cover; iii. During the period from 18/07/1989 to 28/05/2012 the producer had to maintain 20% of the area of each property for all forms of vegetation (identification of the form of vegetation and the period of opening of consolidated situations could be proved with documents or all other forms of proof admissible).

Paraná
✓ Period for landholding regularization: up to 20 years (1/10th of the area every 2 years);
✓ Allows non-consecutive planting of up to 50% exotic species with 50% native species;
✓ The Law allows for the economic exploitation of RL via the Sustainable Forest Management Plan (PMFS);
✓ An exemption of RL recomposition, due to the recognition of deforested areas according to the law of that time, will be recognized by the Environmental Institute of Paraná (IAP) according to the following percentages: i. Up until 01/05/1935 the producer is not required to maintain the RL area (0%); ii. During the period from 02/05/1935 to 15/01/1966, the producer should maintain 25% of areas occupied with forest physiognomy and 0% for Cerrado cover; iii. During the period from 16/01/1966 to 19/07/1989, the producer should maintain 20% of the area of each property with forest cover and 0% for Cerrado cover; iv. During the period from 20/07/1989 to 26/05/2000, the producer should maintain 20% of the area of each property for all forms of vegetation (identification of the form of vegetation and the period of opening of consolidated situations could be proved with documents or all other forms of proof admissible); v. During the period from 28/05/2000 to 25/05/2012, the producer should maintain 20% of the property in addition to the Permanent Preservation Area.

Mato Grosso
✓ Period for regularization: up to 20 years (1/10th of the area every 2 years);
✓ Does not mention non-consecutive planting with up to 50% of exotic species;
✓ Does not mention the possibility of economic exploitation;
✓ Land owners who deforested Legal Reserves up until 26/05/2000 can maintain the following percentages of RL:
Amazon Forest
✓ 50% RL remains at 50% RL;
✓ RL greater than 50%, the percentage of RL existing before conversion must be kept (surplus can be used for compensation);
✓ RL lower than 50% must restore, regenerate, or compensate the RL until reaching 50% of RL.

Cerrado
✓ 20% RL remains at 20% RL;
✓ RL greater than 20%, the percentage of RL existing before conversion must be kept;
✓ RL lower than 20% must restore, regenerate, or compensate the RL until reaching 20% of RL.

Source: (Lima & Munhoz, 2016)

Table 5 – Information on Legal Reserve compensation contained in the Environmental Regularization Programs (PRAs) of São Paulo, Paraná and Mato Grosso

LEGAL RESERVE COMPENSATION
São Paulo
✓ The compensation of RL within the State can be made provided that it is an area of the same extension and in the same biome;
✓ If the proposed compensation of RL presented in PRADA is twice rejected by SMA, the producer must restore the RL on the property itself (this device may be revised);
✓ Compensation of RL liabilities in other states should follow requirements cumulatively: i. Priority areas; ii. Spanning river basins shared with the State of São Paulo, itemized in the SMA Resolution to be approved; iii. The existence of an agreement signed between the State of São Paulo and the state where the RL will be located.
✓ The State of São Paulo has not yet approved the map of priority areas and interstate agreements.
Paraná
✓ Mentions the possibility of RL compensation within the State, but does not establish criteria;
✓ Does not mention the possibility of interstate RL compensation.
Mato Grosso
✓ The compensation of RL within the State can be made provided that it is an area of the same extension and in the same biome;
✓ Compensation of the Cerrado biome is permitted in the Pantanal biome;
✓ Only allows compensation in another state where there are no further areas that can be used within the State of Mato Grosso.

Source: (Lima & Munhoz, 2016)

4. Financing mechanisms for forest restoration[26] in Brazil

In Brazil, there is still an information gap regarding forest restoration. There is no system which accounts for ongoing restoration activity, its costs, location, and business owners. Regarding information on forms of financing, some types of restoration activity are financed by banks together with other productive activities, but since the resources are not segregated, the exact funding amounts for restoration are uncertain. There are also initiatives by rural producers, companies, states, and municipalities using own resources, third party resources, government programs, private funds, or individual donations.[27]

Regarding financial institutions, the National Bank for Economic and Social Development (BNDES) has some credit lines for forest restoration, among them the ABC Program (Low Carbon Agriculture), the BNDES Forest, the Climate Fund, and the BNDES Atlantic Forest Initiative (IBMA). According to a survey by (Costa, 2016), which compiled a set of direct and indirect reimbursable and non-reimbursable operations,

> **Only three direct reimbursable operations accounted for a total of 23 thousand hectares, with R$216 million in financing, with a single operation accounting for R$167 million. ABC's indirect reimbursable support in the ABC Environmental category, which includes restoration, totals 78 operations and R$24 million, less than the non-reimbursable support of the IBMA and the BNDES Ecological Restoration, of R$75 million. These are low figures when compared to the total disbursement of the ABC program as a whole. In the 2012-2013, 2013-2014 and 2014-2015 harvests, the total was approximately R$3 billion each (Costa, 2016, p.224).**

Requests to finance forest restoration were still low by 2015. Even in 2016 there was still no significant demand arising from the obligation to restore natural vegetation, since the deadline for registration with the CAR was extended, and the demand for financing recomposition activity tends to grow from the moment the terms of a commitment agreement are signed by rural property owners.[28] The BNDES Forest Compensation Program, for example, was launched in 2009 to support the regularization of rural properties with RL liabilities, but no operations were presented and the program therefore was not renewed after its expiration.

[26] Although the present study considers forest recovery or restoration to be the basis of this study, this chapter deals with initiatives for financing forest restoration, as this is the term most commonly used in existing initiatives and credit lines. In addition, when dealing with forest restoration, forest recovery actions are also included, since these constitute an earlier stage of restoration of a degraded ecosystem.

[27] (Costa, 2016)

[28] (Costa, 2016)

Similarly, the Climate Fund program for forests, made available since 2012 with attractive interest rates for restoration, also presents a low demand for resources.[29] One instrument in the context of the financing of forest recomposition is the BNDES Mata Atlântica Initiative (IBMA), launched in 2009 by the BNDES with the objective of supporting restoration projects in direct non-reimbursable form, using funds from the BNDES Social Fund.

The IBMA's budget for supporting projects is divided into restoration; management; and training/communication. These projects have an average cost of R$13.5 thousand/hectare, with restoration accounting for 80% of total costs. Some important results from the IBMA, which generated collective benefits, justified non-reimbursable support for activity: formation of ecological corridors; recovery of areas in Conservation Units; investments in the productive chain of restoration; employment and income generation; professional training of low-income population; and conservation of biodiversity.[30]

There are also lines of financing that despite needing adjustments, can already be used by rural landowners, such as the Family Agriculture Program (Pronaf); the Medium Producer Support Program (Pronamp); the BNDES Finame; lines of support from public banks - Banco do Brasil, Banco da Amazônia and Banco do Nordeste; and credit lines made available by private banks. There is a set of agents and financial instruments which can interact to support forest restoration, which are listed in Table 6.

Table 6 – Final beneficiaries, instruments, funders, and sources of funds for forest restoration activity

Final beneficiaries	**rural land owners; States; municipalities; settlements; cooperatives; indigenous peoples; companies; foundations; NGOs.**
Instruments	**Reimbursable financing; non-reimbursable financing; direct donations; payment for environmental services; voluntary carbon market.**
Funders	**companies; development banks; public and private banks; states; municipalities.**
Sources of funds	**Green Climate Fund; countries, multilateral banks; national banks; Climate Fund; various funds; states; municipalities; companies.**

Source: (Costa, 2016, p. 250)

[29] (Costa, 2016)
[30] (Costa, 2016)

Although there are already mechanisms that could potentially be used to finance the areas and producers, there are challenges that need to be overcome so that areas that need to be recovered can receive funding.

From the viewpoint of the productive sector, there is legal uncertainty stemming from the postponement of the deadline for rural producers registering with the CAR. The extension of this period for registration is detrimental to producers who have complied with the original deadline, as well as discrediting the NFC. Any eventual further extension of the deadline could result in a weakening of the image of the Brazilian agriculture and livestock industry before international markets and investors, difficulties in implementing zero deforestation value chain commitments and negatively influence compliance with international agreements, particularly Brazilian targets for the reduction of GHG emissions. Another significant factor of legal uncertainty is the Direct Unconstitutionality Actions (ADIs) filed by the Attorney General's Office in the Federal Supreme Court challenging NFC provisions. At the time of finalizing this document, (December 2016) the ADIs had not been judged by the Supreme Court.

There is a high level of debt among rural producers in Brazil. Data from the Central Bank of Brazil for 2014 indicates that the consolidated debt to banks totalled, between costs, investment, and commercialization, a total of R$290.7 billion, of which R$175.2 billion are investment,[31] representing approximately 22.93% and 13.82% of the GDP of Brazilian agribusiness in 2015.[32] As such, the costs of forest recomposition may increase this debt, if not adequately formulated.

Another complicating factor is the high cost of monitoring operations that are included in forest recomposition. This is due to the difficulty in monitoring the progress of vegetation cover, as well as its maintenance over the period of validity of the credit agreement. These factors increase the cost of financing for the banks, and should be taken into account in the context of providing financing for environmental compliance.

Lastly, there is the question of guarantees. In general, when a producer takes on rural credit, the property is given as a guarantee. To take on credit for carrying out forest recomposition, an additional guarantee is necessary as the same property cannot be given twice as guarantee for two different loans. The guarantee is a central element for the financial sector, as it reduces the risk of the operation for the banks.

[31] (Melles, 2015)
[32] (CEPEA, 2016)

5. Methodology for analyzing the feasibility of financing forest recomposition

Financial modelling

The financial model adopted seeks to understand whether the returns on the main operation over time are potentially sufficient so that land owners can manage the costs of financing forest recomposition. Two analyses were carried out in order to understand a producer's potential ability to pay: i) whether the accumulated annual cash flow of the producer is positive or negative over the projected period; and ii) the percentage of the cost of financing the forest recomposition (financial expense plus amortization) over the profitability of the property.

For the construction of the models, we identified the dominant operational activity of the property, the state in which the property is located, and the client profile, as shown in Table 7.

Table 7 – Financial modelling for ways to solutions for financing recomposition

Type of Restoration	**APP (or RL without economic exploitation)**
Type of Client	**Land owner: medium and large** **Rural producer: small, medium, and large** **Family farmer**
Operational activity	**Sugar cane, grain/soy, livestock, and integrated systems**
Location	**States of SP, PR and MT**

All scenarios are restricted to forest recomposition of APPs and RLs, provided there is no economic exploitation of the latter. As the economic use of areas in APPs is forbidden, there is no additional revenue in these areas. In these cases, it is necessary to assess whether the operational areas of these properties are able to cover the financing costs of the area to be reclaimed for environmental compliance. Such a recovery is necessary regardless of its economic use, so that the property as a whole is in compliance with the law and can function properly. In the case of RLs, the Forest Code permits the economic use of up to 50% of the area, which can therefore contribute to the economic feasibility of forest recomposition. This is, however, not the focus of this study and will be assessed later.

Model variables

Regions assessed

The states of São Paulo, Paraná and Mato Grosso were assessed in the modelling. The state of Mato Grosso was selected as it has approximately a 15% share of Brazilian agriculture, which in turn accounts for about 5% of the country's GDP.[33] In addition, Mato Grosso is the state with the highest accumulated rate of deforestation, corresponding to approximately 36% of the total deforested Brazilian Amazon.[34] It is worth noting, however, that only recomposition of vegetation for the Cerrado portion was assessed.

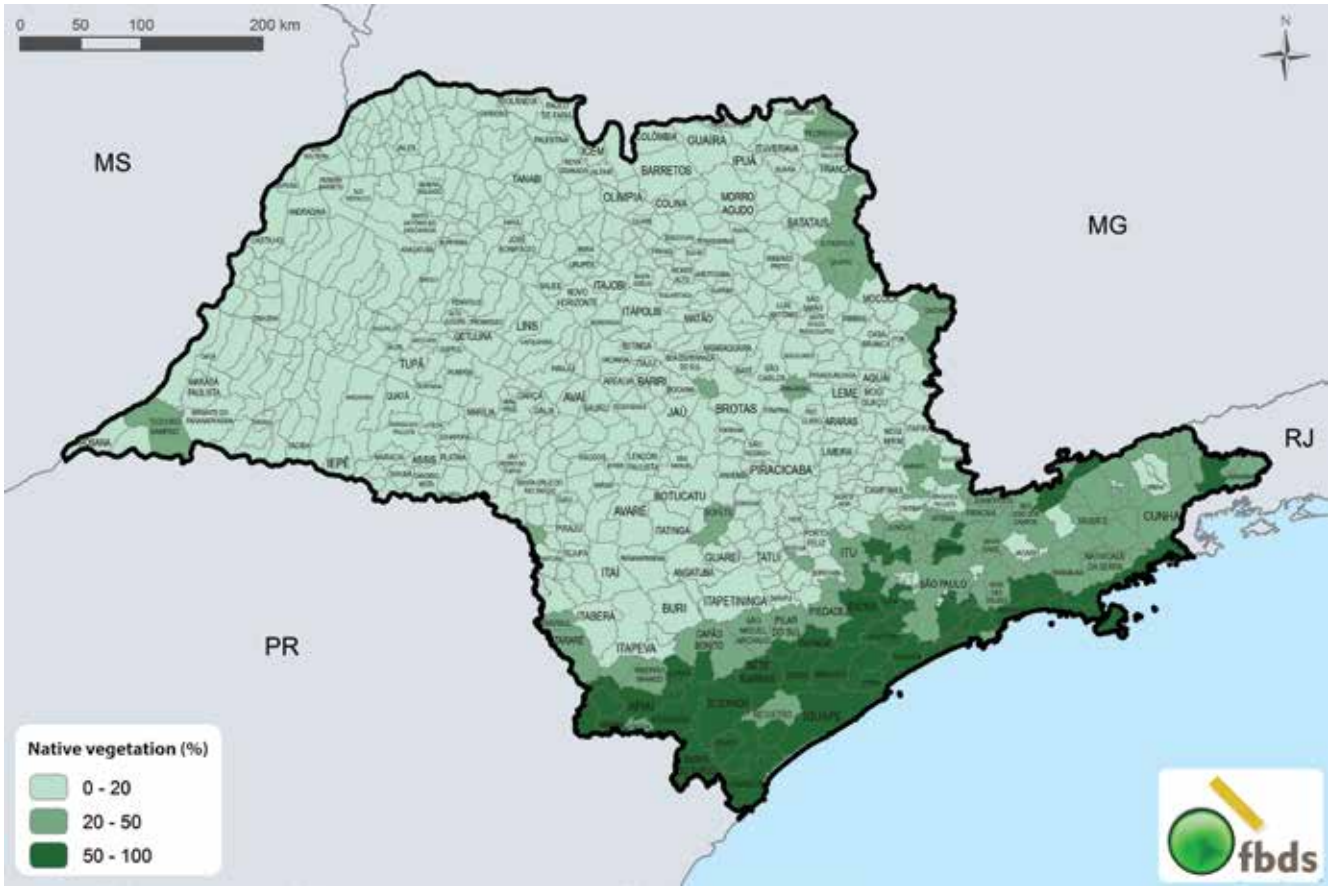
The states of São Paulo and Paraná were selected due to the significance of environmental liabilities in the Atlantic Forest biome. In Paraná, the biome is present in 99% of the area, with only 11.7% of the original vegetation remaining (approximately 2.3 million hectares), with deforestation once again advancing within the state in the period 2014-2015 with a 116% increase in relation to the period 2013-2014.[35] The state of São Paulo, despite being among the seven states with less than 100 hectares of deforestation in 2015, was included in the analysis due to its historical deforestation and its environmental liabilities, as well as its relevance to the national economy.[36]

Two of the three selected states have their environmental liabilities mapped by the Brazilian Foundation for Sustainable Development (FBDS),[37] which, for municipalities of the Cerrado and Atlantic Forest, surveys environmental liabilities in APPs of water bodies following NFC regulations.

According to the FBDS survey, 19% of the territory of São Paulo is composed of natural vegetation. However, many of these remnants are found in areas of Conservation Units, indicating deficits in rural properties. Figure 3 shows municipalities of São Paulo categorized by percentage of remaining native vegetation cover. It should be noted that the great majority of municipalities, especially those located in the Paraná river basin, have below 20% vegetation cover.

[33] (Mapa, 2016)
[34] (Teixeira, Almeida, & Bertella, 2014)
[35] (SOS Mata Atlântica, 2016)
[36] (Victor, Cavalli, Guillaumon, & Filho, 2005)
[37] The Project to Support the Implementation of the CAR – Atlantic Forest and Cerrado has the objective of measuring the environmental liabilities in the APP of water bodies, following the rules of the Native Vegetation Protection Law (or New Forest Code). To this end, the FBDS uses the municipal court and RapidEve images (1: 20,000), for the mapping of soil use, surveying the drainage network, and the spatialization of APPs that need to be recovered. The project also aims to create tools for the validation of the CAR by the States of the Federation and by the Brazilian Forest Service (SFB), to be carried out in the Atlantic Forest and Cerrado Biomes. By November 2016, data analysed for 2,276 Brazilian municipalities in these two biomes had already been shared. Two clear effects of this measure can be seen in the aid for the recovery of natural vegetation in APPs – including based on instruments set forth in the new code - and the formalization of agricultural production, allowing them access to bank credit and sustainable production chains. The project is financed by federations and private sector associations (FEBRABAN, IBÁ, SRB, AGROICONE, ABAG, FENASEG, UNICA and Instituto Aço Brasil), based on a technical cooperation agreement signed with the Ministry of Environment and Embrapa (FBDS, 2016).

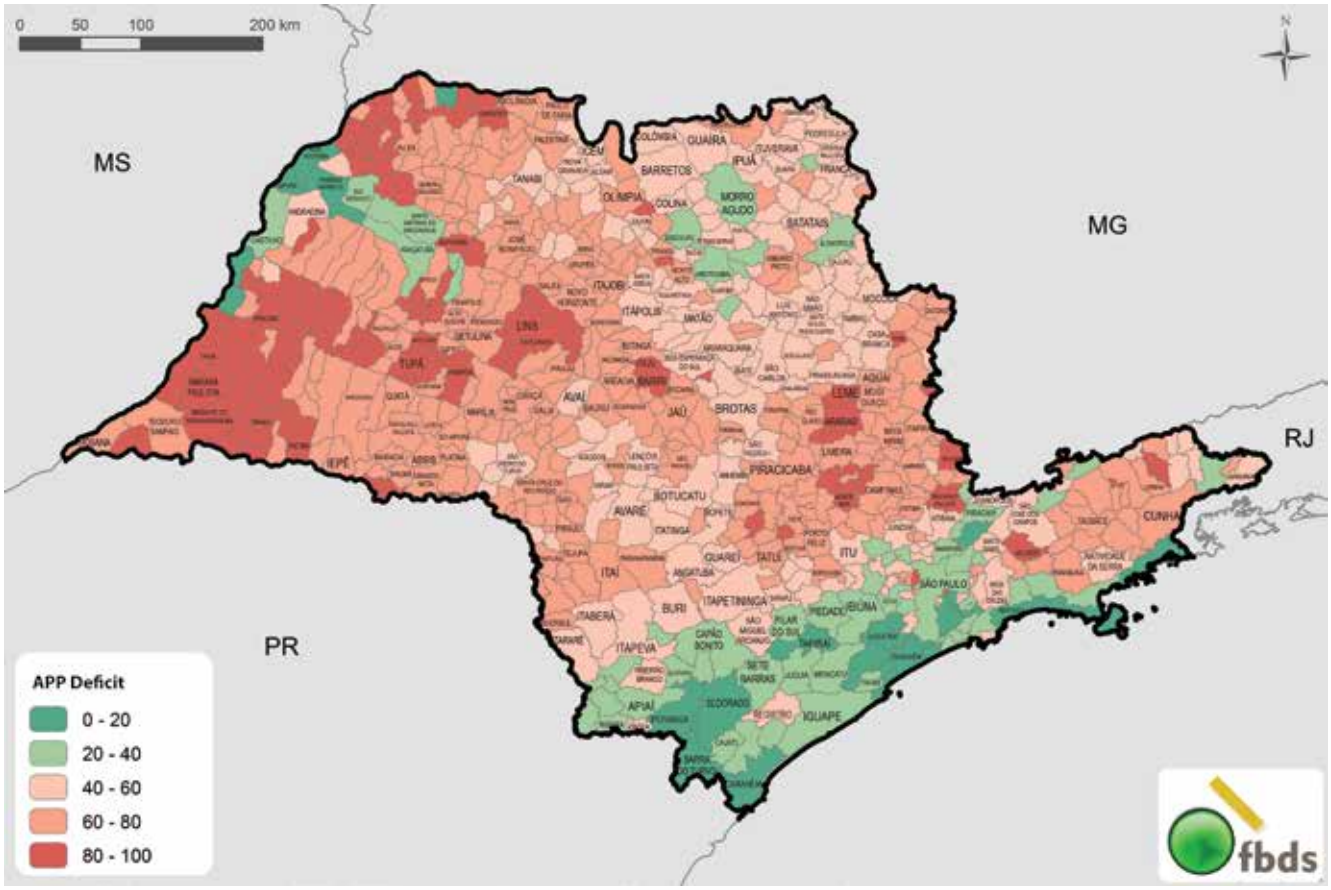
Figure 3 – Municipalities of São Paulo categorized by percentage of remaining native vegetation cover



Source: FBDS, 2016.

Figure 4 only considers data for compliance with Permanent Preservation Areas of watercourses, shown by the FBDS survey. It should be noted that the deficit in water APPs is a representative proportion, with several municipalities with deficits greater than 60% of the area required to be regularized. It is also worth highlighting the areas of Pontal do Paranapanema and Rio do Peixe, with the greatest deficit, historically occupied for beef cattle ranching and more recently for sugarcane crops. Additionally, the Piracicaba-Capivari-Jundiaí basins, and the Paraíba do Sul basin, which supply the largest urban areas of the State, all have high non-compliance rates.

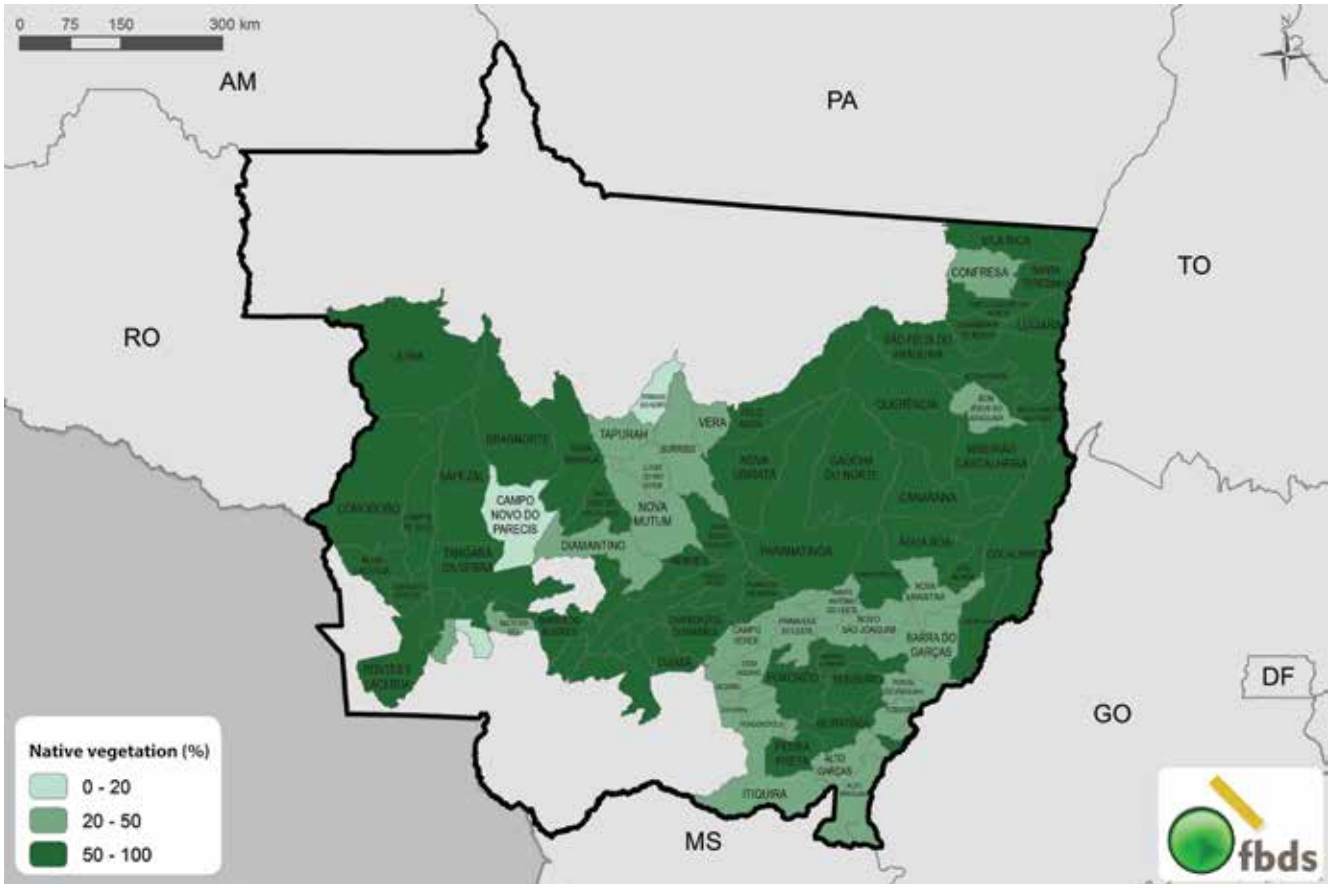
Figure 4 – Liabilities in Permanent Preservation Areas in the State of São Paulo



Source: FBDS, 2016.

For Mato Grosso, the FBDS survey shows that 58% of the territory of the state located in the Cerrado biome is occupied by natural vegetation. Figure 5 shows the municipalities of Mato Grosso categorized by percentage of remaining native vegetation cover. There is a concentration of areas with a lower percentage of native vegetation in the central and south-eastern areas of the State. The low vegetation rate in the municipality of Campo Novo do Parecis is one of the most consolidated in the state of Mato Grosso.

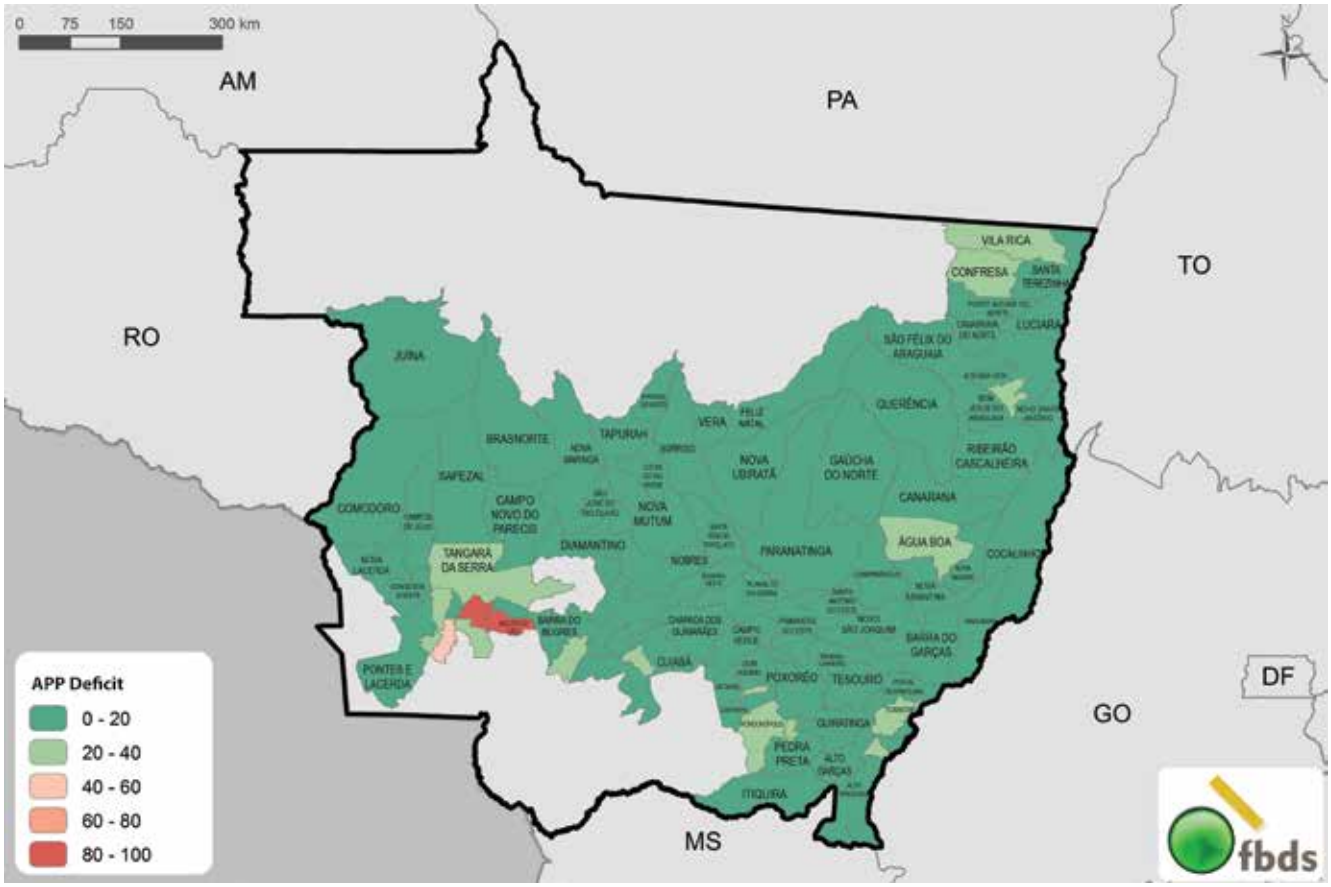
Figure 5 – Municipalities of Mato Grosso categorised according to percentage of remaining vegetation cover



Source: FBDS, 2016.

The data in Figure 6 shows rates of compliance with the Permanent Preservation Areas of watercourses, as surveyed by the FBDS. It should be noted that, in terms of APPs, most municipalities present liability rates of up to 20%, with an average of 13% APP liabilities in mapped areas. Despite rates being relatively low, it should be taken into account that this analysis is only looking at the Cerrado portion and not RL areas, which have high rates of deforestation in the region.

Figure 6 – Liabilities in Permanent Preservation Areas in the State of Mato Grosso



Source: FBDS, 2016.

Productive activities analysed

The following productive sectors were selected for this study: sugarcane and soy, livestock activity, and polyculture systems. Soy and livestock were selected due to their representativeness: in 2015 the agribusiness share of GDP was 21.46%.[38] In the same year, Brazil was the second largest exporter of soy and beef.[39] Sugarcane was selected as it is the main agricultural product of the state of São Paulo.[40] To calculate the operational profitability of these activities, data from the "Agrianual e Agripecuária"[41] study from 2015 was used.

The analysis also looked at different categories of rural producers: small, medium, large, and family farmers - according to the INCRA classification for 'fiscal modules' (modulos fiscais). It also applied the categories of rural landlords and tenants. For each of these clients, different financial products with potential use for forest recomposition without economic use were identified, as shown below:

[38] (Peduzzi, 2015)
[39] (Rocher, 2015)
[40] (Instituto de Economia Agrícola, c2016)
[41] Yearbooks prepared by Informa Economics IEG | FNP consultancy, which is part of Informa PLC's Business Intelligence Division. The yearbooks feature a restricted access database with information on commodity costs and revenues. For use in the present study, access to the database was acquired so as to not make the data publicly available for consultation.

Types of clients analysed

Small, medium, and large producers

- ✓ Rural Credit: Agricultural Working capital
- ✓ Rural Credit: PRONAMP Working capital
- ✓ Rural Credit: ABC Investment Program
- ✓ Rural Credit: ABC Investment Program (reduced rates applicable to small and medium producers)

Family Farming

- ✓ Pronaf income R$360 thousand – working capital
- ✓ Pronaf income R$190 thousand – working capital
- ✓ Pronaf Group B – working capital
- ✓ Pronaf Forest
- ✓ Pronaf Forest – Group B

Simulations

From the variables mentioned above, 69 simulations were then run in the financial model to identify the potential capacity of the producer or rural owner to finance the recomposition, estimating the percentage of their profitability that would be compromised in the process.

In total, 69 simulations were run in the financial model, set out in Table 8.

Table 8 – Summary of the simulations run in the financial model

Production	States	Clients	Financial products	Simulations
Soy	São Paulo Paraná Mato Grosso	Large, medium, and small producers	Working capital PRONAMP Working capital ABC Investment Program ABC Investment Program (reduced rate)	14
Landholding Lease for soy cultivation	São Paulo Paraná Mato Grosso	Large and medium producer	Working capital PRONAMP Working capital	6
Sugarcane	São Paulo Paraná	Large, medium, and small producer	Working capital, PRONAMP Working capital, ABC Investment Program ABC Investment Program (reduced rate)	12

Production	States	Clients	Financial products	Simulations
Landholding Lease for sugarcane cultivation	São Paulo Paraná	Large and medium producer	• Working capital • PRONAMP Working capital	4
Livestock (beef, extensive and semi-intensive)	São Paulo Paraná Mato Grosso	Large, medium, and small producer	• Working capital • PRONAMP Working capital • ABC Investment Program • ABC Investment Program (reduced rate)	28
Family Farming (Profitability established by PRONAF)	1. Pronaf income R$360 thousand – working capital 2. Pronaf income R$190 thousand - working capital 3. Pronaf Group B – working capital 4. Pronaf Forest 5. Pronaf Forest – Group B			5

Source: Elaborated by Authors.

It was considered relevant to carry out additional simulations for forest recomposition with a Payment for Environmental Services (PES) mechanism, that is, adding an additional revenue to the cash flow. These simulations were restricted to the state of São Paulo, due to the availability of data on PES systems. The simulations which factored in the PES to the flow prioritized small producers, as the current PES is a mechanism for complementing income. The models tested with these characteristics were the following:

- ✓ Sugarcane: PRONAMP working capital;
- ✓ Sugarcane: ABC Investment Program (reduced rate);
- ✓ Semi-intensive cattle farming: PRONAMP working capital;
- ✓ Semi-intensive cattle farming: ABC Investment Program (reduced rate);
- ✓ Soy: working capital;
- ✓ Soy: ABC Investment Program (reduced rate).

Model assumptions

For the construction of the modelling exercise explained previously, some assumptions were adopted, classified as: i) operational, and ii) financial

Operational assumption

For definition of the priority clients' categories, the 'fiscal modules' of the INCRA were used, these being i) small producers with up to 4 fiscal modules; ii) medium producer, with 4 to 15 fiscal modules; iii) large producer, with over 15 fiscal modules. As the area of fiscal modules varies by state, Table 9 shows the total area of the property considered.

Table 9 – Average operational area considered

Property size*	Total Area Ha	Operational area Ha
SP - Large	857	600
SP - Medium	300	210
SP- Small	150	105
PR - Large	857	600
PR - Medium	300	210
PR- Small	150	105
MT - Large	2143	1178
MT - Medium	750	412
Family Farming	10	09

* According to Fiscal Modules size (which vary by state): Small – up to 04 fiscal modules; Medium – from 04 to 15 fiscal modules; Large – over 15 fiscal modules.

Source: Elaborated by Authors.

For São Paulo and Paraná, 70% of the total area was considered productive, as 20% of the area corresponds to RLs (in which 10% of APPs may be included) and a further 10% consists of areas not suitable for planting, earmarked for infrastructure, roads, among other uses. For Mato Grosso, 55% of the total area was considered productive, with an estimation of 35% of the area being RLs (in which 10% of APPs may be included) with an average of 10% of the area not suitable for planting, used for infrastructure, roads, among others.

Another variable which was taken into account was the cost of recomposition, which varies according to the chosen method. Table 10 shows the main techniques and their respective average cost used before running the sensitivity analysis.

Table 10 – Cost of recomposition per technique used

Method of Recomposition	Cost R$/ha
Natural regeneration	0*
Total planting	10,000
High-density planting	8,000
Enrichment planting	4,800

* Although regeneration is a natural process which does not incur costs, there may be costs related to removing the degrading/anthropogenic factor, such as for example, the cost of fencing to keep livestock out of areas of native vegetation.

Source: SMA – Environment Office of the State of São Paulo.

In line with the law, recomposition was assumed to be carried out in land plots, with 1/20th of the area of liability recovered per year for properties with annual crops, and for those with longer crop cycles, the area was divided per beginning of each cycle. Considering the cost of restoring each module to 1/20 of the total area, a disbursement profile of the cost of recomposition over a three-year period was outlined, which can be seen in Table 11. A

three-year period was accounted for, with implementation in year 1, and maintenance in years 2 and 3.

Table 11 – Recomposition cost disbursement profile

Year	%
1	45
2	35
3	20

Source: Elaborated by Authors.

Regarding the full term of the financial operation, a model of 24 years was used for rural working capital operations, renewed every two years. The reason for extending the model to 24 years was due to the deadline stipulated by the PRA, of 20 years, added to the two additional years of maintenance for the final implementation, as well as a subsequent year of payment of the last working capital renewal. For operations with financing of investment activity, such as the ABC Program, two alternatives were used: investment in a single transaction with recomposition made once or in two tranches of 7 years of payment each. As such, a total period of 15 years was used, with forest recomposition costs computed in the first 3 years.

The profitability of the crops analysed, i.e. the net margin for the producer, was based on the 2015 data of the Agrianual survey, in constant currency, and is described in Table 12. In addition to operating costs, the Agrianual survey includes financial expenses and taxation - in the company of the rural producer - to calculate the net margin.

Table 12 – Crop profitability

Crop/State (R$/ha/year)	Year 1
Sugarcane (SP)	1,147
Sugarcane (PR)	946
Soy MT - Conventional	1,155
Soy PR – Conventional	1,832
Soy SP – Conventional	1,473

Source: Agrianual, 2015.

The profitability of livestock farming was based on the Agripecuária's[42] 2015 data, described in Table 13.

[42] Yearbooks prepared by Informa Economics IEG | FNP consultancy, which is part of Informa PLC's Business Intelligence Division. The yearbooks feature a restricted access database with information on costs and revenues for the Brazilian agricultural and livestock industries. For use in the present study, access to the database was acquired so as to not make the data publicly available for consultation.

Table 13 – Livestock profitability

Crop/State (R$/ha/year)	Year 1
Extensive (SP)	552
Extensive (PR)	578
Extensive (MT)	347
Semi extensive (SP)*	831
Semi extensive (PR)	918
Semi extensive (MT)	402

Source: Agripecuária, 2015.

According to the National Program for the Strengthening of Family Agriculture (PRONAF), the family income categories described in Table 14 were used.

Table 14 – PRONAF: Categories by maximum annual family income range

	Average annual family income (R$ thousand/year)
PRONAF	360
PRONAF	190
PRONAF B	20

Source: MAPA – Ministry of Agriculture, Livestock, and Supply.

Lastly, regarding models which take the PES into account, simulations were carried out factoring in an average payment of R$200/hectare recovered/year, as a conservative proxy. It is important to highlight that the payment made directly to the Land owner represents, generally, less than 10% of the total cost of the project, as the remainder of the resource is used for a series of actions that increase property value and generate indirect revenue, such as: fencing, environmental compliance of the rural property (notably the recovery of APPs), technical assistance, elaboration of a georeferenced map of the rural property, local jobs in the context of forest recovery activity, and the inclusion of properties in rural sanitation projects.[43] The land owner does not therefore have expenses relating to environmental compliance itself, but is committed to looking after the area.

The sum paid to land owners varies greatly depending on the Program, which has its own valuation methodologies. Normally, the amount is driven by the opportunity costs of the economic activity which could be developed in the protected areas, which must be assessed based on a field study of the profile of agricultural activity in the region. Additionally, within the programs themselves there are variations in the value paid according to the quality of the areas preserved or to be recovered, the size of the property (the smaller the property the greater the value received per hectare) or also the management practices of the operational area of the property. Some references of payment amounts for environmental services per hectare per year practiced in Brazil are:

[43] (Castello Branco, 2015)

Table 15 – PES amounts practiced in Brazil

PES Program	Range of value paid to owner (R$/ha/year)
Water Conservation, in Extrema, MG	R$198.00 (in 2012)
OÁSIS Project – São Paulo - SP	Maximum of R$370.00 (2011)
OÁSIS Project – Apucarana - PR	R$77.00 to R$577.00 (2011)
Water Producer in the Hydrographic Basin Piracicaba/ Capivari/Jundiaí - SP	R$ 125/ha/year for ecological recovery of APPs and R$ 75/ha/year for forest conservation
Water Producer at Rio Camburiú - SP*	R$ 228.00
Conservation Credit System (SICC) of Santa Catarina	R$ 87.50 to 350.00 (2016)

* Project of the Municipal Water and Sanitation Company of Balneário Camburiú (EMASA).

Source: Elaborated by Authors based on (São Paulo (Estado), 2013.

Financial assumptions

All simulations were carried out with existing rural credit products or BNDES transfers. As such, interest rates for financing stipulated in the Agricultural and Livestock Plan (Harvest Plan) 2016/17, described in Table 16, were used.

Table 16 – Financing rates stipulated in the Harvest Plan 2016

	Working capital: Large Producer	Working capital: Medium Producer	Investment: ABC Program	PRONAF Working capital	PRONAF Forest
Term	2 years	2 years	15 years	2 years	12 years
Interest	9.5-11.25% aa	8.5% aa	8.5% aa	5.5% aa	2.5% aa
Reduced Interest Rate	-	-	8% aa	-	-
Interest Group B	-	-	-	0,5% aa	-
Waiting Period	-	-	3 years	-	8 years

Source: Elaborated by Authors.

Simulations using the Monte Carlo method

A traditional financial analysis assumes deterministic values for the projected cash flow assumptions. As such, projections are uncertain points in the future. In this study, cash flows were projected over a 24-year period, with considerable uncertainties regarding the assumptions adopted in the projected cash flow. To incorporate uncertainty and risk into the analysis, a probabilistic simulation was used, in which probability distributions are assumed for certain assumptions selected to calculate the probability distribution of the result.

A Monte Carlo simulation was adopted, which from a deterministic cash flow model, creates thousands of possible scenarios for some of the assumptions used, based on chosen probability distributions, also generating thousands of possible results for the projected cash flows. The objective was to overcome the limitation of the data used for the basic modelling, from the 2015 information from Agrianual and Agripecuária.

A sensitivity analysis was carried out for the variables of recomposition cost, profitability, and interest rates, for the operational activity of soy, cane, and livestock. For each of those productive activities, 100,000 simulations were run, varying, in isolation, the costs of recomposition, interest rates, and profitability. Such factors could be varied simultaneously, however it would be more complex to identify which factor generates a greater impact on the borrower's ability to pay. For this reason, the factors were isolated and analysed separately.

The producer's ability to pay was calculated with the following formula:

$$\frac{\text{Financial expense of forest recomposition} + \text{Principal payment}}{\text{Producer profitability}}$$

Unlike financial modelling in which the analysis was detailed by state and by category of producer, the Monte Carlo simulations adopted a more comprehensive degree of analysis. This is because the ranges of values are large, making it possible to cover all the different outcomes.

The costs of recomposition and the interest rates were considered equal for soy, sugarcane, and livestock, as these values are independent of type of operation. However, profitability varies per type of activity.

The intervals considered in the Monte Carlo simulations were:

Profitability:

- ✓ **Soy: with 90% probability, crop profitability is between R$464 and R$1,538/hectare;**
- ✓ **Livestock: with 90% probability, crop profitability is between R$62.5 and R$287.5/hectare;**
- ✓ **Sugarcane: with 90% probability, crop profitability is between R$456 and R$1,355/hectare.**

Cost of recomposition:

- ✓ **With 90% probability, the costs of full recomposition planting are between R$5,750 and R$19,250/hectare;**
- ✓ **With 90% probability, the costs of fencing are between R$615 and R$2,685/hectare;**

Interest rates:

- ✓ **With 90% probability, interest rates are between 3.69% and 17.55%.**

6. Results

Base modelling

Based on the assumption that a model is a simplification of reality, some limitations of the present study must be considered. One is that modelling considers only the option of working with working capital or investment. However, in reality, the most likely scenario is for rural producers to take part in financing in the form of working capital, combined with other sources of investment. Thus, the fact that only the options for working capital or investing are explored in the models and also in isolation does not imply that it is impossible to explore synergies among other options in a real scenario. Also, a future projection of constant revenue and constant productivity was adopted as a baseline, which can be considered conservative for a medium to long-term projection.

The following tables show the results from the base-modelling for forest recomposition. The column on the left indicates the characteristics of the producers. The middle column, titled "Annual cash flow in the period" indicates whether there was a negative cash flow over the projected period. "The Average Cost of Financing/Profitability" column shows the percentage that the additional debt flow - taken to deal with the costs of forest recomposition – represents to the cash flow of the rural producer. In this case, the smaller, the better.

SOY:

Table 17 – Model results for soy in Paraná

Soy	Annual cash flow in the period	Average financing cost / Profitability
PR – Medium – Pronamp working capital	Positive	4.3%
PR – Large – working capital	Positive	4.4%
PR – Medium – ABC Investment Program (reduced rate)	Positive	8.3%
PR – Small – ABC Investment Program (reduced rate)	Positive	8.3%
PR – Large – ABC Investment Program	Positive	8.5%

Source: Elaborated by Authors.

Table 18 – Model results for soy in São Paulo

Soy	Annual cash flow in the period	Average financing cost / Profitability
SP – Medium – Pronamp working capital	Positive	5.4%
SP – Large – working capital	Positive	5.4%
SP – Medium – ABC Investment Program (reduced rate)	Positive	10.3%
SP – Small – ABC Investment Program (reduced rate)	Positive	10.3%
SP – Large – ABC Investment Program	Positive	10.6%

Source: Elaborated by Authors.

Table 19 – Model results for soy in Mato Grosso

Soy	Annual cash flow in the period	Average financing cost / Profitability
MT – Medium – Pronamp working capital	Positive	8.0%
MT – Large – working capital	Positive	8.7%
MT – Medium – ABC Investment Program (reduced rate)	Positive	16.8%
MT – Large – ABC Investment Program	Positive	17.2%

Source: Elaborated by Authors.

EXTENSIVE LIVESTOCK FARMING:

Table 20 – Model results for extensive livestock farming in Paraná

Livestock- Extensive	Annual cash flow in the period	Average financing cost / Profitability
PR – Large – working capital	Positive	13.8%
PR – Medium – Pronamp working capital	Positive	18.0%
PR – Large – ABC Investment Program	Negative	27.0%
PR – Medium – ABC Investment Program (reduced rate)	Negative	34.6%
PR – Small – ABC Investment Program (reduced rate)	Negative	34.6%

Source: Elaborated by Authors.

Table 21 – Model results for extensive livestock farming in São Paulo

Livestock- Extensive	Annual cash flow in the period	Average financing cost / Profitability
SP – Large – working capital	Positive	14.5%
SP – Medium – Pronamp working capital	Positive	19.4%
SP – Large – ABC Investment Program	Negative	28.3%
SP – Medium – ABC Investment Program (reduced rate)	Negative	37.3%
SP – Small – ABC Investment Program (reduced rate)	Negative	37.3%

Source: Elaborated by Authors.

Table 22 – Model results for extensive livestock farming in Mato Grosso

Livestock- Extensive	Annual cash flow in the period	Average financing cost / Profitability
MT – Large – working capital	Positive	28.8%
MT – Medium – Pronamp working capital	Positive	46.6%
MT – Large – ABC Investment Program	Negative	57.2%
MT – Medium – ABC Investment Program (reduced rate)	Negative	90.6%

Source: Elaborated by Authors.

SEMI-INTENSIVE LIVESTOCK FARMING:

Table 23 – Model results for semi-intensive livestock farming in Paraná

Livestock - Semi-Intensive	Annual cash flow in the period	Average financing cost / Profitability
PR – Large – working capital	Positive	8.7%
PR – Medium – Pronamp working capital	Positive	14.4%
PR – Large – ABC Investment Program	Positive	17.0%
PR – Small – ABC Investment Program (reduced rate)	Negative	23.2%
PR – Medium – ABC Investment Program (reduced rate)	Negative	23.2%

Source: Elaborated by Authors.

Table 24 – Model results for semi-intensive livestock farming in São Paulo

Livestock - Semi-Intensive	Annual cash flow in the period	Average financing cost / Profitability
SP – Large – working capital	Positive	9.6%
SP – Medium – Pronamp working capital	Positive	13.6%
SP – Large – ABC Investment Program	Positive	18.8%
SP – Small – ABC Investment Program (reduced rate)	Negative	26.0%
SP – Medium – ABC Investment Program (reduced rate)	Negative	26.0%

Source: Elaborated by Authors.

Table 25 – Model results for semi-intensive livestock farming in Mato Grosso

Livestock - Semi-Intensive	Annual cash flow in the period	Average financing cost / Profitability
MT – Large – working capital	Positive	24.9%
MT – Large – ABC Investment Program	Negative	49.4%
MT – Medium – Pronamp working capital	Negative	107.2%
MT – Medium – ABC Investment Program (reduced rate)	Negative	208.5%

Source: Elaborated by Authors.

SUGARCANE:

Table 26 – Model results for sugarcane in Paraná

Sugarcane	Annual cash flow in the period	Average financing cost / Profitability
PR – Medium – Pronamp working capital	Negative	39.3%
PR – Small Pronamp working capital	Negative	39.3%
PR – Large – working capital	Negative	39.5%
PR – Medium – ABC Investment Program (reduced rate)	Negative	82.1%
PR – Small – ABC Investment Program (reduced rate)	Negative	82.1%
PR – Large – ABC Investment Program	Negative	84.0%

Source: Elaborated by Authors.

Table 27 – Model results for sugarcane in São Paulo

Sugarcane	Annual cash flow in the period	Average financing cost / Profitability
SP – Medium – Pronamp working capital	Negative	24.9%
SP – Small Pronamp working capital	Negative	24.9%
SP – Large – working capital	Negative	25%
SP – Medium – ABC Investment Program (reduced rate)	Negative	50.7%
SP – Small – ABC Investment Program (reduced rate)	Negative	50.7%
SP – Large – ABC Investment Program	Negative	51.8%

Source: Elaborated by Authors.

LANDHOLDING LEASE:

Table 28 – Model results for soy leasing

Soy – Land Lease	Annual cash flow in the period	Average financing cost / Profitability
Soy MT – Large – working capital	Positive	13.8%
Soy MT – Medium – Pronamp working capital	Positive	13.7%
Soy PR – Large – working capital	Positive	13.8%
Soy PR – Medium – Pronamp working capital	Positive	13.7%
Soy SP – Large – working capital	Positive	13.8%
Soy SP – Medium – Pronamp working capital	Positive	13.7%

Source: Elaborated by Authors.

Table 29 – Model results for sugarcane leasing

Sugarcane – Land lease	Annual cash flow in the period	Average financing cost / Profitability
PR – Medium – Pronamp working capital	Positive	8.5%
PR – Large – working capital	Positive	8.6%
SP – Large – working capital	Positive	9.1%
SP – Medium – Pronamp working capital	Positive	9.0%

Source: Elaborated by Authors.

FAMILY FARMING:

Table 30 – Model results for family farming

Family farming	Annual cash flow in the period	Average financing cost / Profitability
Pronaf income R$360 thousand - working capital	Positive	0.2%
Pronaf income R$190 thousand – working capital	Positive	0.3%
Pronaf Forest – investment	Positive	0.4%
Pronaf Group B – working capital	Positive	5.9%
Pronaf Forest – Group B – investment	Positive	4.0%

Source: Elaborated by Authors.

SMALL PRODUCER WITH PAYMENT FOR ENVIRONMENTAL SERVICES (PES):

Table 31 – Model results for Payment for Environmental

Model with PES (Small Producers in São Paulo)	Annual cash flow in the period	Average financing cost / Profitability
Cane – PRONAMP working capital	Positive	23.5%
Cane –ABC Investment Program (reduced rate)	Negative	48.6%
Semi-intensive cattle farming –PRONAMP working capital	Positive	13.2%
Semi-intensive cattle farming – ABC Investment Program (reduced rate)	Positive	26%
Soy – working capital	Positive	5.3%
Soy – ABC Investment Program (reduced rate)	Positive	10.7%

Source: Elaborated by Authors.

Monte Carlo simulations

The following figures present the results obtained from the Monte Carlo simulations. It should be noted that the Rural Credit Manual does not allow forest recomposition to be categorized as a working capital activity. However, in the simulations it was included as working capital so that it would be possible to estimate the impact on cash flows.

SOY:

The Monte Carlo simulations show that for soy, in the worst-case scenario of the working capital model, the limitation of the producer's payment capacity can reach 17.2%. In the investment modality, limitation can reach close to 33%. The investment modality has a greater impact on the producer's payment capacity because recomposition costs are integrally factored into the first three years of modelling, whereas in the modelling for working capital, they are spread over 20 years.

Figure 7 – Results of the Monte Carlo simulation for soy and soy land lease, in the working capital model

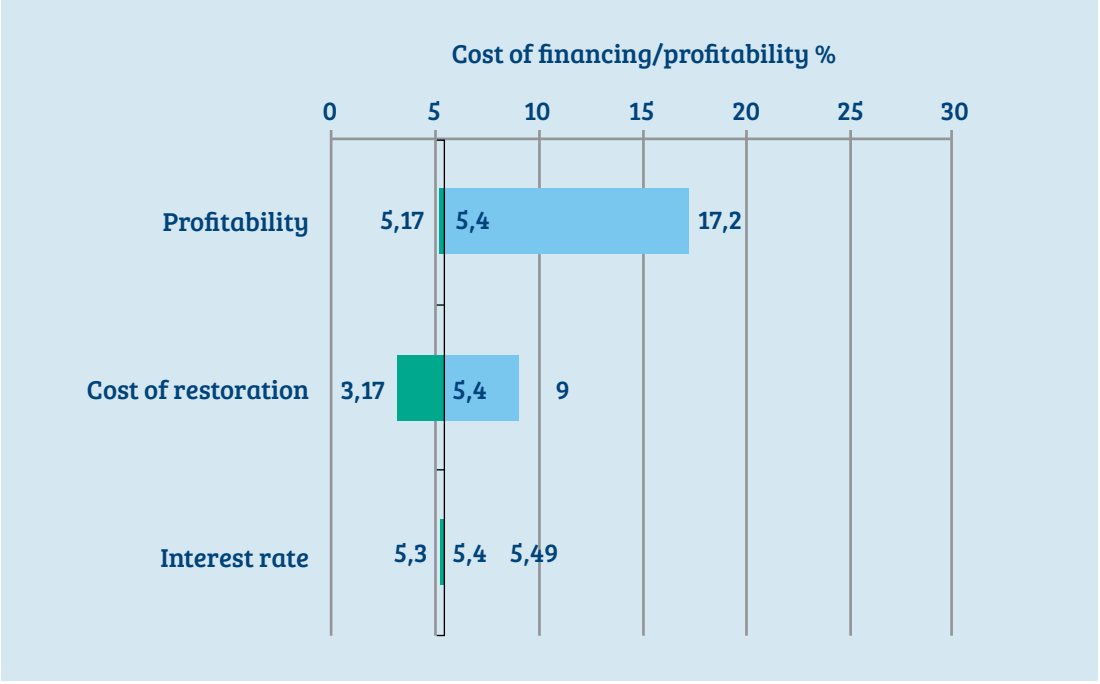
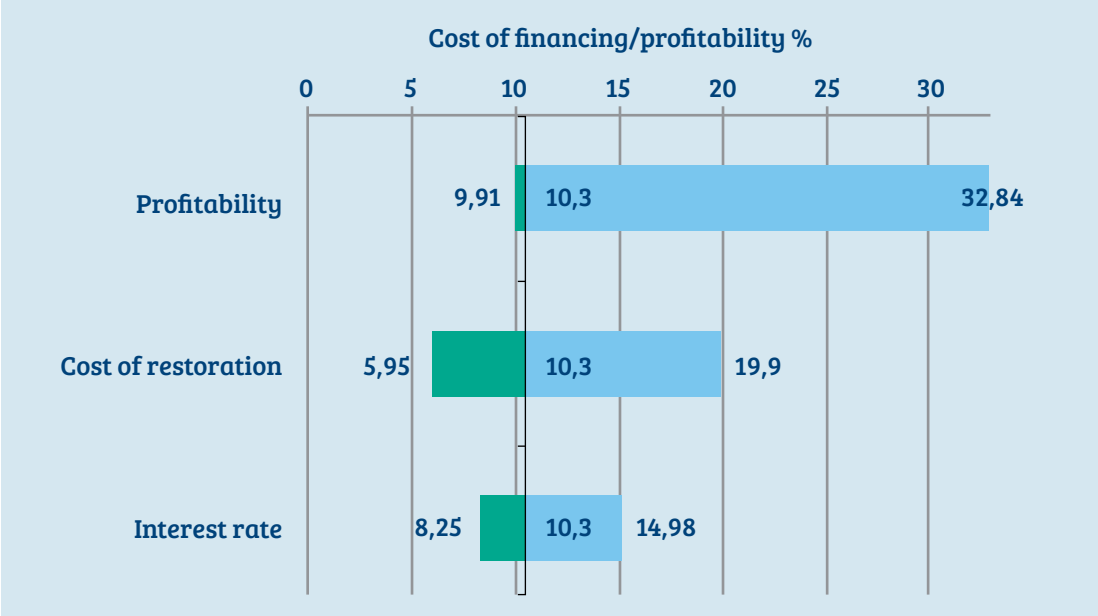


Figure 8 – Results of the Monte Carlo simulation for soy and soy leasing, in the investment model



SUGARCANE:

The Monte Carlo simulations indicate that for sugarcane, in the worst-case scenario for the working capital model, the limitation of the producer's payment capacity reaches 62.6%. In the investment modality, it can reach 127.3%. For sugarcane, an additional scenario was run for the investment modality, in which two 7-year installments were factored, instead of a single 15-year tranche. However, the results of the second simulation continue to point to a limitation of over 100% of the cash flow of a rural producer to deal with the flow of financing.

Figure 9 – Results of the Monte Carlo simulation for sugarcane, in the working capital model

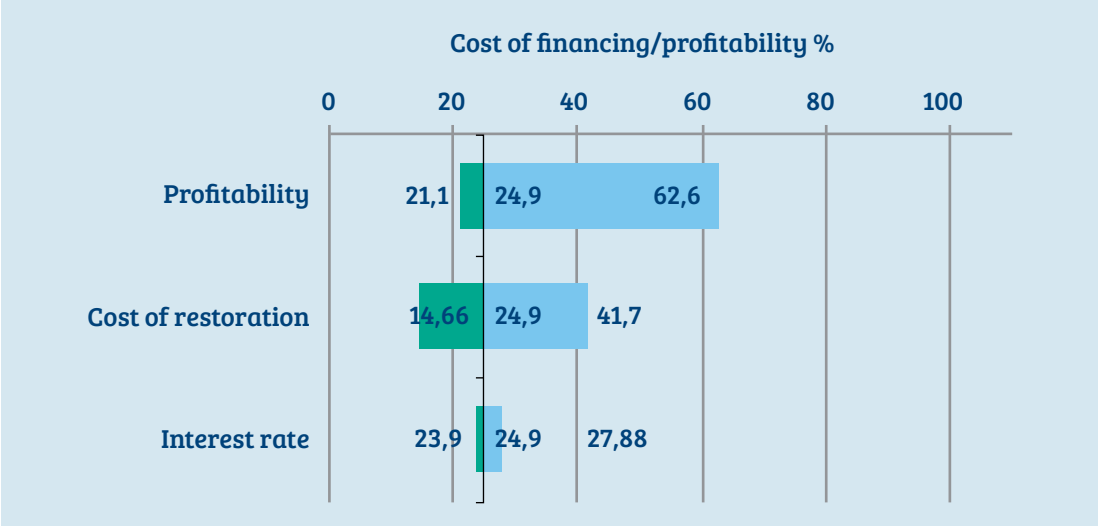


Figure 10 – Results of the Monte Carlo simulation for sugarcane, in the investment model

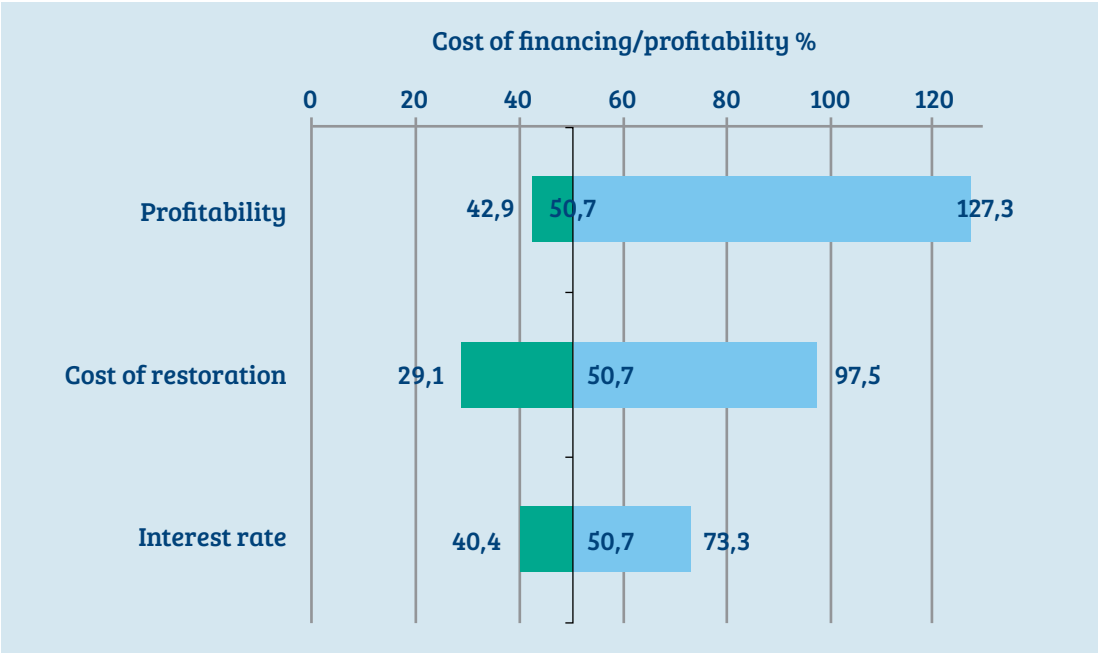
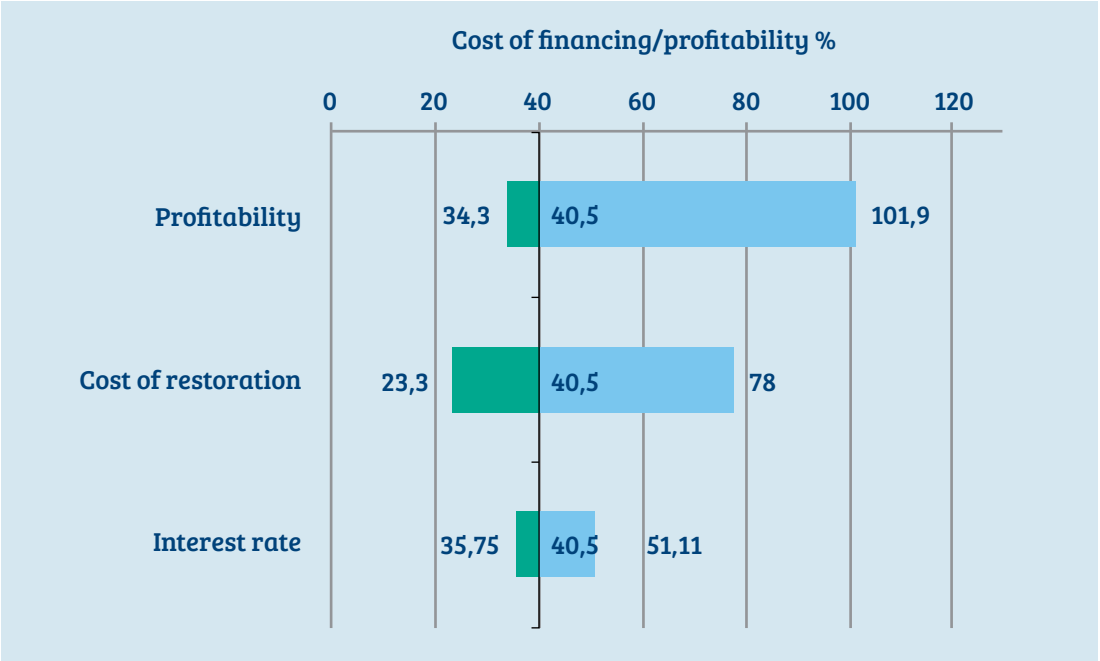


Figure 11 – Results of the Monte Carlo simulation for sugarcane, in the 7-year investment model



LIVESTOCK:

The Monte Carlo simulations indicate that for livestock, in the worst-case scenario of the working capital model, limitation of the producer's payment capacity can reach 159.4%. In the investment modality, it can reach 310.3%.

Figure 12 – Results of the Monte Carlo simulation for livestock, in the working capital model

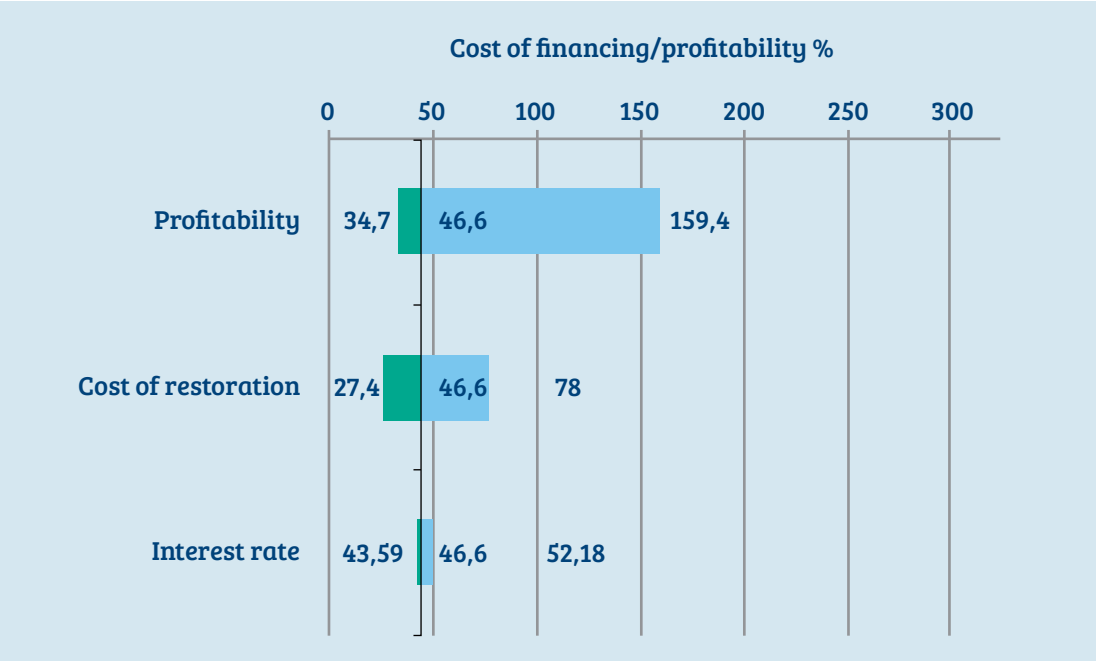
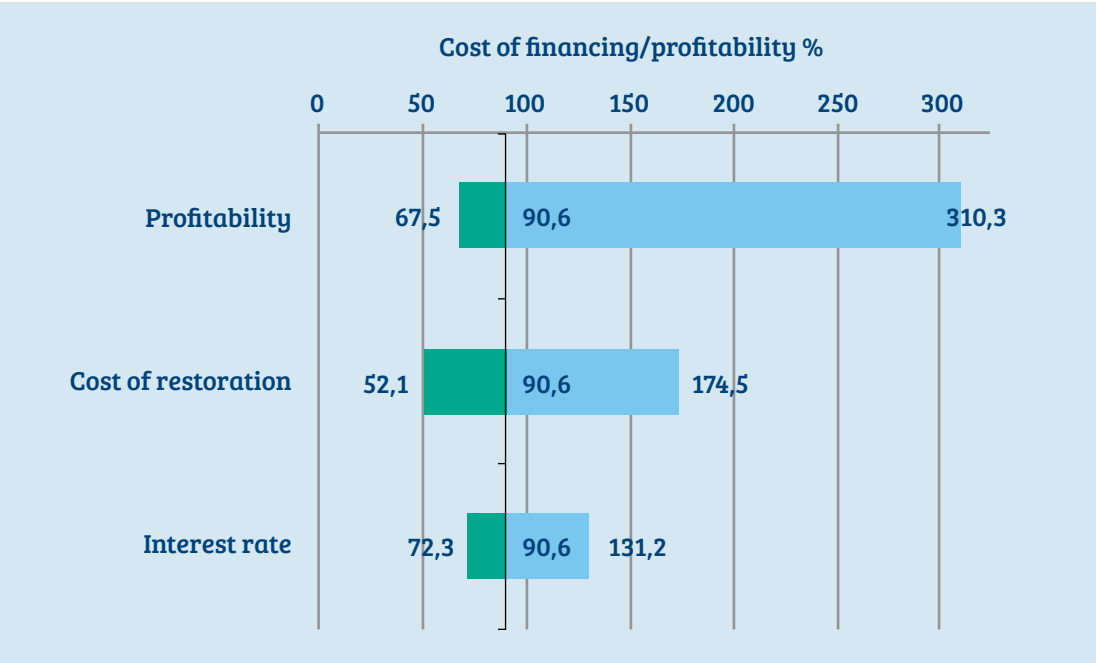


Figure 13 – Results of the Monte Carlo simulation for livestock, in the investment model



7. Analysis of results

Base case analysis

Soy cultivation as a operational activity on rural properties represents, of the options analysed, the best opportunity for carrying out forest recomposition with financing at the interest rates used. This is because, in addition to not presenting a negative cash flow for the locations and profiles of the producers analysed, soybean presents the lowest percentages of limitation of cash flows due to financing costs. For working capital, this percentage was between 4.3% and 8.7%. For working capital in addition to landholding lease as an economic activity, between 8.5% and 13.8%. And for investment, between 8.3% and 17.2%. The lowest impact rates were found in the state of Paraná and for medium producers of all regions. For soy, there was a twofold increase in impact for investment financing in relation to working capital, i.e. working capital operations proved to be more attractive, with a gradual reduction of the operational area.

For extensive livestock farming, the average cost of financing per profitability was higher than that observed for soy. Positive annual cash flows were obtained for all working capital simulations, and negative for all investment simulations. The impact on client payment capacity was between 13.8% and 46.6% for working capital, and between 27% and 90.6% for investment. The most attractive opportunities were to be found in the working capital modality in São Paulo and Paraná, for large and medium producers.

For semi-intensive livestock farming, all working capital simulations yielded positive annual cash flows, and almost all investment simulations yielded negative, with the exception of the ABC investment program for large producers. The impact on client payment capacity was between 8.7% and 107.2% for working capital, and between 17% and 208.5% for investment.

Compared to extensive livestock farming, in the intensive sector there are potential priority solutions, as this type of activity is more profitable (according to Agrianual data) and can better assimilate the costs of forest recomposition, with the exception of results obtained for medium producers in Mato Grosso, where semi-intensive livestock farming showed lower profitability. These numbers occurred because commodity prices where low in the region in 2015 and offset the costs of intensification. For this reason, sensitivity analysis was performed taking into account variations in producer profitability.

For livestock in general, the lowest rates of impact were found in the semi-intensive modality for the state of Paraná and, generally speaking, for large producers. In addition, working capital operations proved to be more attractive, with a gradual reduction of the operational area.

For sugarcane cultivation, all simulations yielded negative annual cash flows. The percentages of impact of the cost of financing on profitability were higher than those obtained for soy, but lower than those of livestock. For working capital, this figure was between 24.9% and 39.5%. For working capital with leasing as an economic activity, between 8.5% and 9.1%. For investment, between 50.7% and 84%. The lowest impact rates were found in the state of São Paulo and, in general, for medium producers and leasing. For this commodity, as with soy, impact on investment financing was twofold compared to that of working capital. Once again, working capital operations proved to be more attractive, with a gradual reduction of the operational area.

It should be mentioned that for sugarcane, results in 2015 were less favourable, reflecting the reality of the sector in that year, but which showed signs of improvement in 2016. However, the liability of this sector is concentrated mainly in RL areas and not APPs, as a compliance effort has already been made for these areas - mainly in São Paulo, with the Agro-environmental Protocol. In this sector, there is a perceived greater interest in compensation for the regularization of RL liabilities.

In terms of landholding lease, for sugarcane as well as soy, there were no negative cash flow cases in the period analysed. The results obtained were slightly better for medium producers than for large producers, as generally medium producers have access to credit lines such as the ABC Program and PRONAMP, with better interest rates than those applied to large producers. Additionally, it is important to mention that it was not possible to make an adequate distinction of profitability between small and medium producers, since the source of the data used – the Agrianual – doesn't specify this distinction. Thus the results generated by the model present a linear variation, i.e. there is no difference between small and medium producers.

For family agriculture, positive cash flows were obtained from all simulations. The impact on client payment capacity was between 0.2% and 5.9% for working capital and between 0.4% and 4% for investment. However, the specificities of this profile should be taken into account and adequately put into context, because although the percentage of cost of financing/ profitability is low, the level of capacity of financial support of a family farmer is different to that of a medium or large producer. In this case, possible solutions may involve the use of non-refundable resources to help carry out environmental regularization.

Simulations were also run factoring in Payment for Environmental Services, considered a criterion of additionality of income to assist the producer. For PES simulations, only a single negative annual cash flow was obtained, related to the ABC investment program for sugarcane. The impact on the client's payment ability was between 5.3% and 23.5% for working capital, and between 10.7% and 48.6% for investment. Currently, such a payment is not systematically available, current, nor applicable, but thinking in the long term, it is important to analyse the relevance of this type of payment. In the models run, the PES did not prove to be especially relevant: it reduced the percentage of expense in between 0.1% and 4.6%. However, there are some reasons that may have led to this result: the price currently paid for providing environmental services is relatively low, and PES was applied to only 10% of the property being recovered and not to the total native vegetation existing on the property. Although the simulations were only run for the state of São Paulo, the difference is likely to be similar in other locations, given that it is an incremental type of payment. PES improved client ability to pay in the investment scenario, as forest recomposition is performed in a less fragmented way than with working capital, in which 1/20th of the area must be restored annually.

It should be highlighted that the assumptions used for this model are conservative and have the limitation of using the profitability of a single year. Even so, potential solutions and priority areas for financing forest recomposition were found, which in turn represent potential future operations for future financial institutions, depending on the risk appetite of each institution. It is necessary to work on solutions for the client, thinking about the management of the property as a whole, including recovery as a component of its total activity, thus creating incentives for the producer as well as command-and-control mechanisms.

Analysis of Monte Carlo simulations

For the soy simulations, with the given assumptions, all variables analysed displayed a low impact on the payment capacity of financing forest recomposition. The profitability indicator was the most sensitive to modelling results, as variations in this indicator affected the customer's payment capacity most significantly, reaching, at the lowest index of profitability considered for the simulations, a limitation of up to 17% of the profitability of producers for payment of expenses relating to forest recomposition in the working capital model, and up to 33% in the investment model. The three indicators considered showed greater impact on the payment capacity of financing in the investment model.

For the sugarcane simulations, with the given assumptions, all variables analysed displayed a significant impact on the payment capacity of financing forest recomposition. The profitability indicator was the most sensitive to modelling results, as variations in this indicator affected the customer's payment capacity most significantly, reaching, at the lowest index of profitability considered for the simulations, a limitation of up to 63% of producer income for payment of expenses relating to forest recomposition in the working capital model, and up to 127% and 102% in the investment models of 1 and 7 years, respectively. As with the soy simulations, the three indicators considered showed greater impact on the payment capacity of financing in the investment model.

For the livestock simulations, with the given assumptions, all variables analysed displayed a significant impact on the payment capacity of financing forest recomposition, even greater than those observed with sugarcane. Of the three variables, the profitability indicator was the most sensitive to modelling results, as variations in this indicator affected the customer's payment capacity most significantly, reaching, at the lowest index of profitability considered for the simulations, a limitation of up to 160% of producer income for payment of expenses relating to forest recomposition in the working capital model, and up to 310% in the investment model. As with soy and sugarcane, the three indicators considered showed greater impact on the payment capacity of financing in the investment model.

Generally speaking, it is perceivable through the sensitivity analysis that profitability was the assumption that generated results with the greatest risk for the debt flow. Cost of recomposition was also significant for sugarcane and especially livestock, but was still significantly less of an impact on the producer's ability to pay than profitability. Of the three variables, the one that generated the least impact in the simulations was the interest rate. The interest rate was the assumption that least influenced the payment capacity of producers, showing low sensitivity rates. However, it proved to have a greater impact on investment models than on working capital models. Undoubtedly, the interest rate is a key component in the feasibility analysis of financing. As recomposition activity considered in the modelling does not add revenue to the producer's cash flow, the profitability variable was more sensitive to the simulated shocks. It was also observed that the working capital model performed better in terms of the financing cost/profitability indicator for all activities considered, demonstrating a greater capacity of payment when rural producers choose to receive resources in phases. This also implies the phased execution of forest recomposition and a loss of operational area distributed over time.

8. Recommendations

To meet the challenges exposed, the financial institutions participating in the Working Group created to monitor and discuss the results of this study proposed, in partnership with the technical team of the study, the following recommendations.

Improvement in the ABC Program

Regarding the ABC Program, FEBRABAN has been discussing improvement proposals with the BNDES, the Ministry of Agriculture (MAPA), the Ministry of Finance, and the Ministry of Environment (MMA) aimed at further developing this Program. Given that the ABC Environmental line is aimed at recovery of APPs and RLs, an increase in the volume of disbursed resources could contribute to the feasibility of forest recomposition in the country.

The first proposal is regarding the simplification of the required documentation when closing contracts, making it optional for the ABC Environmental line to present proof of sufficient profitability to ensure that paying off the obligations is tied to the project to be financed (MCR 13- 7, described in Appendix 3). Given that the investment may not generate economic returns, such as the recovery of APPs, it is recommended that the profitability of the operational activity of the property be considered as a form of verification. BNDES has already suspended the maintenance requirement in the dossier of operations of proof of financial liquidations for individuals and companies classified as small and medium enterprises (SMEs), keeping what was established in MCR 2.7 (Appendix 4).

The second proposal addresses a review of the environmental licensing requirements assessment, to be discussed within the Ministry of the Environment (MMA). The suggestion aims to standardize the requirements established for individuals and companies and avoid subjectivity when interpreting these requirements. Although the ABC Environmental has an environmental licensing requirement for projects wishing to receive financing, the challenge of adequately addressing such a topic is recognized, as each state of the Federation has its own legislation on environmental licensing.

The third proposal addresses the creation of a new line of financing levelled with the objectives of the ABC Program, based on a broader structure of the ABC model, without equilibrium rates from the National Treasury. Such a proposal addresses operating and financing conditions different to those of the ABC Program. Table 32 describes the business model proposed.

Table 32 – Business Model: structure of the ABC Model without National Treasury equalization

Pilot Program:	ABC Agroindustry and integration
Beneficiaries:	a) Companies or cooperatives operating in the agricultural sector. b) Companies or cooperatives who are buyers of agricultural products (that have rural producers in their supply chain).
Financial cost:	Long-term Interest Rate
BNDES remuneration:	From 1.5 % p.a.
Intermediation rate (indirect operations):	0.1% p.a. to 0.5% p.a.
Rem. financial agent:	3.5% p.a.
BNDES share:	Up to 80% of eligible items.
Credit risk rate (direct operations):	Rate according to the BNDES Operational Policies
Term of financing:	Same as currently defined by the ABC, according to technology.
Promotion:	Promotion by FEBRABAN
Guarantees:	At the discretion of the Financial Agent (observing the usual restrictions).
Budget:	Up to 300 million proposed

Source: FEBRABAN.

Rural Credit

There are two proposals regarding the Rural Credit Handbook (MCR). The first is an increase in the credit limit for producers who have already completed, or are in the process of recovering their areas. The proposal is not to increase the total amount of resources earmarked for the recovery, but to allow banks the option of raising their credit ceiling according to the stage of recovery. A "lift ceiling" is therefore proposed, a concept previously used in the MCR. Considering the current limit of R$3 million,[44] the proposal would increase it by up to R$500,000 for producers who have the PRA or are in search of specific financing for recomposition and compliance with legislation; and by up to R$1 million for producers who are already in compliance with the new Forest Code.

[44] Total Rural Credit PAP 2016-2017: R$185 billion.

The second proposal is to insert the possibility of financing forest recomposition in working capital and not just investment, as is the current situation. To do so, inserting recomposition in the MCR as a financeable item is recommended.

Reduction of credit risk

In addition to the aforementioned sources of funding, there is also a need for access to guarantee mechanisms through international or national development funds and multilateral institutions - such as, for example, the World Bank - and access to non reimbursable funds via international funds - such as the GEF.

Furthermore, there has been an observable trend in international markets for access to resources of international conservation funds with potential for a return, so-called impact investing, where Environmental Investment Funds (also called Biodiversity Funds) are a highlight. These are intended to support the conservation of biodiversity through more sustainable business practices in the portfolio of companies in which the fund has invested its capital, and investors of these funds receive a return perspective on their investment in both financial and conservation terms. These funds vary in size and scope, but none of them have yet to reach the scale or rate of return as competitive as a typical venture capital, hedge or private equity fund.[45]

Training and capacity building

Finally, capacity building is an important component in ensuring the effective progress of forest recovery in the country. The productive sector, financial institutions, and class associations must elaborate and carry out training in the subject to align understanding. It is equally important to stimulate the forest recovery chain as a whole from the technicians responsible for planting and monitoring, responsible for the plant nurseries, producers, to the financial institution.

[45] (WWF, 2009)

9. Conclusion

The best results, i.e. those with the lowest impact on the profitability of the client, were those which opted for financing via short-term working capital operations, with a gradual reduction of the operational area.

For soy, with the given assumptions, all the markets analysed displayed low impact on payment capacity of financing forest recomposition, with a special focus on the Paraná region and medium and large producers in all regions. In the landholding lease modality, with the given assumptions, all sugarcane and soybean markets analysed presented low impact on payment capacity.

In all cases, analysis reinforced that one of the most important risk factors for the flow of financing is the profitability of the operational activity, as forest recomposition of APPs does not yield additional economic returns. In this context, financing models that consider the management of the property as a whole and encourage the increase of productivity can contribute to enable the environmental land regularization of rural properties. Investing in clients that have better natural capital management may also pose lower risks for financial institutions.

In addition to the production profitability, another factor which proved to be relevant in determining the producer's ability to pay was the cost of forest recomposition. There is still a great lack of data on forest recovery costs in Brazil, but there is a clear need for the development and dissemination of low cost methods.

As a general result of the modelling exercises and simulations carried out, it was be observed that interest rate reduction in isolation is not enough to solve the feasibility challenge of forest recovery, given the adopted assumptions.

In addition to looking at the direct costs associated with vegetation recovery, it is important to consider that there are gains which are difficult to measure. Areas with the presence of vegetation feed a flow of benefits provided by nature for human well-being, so-called ecosystem services. Such benefits, such as water provision, water quality regulation, global climate regulation, regulation of soil erosion, and regulation of pollination, are felt not only by society but also by farmers.

Policies and mechanisms which recognize and remunerate positive externalities must be considered in a way that encourages the conservation of native vegetation and the maintenance of standing forests, while allowing the continuation of operational activity in a competitive and sustainable way. In this regard, it is important to emphasize the importance of advancing measures aimed at better management of natural capital in Brazil, such as tendencies of payment for environmental services and carbon pricing. As a suggestion for further consideration, it is recommended that such analysis be replicated with Legal Reserves areas where there is a possibility of economic exploitation, as well as hybrid financing models - reimbursable and non-reimbursable - that can reduce credit risk and improve producer payment capacity.

10. Bibliographic references

Assaf Neto, A. (2006). *Finanças Corporativas e Valor*. São Paulo: Atlas.

Banco Central do Brasil. (24th September, 2016). *MCR - Manual de Crédito Rural*. Source: Banco Central do Brasil: http://www3.bcb.gov.br/mcr

Benveniste, L. M., & Spindt, P. A. (1989). How investment bankers determine the offer price and allocation of new issues. *Journal of Financial Economics*, v. 24, pp. p. 343-361.

Bonn Challenge. (c2016). *The Challenge*. Source: Bonn Challenge: http://www.bonnchallenge.org/content/challenge

Brasil. (25th May, 2012). *Law No. 12,651, 25th May 2012*. Source: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/L12651compilado.htm

Castello Branco, M. R. (2015). *Pagamento por serviços ambientais: da teoria à prática*. Rio Claro (RJ): ITPA.

CEPEA. (2016). *PIB do Agronegócio - Dados de 1995 a 2015*. Source: CEPEA - Centro de Estudos Avançados em Economia Aplicada: http://cepea.esalq.usp.br/pib/

Climate Bonds Initiative. (Accessed 2015a.). Source: Green Bonds: Explaining green bonds. : http://www.climatebonds.net/market/explaining-green-bonds

Climate Bonds Initiative. (Accessed 2015). Source: Second Opinion.

Climate Bonds Initiative. (Accessed 2015b). *Green Issuers*. Source: http://www.climatebonds.net/market/green-issuers.

Costa, M. M. (2016). *Financiamento para a restauração ecológica no Brasil. In: Silva, A. P. M.*; Marques, H. R.; Rosa, R. H. (Org.) Mudanças no código florestal brasileiro: desafios para a implementação da nova lei. Rio de Janeiro: IPEA - Instituto de Pesquisa Econômica Aplicada.

Delgado, C., Wolosin, M., & Purvis, N. (2015). Restoring and protecting agricultural and forest landscapes and increasing agricultural productivity. *Working paper for Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*.

DTCC. (2004). *Corporate Bond Operational Underwriting Process*.

EIB. (2014). *Taps Climate Aware Bond (CAB)*.

Embrapa. (27th July 2016). *Sobre a Lei 12.651/2012*. Source: Código Florestal. Contribuições para adequação ambiental da paisagem rural.: https://www.embrapa.br/codigo-florestal/entenda-o-codigo-florestal/

FBDS. (2016). *Projeto de Apoio à Implantação do CAR - Mata Atlântica e Cerrado*. Source: Fundação Brasileira para o Desenvolvimento Sustentável - FBDS: http://www.fbds.org.br/article.php3?id_article=574

Forest Trends. (2015). *Incentivos Econômicos para Serviços Ecossistêmicos no Brasil*. Rio de Janeiro.

Freitas, M. C. (1999). *Abertura do Sistema Financeiro no Brasil nos Anos 90*. São Paulo: Fapesp/Ipea.

Goldman Sachs. (2014). *Environmental Finance Innovation Summit*.

Green Bonds Principles. (2014). *Voluntary Process Guidelines for Issuing Green Bonds*.

Guedes, F. B., & Seehusen, S. E. (2011). *Pagamentos por Serviços Ambientais na Mata Atlânica: lições aprendidas e desafios*. Brasília: MMA.: Ministério do Meio Ambiente – Secretaria de Biodiversidade e Florestas. .

IBGE. (2006). *Censo Agropecuário 2006*. Source: IBGE - Instituto Brasileiro de Geografia e Estatística: http://www.ibge.gov.br/home/estatistica/economia/agropecuaria/censoagro/2006/

INPE - Instituto de Pesquisas Espaciais. (2016). *Projeto PRODES: Monitoramento da Floresta Amazônica Brasileira por Satélite*. Source: OBT/INPE - Coordenação Geral de Observação da Terra/ Instituto de Pesquisas Especiais: http://www.obt.inpe.br/prodes/index.php

Instituto de Economia Agrícola. (c2016). *Cana-de-Açúcar*. Source: Secretaria de Agricultura e Abastecimento. Instituto de Economia Agrícola (IEA).: http://ciagri.iea.sp.gov.br/nia1/cadeia/cadeiaCana.aspx

Kishinami, R., & Watanabe Jr, S. (May 2016). *Quanto o Brasil precisa investir para recuperar 12 milhões de hectares de floresta?* Source: Instituto Escolhas: http://coalizaobr.com.br/index.php/documentos-da-coalizao?download=36:quanto-o-brasil-precisa-investir-para-recuperar-12-milhoes-de-hectares-de-floresta

KPMG. (2015). *Sustainable Insight Gearing up for green bonds - Key considerations for bond issuers*.

Lawson, S., Blundell, A., Cabarle, B., Basik, N., Jenkins, M., & Canby, K. (2014). *Consumer Goods and Deforestation: An Analysis of the Extent and Nature of Illegality in Forest Conversion for Agriculture and Timber Plantations*. Forest Trends.

Lima, R. C. (31st March 2015). *A agenda pós-CAR*. Source: Estadão: http://economia.estadao.com.br/noticias/geral,a-agenda-pos-car-imp-,1661093

Lima, R. C., & Munhoz, L. (2016). *Programas de Regularização Ambiental (PRAs). Um guia para orientar e impulsionar o processo de regulamentação dos PRAs nos estados brasileiros*. São Paulo: Agroicone, INPUT.

MAPA. (12th January 2016). *Exportações do agronegócio crescem em dezembro e indicam cenário favorável para 2016*. Source: Ministério da Agricultura, Pecuária e Abastecimento: http://www.agricultura.gov.br/comunicacao/noticias/2016/01/exportacoes-do-agronegocio-crescem-em-dezembro-e-indicam-cenario-favoravel-para-2016

Mapa. (2016). *Projeções do agronegócio. Brasil 2015/16 a 2025/26. Projeções de longo prazo*. Brasília, DF: Ministério da Agricultura, Pecuária e Abastecimento.

Mathews, J. A., & Kidney, S. (2010). *Climate bonds: mobilizing private financing for carbon management. Carbon Management* (Vol. 1). ISSN 1758-3004.

Melles, C. (3rd September 2015). *Endividamento rural chega a R$ 230 bilhões; setor cafeeiro deve R$ 11,1 bilhões*. Source: Notícias Agrícolas: http://www.noticiasagricolas.com.br/noticias/cafe/161301-endividamento-rural-chega-a-r-230-bilhoes-setor-cafeeiro-deve-r-111-bilhoes.html#.V8l1jPkrLcs

MMA. (c2016). *Biodiversidade Brasileira*. Source: Ministério do Meio Ambiente: http://www.mma.gov.br/biodiversidade/biodiversidade-brasileira

MMA. (c2016). *Unidades de Conservação: O que são*. Source: Ministério do Meio Ambiente: http://www.mma.gov.br/areas-protegidas/unidades-de-conservacao/o-que-sao

Observatório do Código Florestal. (7th June 2016). Ofício no 05/2016. Rio de Janeiro, RJ, Brasil.

Peduzzi, P. (10th December 2015). *Participação da agropecuária no PIB sobe para 23% em 2015*. Source: Agência Brasil. Empresa Brasil de Comunicação S/A.: http://agenciabrasil.ebc.com.br/economia/noticia/2015-12/participacao-da-agropecuaria-no-pib-sobe-para-23-em-2015

Petrasek, L. (2010). *Multimarket trading and the cost of debt: Evidence from global bonds*.

PMDBBS. (c2016a). *Monitoramento da Caatinga*. Source: Projeto de Monitoramento do Desmatamento dos Biomas Brasileiros por Satélite - PMDBBS. Caatinga.: http://siscom.ibama.gov.br/monitora_biomas/PMDBBS%20-%20CAATINGA.html

PMDBBS. (c2016b). *Monitoramento do Cerrado*. Source: Projeto de Monitoramento do Desmatamento dos Biomas Brasileiros por Satélite - PMDBBS. Cerrado.: http://siscom.ibama.gov.br/monitora_biomas/PMDBBS%20-%20CERRADO.html

PMDBBS. (c2016c). *Monitoramento da Mata Atlântica*. Source: Projeto de Monitoramento do Desmatamento dos Biomas Brasileiros por Satélite - PMDBBS. Mata Atlântica.: http://siscom.ibama.gov.br/monitora_biomas/PMDBBS%20-%20MATA%20ATLANTICA.html

PMDBBS. (c2016d). *Monitoramento do Pampa*. Source: Projeto de Monitoramento do Desmatamento dos Biomas Brasileiros por Satélite - PMDBBS. Pampa.: http://siscom.ibama.gov.br/monitora_biomas/PMDBBS%20-%20PAMPA.html

PMDBBS. (c2016e). *Monitoramento do Pantanal*. Source: Projeto de Monitoramento do Desmatamento dos Biomas Brasileiros por Satélite - PMDBBS. Pantanal.: http://siscom.ibama.gov.br/monitora_biomas/PMDBBS%20-%20PANTANAL.html

Rocher, J. (25th May 2015). *Brasil perde liderança na exportação de soja e carne bovina*. Source: Gazeta do Povo: http://www.gazetadopovo.com.br/agronegocio/agricultura/brasil-perde-lideranca-na-exportacao-de-soja-e-carne-bovina-1uymjz48o0c0qsmd707rnjsqz

S&P. (2015). *Ratings Criteria*.

São Paulo (Estado). (2013). *Experiências de pagamentos por serviços ambientais no Brasil*. (S. Pagiola, H. C. Glehn, & D. Taffarello, Eds.) São Paulo: Secretaria do Meio Ambiente / Coordenadoria de Biodiversidade e Recursos Naturais.

SER - Society for Ecological Recomposition. (2004). *International Primer on Ecological Recomposition*.

Sistema Ambiental Paulista. (3rd November 2015). *SiCAR-SP lança novas ferramentas para facilitar a utilização*. Source: Sistema Ambiental Paulista, Governo do Estado de São Paulo.: http://www.ambiente.sp.gov.br/2015/11/03/sicar-sp-lanca-novas-ferramentas/

Sistema Ambiental Paulista. (c2016). *SICAR*. Source: Sistema Ambiental Paulista, Governo do Estado de São Paulo.: http://www.ambiente.sp.gov.br/sicar/

Soares-Filho, B. S. (2013). *Impacto da revisão do Código Florestal: como viabilizar o grande desafio adiante?* Secretaria de Assuntos Estratégicos - SAE. Subsecretaria de Desenvolvimento Suetntável - SSDS.

Society for Ecological Recomposition (SER) International. (2004). *Princípios da SER International sobre a restauração ecológica.* Source: http://c.ymcdn.com/sites/www.ser.org/resource/resmgr/custompages/publications/SER_Primer/ser-primer-portuguese.pdf

SOS Mata Atlântica. (25th May 2016). *Fundação e INPE divulgam dados do Atlas dos Remanescentes Florestais da Mata Atlântica no período de 2014 a 2015*. Source: SOS Mata Atlântica. Projects.: https://www.sosma.org.br/projeto/atlas-da-mata-atlantica/dados-mais-recentes/

Teixeira, R. F., Almeida, L. T., & Bertella, M. A. (março de 2014). Desmatamento no Estado de Mato Grosso: Avaliação de Convergência e Interação Especial (2000-2008). *Análise Econômica, Porto Alegre, ano 32, n. 61*, pp. p. 245-275.

ten Kate, K., Bishop, J., & Bayon, R. (November 2004). *Biodiversity offsets: Views, experience, and the business case.* IUCN, Gland, Switzerland and Cambridge, UK and Insight Investment,London, UK. Source: http://www.iucn.org/sites/dev/files/import/downloads/bdoffsets.pdf

The Global Partnership on Forest and Landscape Recomposition. (n.d.). *http://www.forestlandscaperecomposition.org/resource/nature-resilience-ecological-recomposition-partners-business-next-generations.*

Victor, M. A., Cavalli, A. C., Guillaumon, J. R., & Filho, R. S. (2005). *Cem Anos de Devastação - Revisitada 30 Anos depois*. Brasília, DF: Ministério do Meio Ambiente. Secretaria de Biodiversidade e Florestas. Diretoria do Programa Nacional de Conservação da Biodiversidade.

WorldBank. (2013). *Green Bond Symposium*.

Wunder, S. (2005). *Payments for environmental services: Some nuts and bolts*. Center for International Forestry Research; CIFOR Occasional Paper No. 42.

WWF. (2009). *Guide to Conservation Finance.* Source: World Wildlife Fund: http://awsassets.panda.org/downloads/wwf_guide_to_conservation_finance.pdf

11. Appendixes

Appendix 1 – Organizations consulted during project preparation

Associations

1. Aprosoja – Association of Soybean Producers
2. UNICA – Brazilian Sugarcane Industry Association
3. ABIOVE – Brazilian Oilseed Processors Association
4. ABIEC – Brazilian Beef Exporters Association

Specialists

5. Agroicone
6. CPI – Climate Policy Initiative
7. WRI – World Resources Institute
8. Brazilian Coalition on Climate, Forests, and Agriculture
9. FBDS – Brazilian Foundation for Sustainable Development

Financial Institutions

10. BNDES
11. Banco do Brasil
12. Bradesco
13. Caixa Econômica Federal
14. Itaú Unibanco
15. Rabobank
16. Santander

Government

17. MAPA – Ministry of Agriculture, Livestock and Food Supply – Secretariat of Forest Affairs
18. Environmental Office of the State of São Paulo

Appendix 2 – Main changes between the old and new Forest Code

Old Forest Code (Law No. 4,771, 15/09/1965 altered by PM No. 11511, 25/06/1996	Current Forest Code (Law No. 12,651, of 25th May 2012, altered by Law No. 12,727 and Decree 7,830 of 17/10/2012)	Reduction
Legal Reserve		
For conservation purposes		
I – Located in the Legal Amazon: a) 80% (eighty percent), of the property situated in forest areas; b) 35% (thirty-five percent), of the property situated in the cerrado; c) 20% (twenty percent), of the property situated in fields;	Idem	–
II – Situated in other regions of the country: 20% (twenty percent). Article No. 16	Article No. 12	
For recomposition purposes*		
50% (fifty percent) of the property exclusively for the purpose of regularization where indicated by the Ecological-Economic Zoning. Article No. 16 § No. 5	Idem Article No. 13	–
	Factoring of Permanent Preservation Areas in the calculation of the Legal Reserve percentage of the property is permitted, provided the property is included in the Rural Environmental Registry. Article No. 15	≈ 4 Mha
	Up to 4 fiscal modules, the Legal Reserve will be constituted with the area occupied with native vegetation existing on 22nd July, 2008. Article No. 67	≈ 17 Mha
	50% for recomposition purposes, where the municipality has more than 50% of the area occupied by nature conservation units of public domain and approved indigenous lands Article No. 12 § No. 4	≈ 1 Mha
	50% when the state has approved Ecological-Economic Zoning and more than 65% (sixty-five percent) of its territory occupied by publicly-owned nature conservation units and approved indigenous lands. Article No. 12 § 5	

Permanent Preservation Areas		
For conservation purposes		
30 meters, for watercourses less than 10 meters wide; 50 meters, for watercourses that are 10 to 50 meters wide; 100 meters, for watercourses that are between 50 and 200 meters wide; 200 meters, for watercourses that are between 200 and 600 meters wide; 500 meters for watercourses with a width exceeding 600 meters; Surrounding areas of lakes and natural lagoons, a band with a minimum width of: 100 meters, in rural areas, except for a body of water with up to 20 hectares of surface, whose band will be 50 meters. Article No. 2	Idem Article No. 4	–
For recomposition purposes *		
	Up to 1 fiscal module: recomposition of marginal strips up to 5 meters, measured from the edge of the regular bed channel, regardless of the width of the water course. From 1 to 2 fiscal modules: 8 meters. From 2 to 4 fiscal modules: 15 meters. From 4 to 10 fiscal modules: 20 meters for watercourses up to ten meters wide. For larger widths, the rule of greater than 10 modules follows. Greater than 10 modules: half the width of the watercourse, with a maximum of one hundred meters, measured from the edge of the regular bed channel. Of lakes, ditto up to 4 modules, 30 meters for larger modules. Article No. 61 § No. 6 APP will not exceed 10% of the total area of the property, for rural properties with an area of up to 2 fiscal modules or 20% of the total area of the property, for rural properties with an area of more than 2 and up to 4 fiscal modules. Article No. 61-B	≈ 1 Mha ≈ 0 Mha

* Consolidated rural area: area of rural property with anthropogenic occupation previous to 22nd July, 2008.

Source: (Soares-Filho, 2013)

Appendix 3 – Rural Credit Manual 13.7

Title: Rural Credit
Chapter: Programs with BNDES Resources - 13
Section: Program for Reducing Greenhouse Gases Emissions in Agriculture (ABC Program) – 7

1 - The Program for Reducing Greenhouse Gases Emissions in Agriculture (ABC Program) is subject to the following specific conditions: (Res 3,979 art. 1; Res 4,105 art. 6; Res 4,124 art. 6; Res 4,227, art. 6; Res 4,258 art. 1; Res, 4,338, art. 7; Res 4,421 art. 8; Res 4,486 art. 6; Res 4,488 art. 4)

a) objectives: (Res 3,979, art. 1)
   I - to reduce greenhouse gas emissions from agricultural activity;
   II - to reduce deforestation;
   III - to increase agricultural production on a sustainable basis;
   IV - to adapt rural properties to environmental legislation;
   V - to expand the area of cultivated forests;
   VI - to stimulate the recovery of degraded areas;

b) beneficiaries: rural producers and their cooperatives, including transfer to associates; (Res 3,979, article 1)

c) purpose of credit investment: (Res 4,105, art. 6; Res 4,488 art. 4)
   I - recovery of degraded pastures (ABC Recovery); (Res 4,105, art. 6)
   II - Implementation and improvement of organic agricultural production systems (ABC Organic); (Res 4,105, art. 6)
   III - Implementation and improvement of "no till" planting systems (ABC Direct Planting); (Res 4,105, art. 6)
   IV - Implementation and improvement of crop-livestock integration systems, crop-forest, livestock-forest, or crop-livestock-forest, and agroforestry systems (ABC Integration); (Res. 4,105, art. 6)
   V - Implementation, maintenance and improvement of the management of commercial forests, including those destined for industrial use or charcoal production (ABC Forest); (Res. 4,105, art. 6)
   VI - adaptation or regularization of rural properties in response to environmental legislation, including legal reserve recovery, permanent preservation areas, recovery of degraded areas and implementation and improvement of sustainable forest management plans (ABC Environmental); (Res. 4,105, art. 6)
   VII -Implantation, improvement and maintenance of waste and animal waste treatment systems for the generation of energy and composting (ABC Waste Treatment); (Res. 4,105, art. 6)
   VIII - Implementation, improvement and maintenance of dendezeiro (oil palm) forests, primarily in degraded operational areas (ABC Dendê); (Res. 4,105, art. 6)
   IX - Encouragement of the use of biological nitrogen fixation (ABC Fixation); (Res. 4,105, art. 6)
   X - Implementation, improvement and maintenance of açaí and cacao plantations in the Amazon biome, provided that the conditions of MCR 2-1-12 (ABC Amazonian Biome) are met; (Res. 4,488 art. 4)

d) Financeable items, provided they are linked to projects with the purposes listed in item "c": (Res. 3,979, art. 1; Res. 4,105, art. 6; Res. 4,227, art. 6; Res. 4,338, art 7)
   I - Preparation of technical project and geo-referencing of rural properties, including technical and administrative expenses related to the environmental regularization process; (Res. 3,979, art. 1)
   II - technical assistance required up until maturity of the project; (Res. 3,979, art. 1)

III - relocation of internal roads of rural properties for environmental compliance purposes; (Res. 3,979, art. 1)

IV - Acquisition of inputs and payment of services for the implementation and maintenance of projects financed; (Res. 3,979, art. 1)

V - Payment of services for the conversion of organic production and its certification; (Res. 3,979, art. 1)

VI - Acquisition, transport, application, and incorporation of agricultural correctives (limestone and others); (Res. 3,979, art. 1)

VII -Marking and construction of terraces and implementation of soil conservation practices; (Res. 3,979, art. 1)

VIII - Green fertilization and planting of cover crops (Res. 3,979, art. 1)

IX - Acquisition of seeds and seedlings for pasture and forest formation; (Res. 3,979, art. 1)

X - Implementation of forest nurseries; (Res. 3,979, art. 1)

XI - (Tree) stump removal operations; (Res. 3,979, art. 1)

XII -Implementation and recovery of fences, acquisition of fence energizers, acquisition, construction or renovation of drinking fountains and salt cellars pits; (Res. 3,979, art. 1)

XIII - Purchase of cattle, buffaloes, sheep and goats for reproduction, rearing and finishing, semen, ova, and embryos of these species, limited to 40% (forty percent) of the amount financed; (Res. 4,338, art. 7)

XIV - Acquisition of machinery, implements and equipment of national manufacture, including for the implementation of irrigation systems, for agriculture and livestock, biodigesters, machines and equipment for composting and for energy production and storage, limited to 40% percent) of the amount financed, except for the item related to MCR 13-7-1- "c" -VII, whose financing limit may be up to 100% (one hundred percent) of the value of the project to be financed; (Res. 4,105, art. 6)

XV - Construction and modernization of facilities in rural property; (Res. 3,979, art. 1)

XVII - Expenses related to the use of own labour, provided they are compatible with structures of regional production costs (technical coefficient, price and value), indicated by official research or technical assistance institutions (federal or state), and provided that they refer to projects that are structured and technically assisted, assuming, in this hypothesis, that the verification of the application for the resources is made through the presentation of an official technical assistance report attesting that the service, object of the financing, was carried out in accordance with the project, and said report must be presented at least once every calendar semester; (Res. 3,979, art. 1)

e) Working capital associated with the investment may be financed, limited to 30% (thirty percent) of the amount financed, permitted to raise to: (Res. 3,979, art. 1)

I - Up to 35% (thirty-five percent) of the amount financed, when intended for the establishment and maintenance of commercial forests or recomposition of permanent preservation areas or legal reserves;

II - Up to 40% (forty percent) of the amount financed, when the project includes the acquisition of cattle, sheep and goats for breeding, rearing and finishing, and semen of these species;

f) Credit limits per agricultural year, independently of other credits granted under controlled rural credit resources: (Res. 4,421 art. 8; Res. 4,486 art. 6)

I - R$ 2,200,000.00 (two million and two hundred thousand reais) per beneficiary, observing the provisions of item II; (Res. 4,486 art. 6) (*)

II - In the case of financing for the implementation of commercial forests, the limit referred to in item I may be raised to R $ 3,000,000.00 (three million reais) for rural producers with up to 15 (fifteen) fiscal modules, and up to R $ 5,000,000.00 (five million reais), for rural producers with more than 15 (fifteen) fiscal modules; (Res. 4,421 art. 8)

g) Financial charges: effective interest rate of 8.5% pa (Eight and five tenths per annum) for operations contracted as of 1/7/2016; (Res. 4,486 art. 6)
h) Credit release: in instalments, according to the project schedule; (Res. 3,979, art. 1)
i) Reimbursement, in semi-annual or annual instalments, according to the technical project and the revenue stream of the benefited property, in: (Res. 3,979, art. 1; Res. 4,124, art 6)
   I - Up to 5 (five) years, with a grace period of up to 24 (twenty-four) months, when the credit is for the implementation of nurseries of forest trees; (Res. 3,979, art. 1)
   II - Up to 8 (eight) years, with up to 36 (thirty-six) months of grace, in the case of investments for compliance of organic agriculture systems and the recovery of pastures and productive systems with crop-livestock, crop-forest, livestock-forest, or crop-livestock-forest integration, with extension of up to 12 (twelve) years when the forest component is present; (Res. 3,979, art. 1)
   III - Up to 12 (twelve) years, with a grace period of up to 8 (eight) years, not to exceed 6 (six) months from the date of the first cut, when dealing with projects for the implementation and maintenance of commercial forests and for the production of charcoal. The term may be extended to up to 15 (fifteen) years at the discretion of the financial institution and when the forest species so justifies it, and the grace period may be extended to the payment of interest, provided for in the project; (Res. 3,979, art. 1)
   IV - Up to 15 (fifteen) years, with a grace period of up to 12 (twelve) months, in the case of projects for the recomposition and maintenance of permanent preservation areas or legal reserves; (Res 3,979, art. 1)
   V - Up to 12 (twelve) years, with a grace period of up to 6 (six) years, in the case of projects for the implementation and maintenance of dendezeiro (oil palm) forests; (Res. 3,979, art. 1)
   VI - Up to 10 (ten) years, with a grace period of up to 5 (five) years, according to the project, for the other purposes not included in the preceding paragraphs. (Res. 4,124 art. 6)

2 - Documents required for concession of financing referred to in this Section, in addition to the others required for the concession of investment financing: (Res. 3,979, art. 1; Res. 4,057, art. 3; Res. 4,227, art. 6)

a) In the financing of integrated plantation-livestock, plantation-forest, livestock-forest, or plantation-livestock-forest systems, pasture recovery, commercial forestry, and "no till" planting systems: (Res. 4,057, art. 3; Res. 4,227, art. 6)
   I - Specific technical project, signed by a qualified professional, containing mandatory identification of the property and its total area; (Res. 4,057, art. 3)
   II - Descriptive sketch and history of use of the project area to be financed containing at least 4 points of the perimeter of said area as measured by Global Navigation Positioning System (GPS) or other more accurate gauging instrument; (Res. 4,057, art. 3)
   III - Vouchers of soil analysis and the respective agronomic recommendation, containing organic matter content of soil, in addition to the usual items; (Res. 4,227, art. 6)
   IV - Agricultural, agroforestry, or forestry management plan, as applicable, of the project area; (Res. 4,057, art. 3)
b) In financing that includes compliance or regularization of rural properties with environmental legislation, including recovery of legal reserves, permanent preservation areas, and treatment of waste and residue, among others: (Res. 3,979, art. 1; Res. 4,057, art. 3)
   I - Evidence of sufficient profitability to ensure the discharge of obligations; (Res. 3,979, art. 1)
   II - Specific technical project, signed by a qualified professional, containing mandatory identification of the property and its total area; (Res. 4,057, art. 3)

III - Descriptive sketch and history of use of the project area to be financed containing at least 4 points of the perimeter of said area as measured by Global Navigation Positioning System (GPS) or other more accurate gauging instrument; (Res. 4,057, art. 3)

c) In projects for organic agriculture: (Res. 3,979, art. 1)
   I - For conversion projects: declaration of follow-up of the conversion project issued by the certifier; and
   II - For certified producers: registration with the National Registry of Organic Producers;
d) In financing that includes the implementation of sustainable forest management plans: management plan approved by the competent environmental agency. (Res. 3,979, art. 1)

3 - Under the ABC Program, the granting of emergency credit for the financing of rice farmers in Rio Grande do Sul, whose municipalities have decreed a state of emergency as a result of floods, downpours, and flash-flooding from 1/11/2009 to 31/3/2010, recognized by the State Government, for the recovery of the productive capacity of damaged areas and carrying out the 2010/2011 harvest, in these same areas, observing the established general norms for the granting of rural credit and the following additional conditions: (Res. 3,979, art. 1)

a) Beneficiaries: farmers whose production area is located in the municipalities covered by the caput and who had all or part of their productive unit damaged by the events, proven by means of a technical report prepared by a qualified professional, recognized by the financial institution;
b) Financeable items: expenses necessary for the recovery of infrastructure damaged by the events dealt with in this item, as well as expenses related to the costs of recovering the soil or degraded areas and the formation of the 2010/2011 harvest when it was installed in the damaged area of the 2009/2010 harvest;
c) Limit per beneficiary: regardless of other limits established for this program:
   I - R$ 600,000.00 (six hundred thousand reais), not exceeding R $ 2,500.00 (two thousand and five hundred reais) per hectare of rice, limited to the financing of the area that effectively requires recovering;
   II - Should the damaged area exceed 25% (twenty-five percent) of the area planted with rice in the 2009/2010 harvest, financing for the 2010/2011 harvest may cover up to 100% (one hundred percent) of the area to be cultivated, respecting the limits per beneficiary and per hectare referred to in item I of letter "c" of this item;
d) Financial charges: effective interest rate of 5.75% p.a. (Five and seventy-five hundredths per cent per year);
e) Form and term of repayment: in semi-annual or annual instalments, according to the income stream of the enterprise, observing the term of up to 8 (eight) years, with a grace period of up to 2 (two) years;
f) Deadline for contracting: 30/09/2011;
g) Operation risk: Financial Institution;
h) Guarantees: those accepted in rural credit;
i) Source and limits of resources: BNDES System, for the amount of R$ 204,000,000.00 (two hundred and four million reais).

4 - The provisions of art. 2, § 4, of Resolution No. 3,575, of 29/5/2008, as amended by Resolution No. 3,712, dated 16/4/2009, does not apply to operations contracted in the modality set forth in item 3. (Res. 3,979, Article 1)

5 - For producers who qualify as beneficiaries of the Pronamp National Support Program, as provided in MCR 8-1, financing may be granted under this Section applying the effective interest rate of 8% pa. (Eight per cent per annum). (Res 4,486 art. 6)

Appendix 4 – Rural Credit Manual 2.7

Title: Rural Credit
Chapter: Basic Conditions - 2
Section: Auditing – 7

1 - The direct auditing of all credits is mandatory, except for the cases expressly set forth in this manual, including direct auditing by sampling. (Res. 3,884 art. 1)

2 - The auditing must be carried out: (Res. 3,235, Res. 3,369 art. 1 II, Cta-Cir 3,719 art. 3)

a) of agricultural working capital: before the harvest period; (Res. 3,235; Res. 3,369 art. 1 II)
b) of marketing financing: during the course of the operation; (Cta-Circ 3,719 art. 3)
c) of livestock working capital, at least once in the course of the operation, at a time when it is possible to verify its correct application; (Res. 3,235; Res. 3,369 art. 1 II)
d) In the case of investment for construction, renovations, or extensions of facilities, until the execution schedule foreseen in the project is completed; (Res. 3,235; Res. 3,369 art. 1 II)
e) Other financing: up to 60 (sixty) days after each use, to prove the completion of works, services or acquisitions. (Res. 3,235; Res. 3,369 art. 1 II)

3 - Direct auditing of the projects is required in all "extant" credits granted to the same borrower when the sum of the contracted amounts exceeds: (Res. 4,174 art. 4)

a) R$250,000.00 (two hundred and fifty thousand reais), in the case of rural credit operations:
   I - Supported by the National Program for the Strengthening Family Agriculture (Pronaf);
   II - Beneficiaries of economic subsidies granted under Law No. 8,427, of the 27/5/1992;
   III - Backed by the Constitutional Financing Fund of the North (FNO), the Northeast (FNE), and the Centre-West (FCO);
b) R$300,000.00 (three hundred thousand reais), in the case of transactions not covered by item "a".

4 - Sampling consists in directly auditing the minimum percentage of the number of extant credits deferred in each agency, in the last 12 (twelve) months, without harming the indirect controls of the financial institution. (Res. 3,884 art. 1)

5 - Direct auditing is permitted by sampling of extant credits granted to the same borrower, observing the following ranges of value and minimum percentages:

a) Credits under Pronaf, other economic subsidy operations under Law No. 8,427/1992, and/or backed by funds from FNO, FNE and FCO, with contracted value:
   I - Up to R$ 40,000.00 (forty thousand reais): 5% (five percent);
   II - Higher than R$ 40,000.00 (forty thousand reais) up to R$ 200,000.00 (two hundred thousand reais): 10% (ten percent);
   III - Higher than R $ 200,000.00 (two hundred thousand reais) up to R $ 250,000.00 (two hundred and fifty thousand reais): 15% (fifteen percent);
b) Credits with a contracted value of up to R $ 300,000.00 (three hundred thousand reais), in the case of operations not included in the caput of item "a": 10% (ten percent);

6 - The central or regional body of the financial institution must select credit for sampling under criteria of broad diversification of borrowers and purposes. (Res. 3,884 art. 1)

7 - It is incumbent upon the supervisor to verify the correct application of budgetary resources, the development of the financed activities and the situation of the guarantees, where applicable. (Res. 3,235)

8 - In the event of a finding of criminal offenses or tax fraud, the financial institution must communicate the facts to the Central Bank of Brazil, forwarding the documents proving irregularities, with a view to adopting the appropriate measures with the Public Prosecutor's Office or the tax authorities. (Res. 3,235)

9 - Any omission or negligence in verifying the correct application of budgetary resources will subject the infractor to regulatory sanctions. (Res. 3,235)

10 - Audit results must be recorded in a specific report, with the technical assessment at portfolio level being responsible for recording in the appropriate field or as an attached document, as part of the report, the measures taken by the agency to remedy eventual verified irregularities. (Res. 3,884 art. 1)

11 - Direct inspection, including by sampling, may be carried out by the financial institution itself or by a specialized individual or company, by means of an agreement. (Res. 3,884 art. 1)

12 - The audit is void if carried out by: (Res. 3,235; Res. 3,884 art. 1)

a) By a company or person contracted directly by the borrower to provide technical assistance at company level; (Res. 3,884 art. 1)
b) By a company in which the borrower participates directly or indirectly. (Res. 3,235)

13 - The beneficiary is responsible for the audit of sub-loans, and the financier may also exercise it, if deemed convenient. (Res. 3,235)

14 - The measurement of plantation or pasture is mandatory as an integral part of the audit, when the area of a crop financed by the same financial institution exceeds 1,000 (one thousand) hectares in the same property, except if the financing is exclusively destined to the isolated acquisition of agricultural pesticides and their respective application (Res. 3,235)

15 - The provisions of the previous item do not alter the requirement of measurement resulting from a specific standard of the Rural Insurance Program (Proagro). (Res. 3,235)

16 - The measurement must be carried out on a timely basis to gauge the extent of the planted area. (Res. 3,235)

17 - Verification of areas of no more than 1,000 (one thousand) hectares must be carried out as part of normal auditing services, under routine methods. (Res. 3,235)

18 - The Central Bank of Brazil may require measurement of plantations or pastures whenever, in its judgment, the data analysis of the Rural Credit Operations System and Proagro (Sicor) indicate. (Res. 3,235)

19 - Spreadsheets, maps, sketches, or similar documents are required, indicating reference points and proof of the methodology adopted in the measurement whenever the measured area exceeds 1,000 (one thousand) hectares. (Res. 3,235)

20 - The measurement can be performed by a service provider, a professional contracted specifically for the purpose or from the financial institution's own team of staff. (Res 3,235)

21 - It is permissible for the measurement to be made by a professional from the transferor cooperative, for the purpose of auditing sub loans. (Res. 3,235)

22 - The measurement of plantations or pastures constitutes part of the audit service, with the expenses run on behalf of the financier. (Res. 3,884 art. 1)

23 - In the case of a measurement requested by the Central Bank of Brazil, its cost must be apportioned between financial institutions, proportionally to the area financed in each one. (Res. 3,235)

24 - The borrower may be required to reimburse expenses incurred with inspection or measurement of plantations and pastures, in the case of: (Res. 3,235)

a) Audit or measurement frustrated through their fault; (Res. 3,235)
b) Extraordinary audit or measurement, carried out by virtue of an irregularity of conduct; (Res. 3,235)
c) Audit or measurement where a reduction of more than 20% (twenty percent) in the planted area is verified, as compared to that declared in the credit instrument. (Res. 3,235)

25 - The Central Bank of Brazil is authorized to supervise the rural credit operations carried out by financial institutions, including with borrowers, and the credit instrument must contain an explicit clause to this effect. (Res. 3,235)

26 - The financial institution must appoint an auditor to carry out inspections at the rural property level, in conjunction with representatives of the Central Bank of Brazil, without charge to the latter, whenever such an appointment is requested by the oversight of that municipality. (Res. 3,884 art. 1)

27 - The Central Bank of Brazil pays interest at 12% p.a. (Twelve percent per annum) and updates it based on the Referential Rate (TR) on the required deposits of financial institutions in administrative and similar processes, pertaining to rural credit, when their return occurs due to the provision of the appeal filed. (Res. 3,235)

Source: (Banco Central do Brasil, 2016)

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