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How can the bioeconomy fight poverty in the Amazon?

INSTITUTO
ESCOLHAS

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Summary

1. Main findings

FOREST RECOVERY

The recovery of 5.9 million hectares of forests in Para has the potential to generate BRL 13.6 billion in revenue, create 1 million direct jobs and reduce the poverty rate in the state by 50%.

The recovery of 1.9 million hectares of forests in Maranhão has the potential to generate BRL 4.6 billion revenue, create 350 thousand direct jobs and reduce the poverty rate in the state by 21,5%.

HORTICULTURE

The increase in vegetable production to 170 thousand tonnes in Pará has the potential to generate BRL 682 million in revenue, create 86 thousand direct jobs and reduce the poverty rate in the state by 6%.

The increase in vegetable production to 187 thousand tonnes in Maranhão has the potential to generate BRL 600 million revenue, create 134 thousand direct jobs and reduce the poverty rate in the state by 9%.

Photo: ©2011CIAT/NeilPalmer

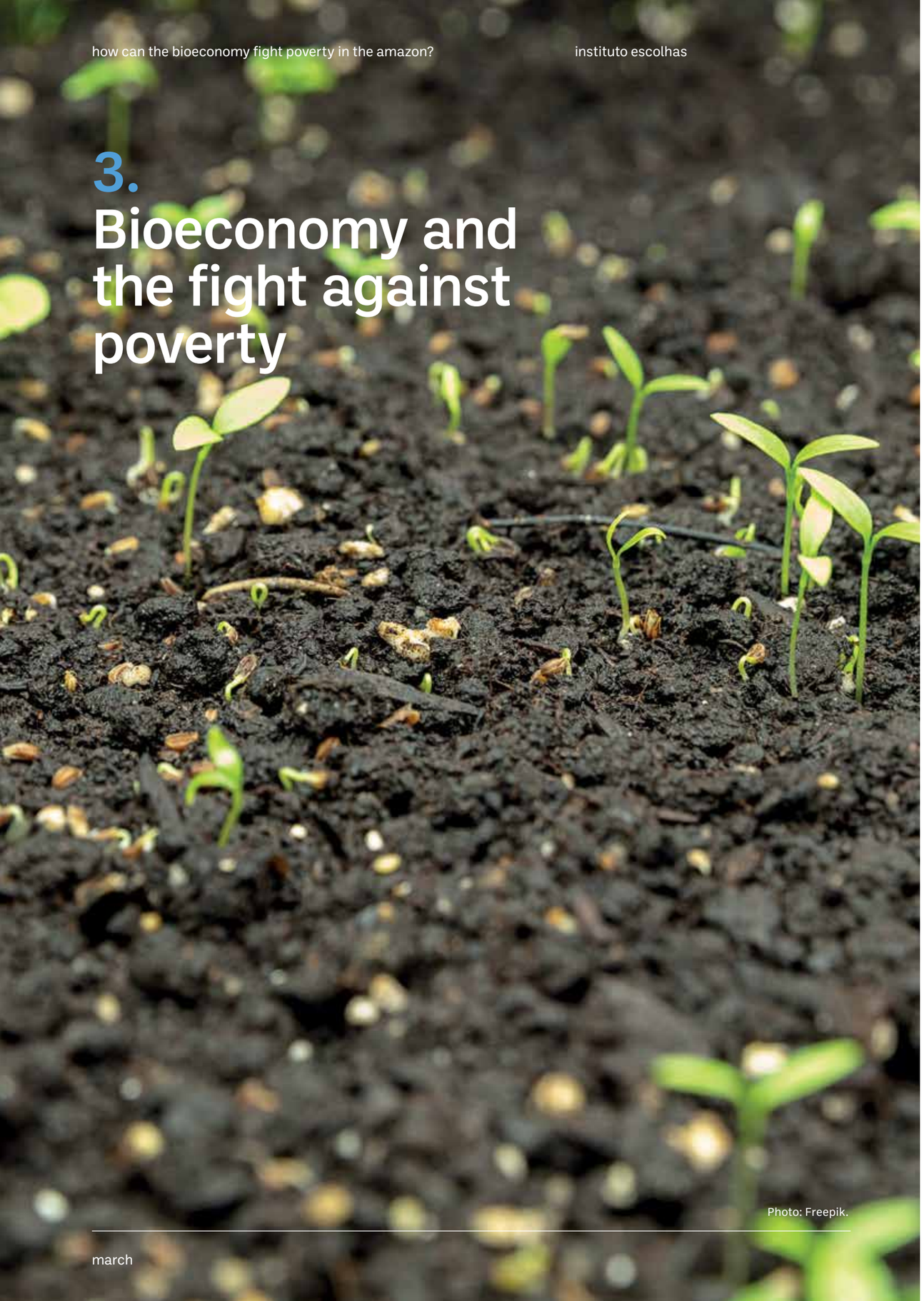
2. Introduction

Fighting poverty can contribute to the end of deforestation in the Amazon. The reduction of 1% of people in extreme poverty – or 35 thousand people – has the potential to reduce deforestation in the Legal Amazon by 3.3%, equivalent to 27 thousand hectares. The 1% increase in the formal employment index – 42 thousand jobs – could decrease deforestation in the region by 8.4%, equivalent to 67.2 thousand hectares[1]. These are data that reinforce the importance of combining policies to combat deforestation with policies to combat poverty.

The reality of the Amazon demands a strategy for facing poverty which, besides increasing and distributing income, encourages the provision of jobs not linked to activities that degrade the environment. This entails promoting a transition that substitutes economic activities associated with deforestation, environmental degradation and the concentration of income for others that promote environmental conservation and recovery, the generation and distribution of local income and the inclusion of the most vulnerable.

In order to contribute to such a transition, this study by Instituto Escolhas analyses two bioeconomy activities: forest recovery and horticulture. The findings present estimates of the potential for generating employment and income, as well as important factors to ensure the productive inclusion of people living in poverty in the Amazonian states of Maranhão and Pará, whose socioeconomic indices point to severe income deprivation.

1
Instituto Escolhas. **Could the fight against poverty contribute to stop deforestation in Brazil?. EXECUTIVE SUMMARY** Sao Paulo, 2022. Available here.



3. Bioeconomy and the fight against poverty

Photo: Freepik.

What bioeconomy activities would have the potential to include individuals in socially vulnerable situations? To answer this question, the study focused on the socioeconomic data of the states of Pará and Maranhão.

BIOECONOMY

In this paper, the term bioeconomy refers to economic activities that encompass all biodiversity value chains, driven by traditional knowledge, science and the search for innovation in the use of biological and renewable resources. The aim is to generate circular, regenerative, sustainable, and inclusive economic activity with collective and local benefits. **Examples of bioeconomy are:**

- **Activities that carry out sustainable forest** management to extract products such as nuts, fruits, rubber, oils, wood, fish, fibres and medicinal plants; and the industries that process these products (food, drinks, cosmetics, pharmaceuticals, fashion, construction);

- **Sustainable agriculture, fish farming and tourism, environmental services**, research and education for the development of the bioeconomy in the region.

Maranhão

63% (or **4.4 million** people) were living in extreme poverty (1 million) and poverty (3.4 million) in the state in 2020.

BRL 662 was the average monthly household income per capita in the state between 2012 and 2020, compared to BRL 1,351 recorded in Brazil.

12 years of average schooling, the equivalent of completed secondary education, was a period seen only among the 10% with the highest average income in 2020. In the 10% of households with lower average income, residents' schooling was less than **7 years**.

1 million children (under 14 years) were living in poverty and **339 thousand** in extreme poverty in 2020.

15.5% of the state's workforce[2] was unemployed in 2020. The unemployment rate reached **27.5%** of the labour force in poverty and **42.5%** of the labour force in extreme poverty.

48.7% of the labour force in extreme poverty lived in rural areas in 2020.

Source: IBGE, Continuous PNAD, 2020.

2
According to the IBGE, the labour force is composed of occupied and unemployed people in the survey's reference week. Those individuals are considered to be unemployed in the reference week if they did not have a job in that week. However, they took some effective action to get a job in the thirty-day reference period and were available to begin work in the reference week or if they had already obtained a job and would start work in less than four months. Available here, only in Portuguese. (Accessed in March 2023.)

Pará

45% (or **3.9 million** people) were living in extreme poverty (656 thousand) and poverty (3.2 million) in the state in 2020.

BRL 864 was the average monthly household income per capita in the state between 2012 and 2020, compared to BRL 1,351 recorded in Brazil.

12 years or more of average schooling, the equivalent of completed secondary or higher education, was a period seen only among the 10% of the group of households with the highest average income in 2020. In the 10% of households with lower average income, residents' schooling was less than **7,2 years**.

992 thousand children (under 14 years) were living in poverty and **210 thousand**, in extreme poverty in 2020.

10.5% of the state's labour force was unemployed in 2020. The unemployment rate reached **18.9%** of the labour force in poverty and **38,5%** of the labour force in extreme poverty.

47.1% of the labour force in extreme poverty lived in rural areas in 2020.

Source: IBGE, Continuous PNAD, 2020.

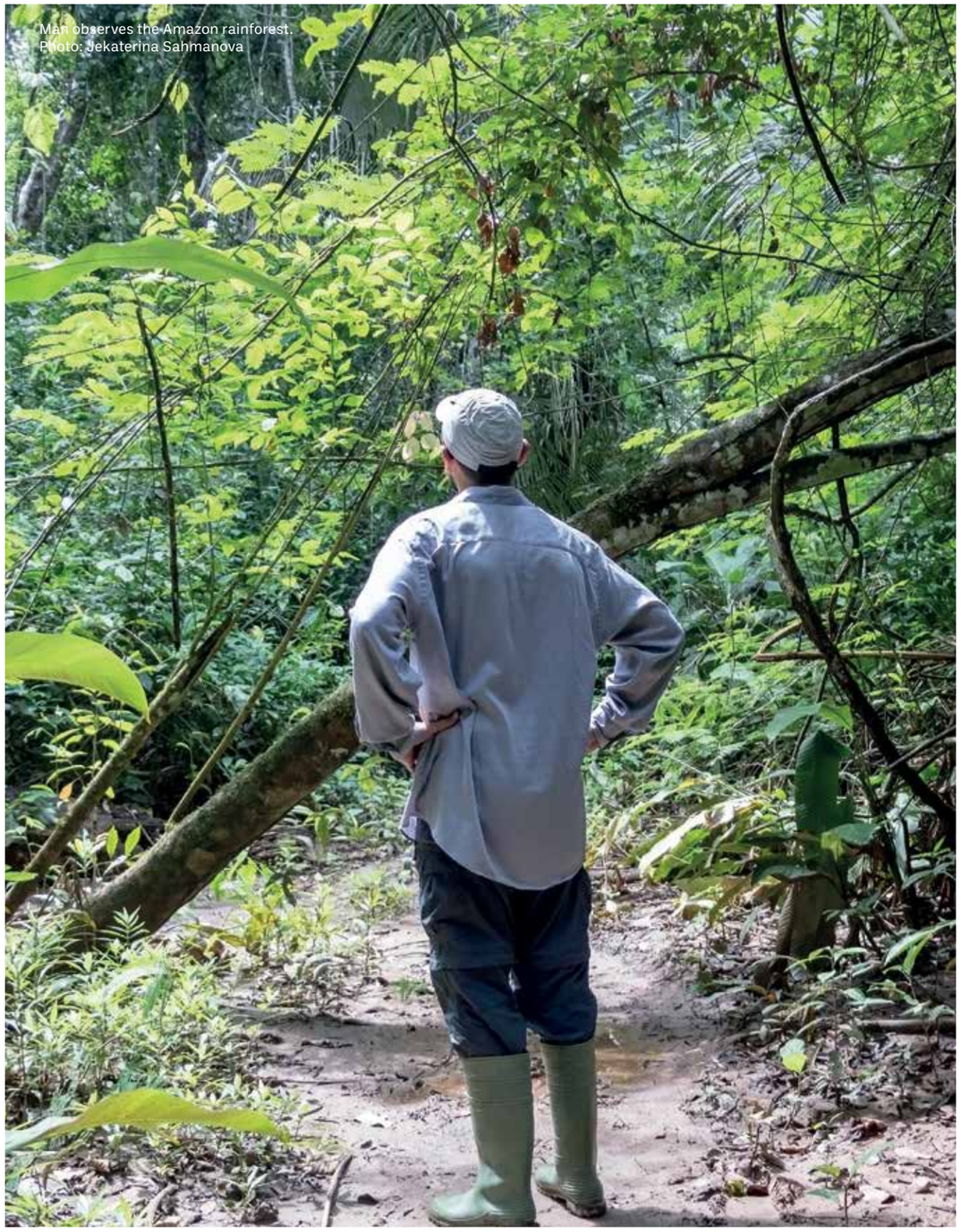
In both states, a significant part of the labour force in extreme poverty is living in rural areas. At the same time, agriculture and cattle ranching are of great importance to the economies of both Pará and Maranhão, representing around 9% of the added value of the GDP of the two states in 2019 (behind services and industry), with an emphasis on soybean production and cattle ranching, directly associated with deforestation.

There were 24 million heads of cattle in Pará in 2021 - 11% of the national herd and 43% of that of the North region. Maranhão had 8.6 million heads – 4% of the national herd and 27% of the Northeast[3] region.

Soybean production is the largest in terms of area occupation in both states. In twenty years, between 2001 and 2021, the area of cultivation of this legume grew from 1,000 to 754,000 hectares in Pará and from 213,400 to 1 million hectares in Maranhão[4].

Although soybean farms accounted for about 1% of the total staff employed in agricultural and livestock farms in the states of Pará and Maranhão in 2017, the occupation rate per farm was high in relation to other crops, reaching 9 people in Pará and 15 in Maranhão. Cattle ranching, meanwhile, accounted for 27% of the total staff employed in farming establishments in Pará and 31% in those in Maranhão, with an occupation rate of 3.5 and 3.6 people per establishment, respectively, very close to the two states' overall rate for establishments in 2017 (3.4 in Pará and 3.2 in Maranhão)[5].

Given the economic importance of these activities that are not committed to the conservation and regeneration of the region, the question is: how can we promote the transition to a more sustainable economy that guarantees, at the same time, the inclusion of the most vulnerable labour force? What economic activities could contribute to these objectives?


Man observes the Amazon rainforest.
Photo: Jekaterina Sahmanova

3
IBGE – Municipal Livestock Survey 2021.

4
IBGE – Municipal Agricultural Survey 2021.

5
IBGE– Agricultural and Livestock Census 2017

I. Horticulture

Despite having low economic significance - among the total of agricultural products commercialised in 2017, sales revenues represented only 3.6% in Pará and 2.1% in Maranhão - horticulture has characteristics that indicate great potential for productive inclusion of the labour force.

Legumes and vegetables can be grown on small properties, with low investment and high potential for inclusion in credit policies such as the National Programme for the Strengthening of Family Farming (Pronaf). Small areas also make it possible to make intensive use of production factors such as land and labour, which enhances the productive inclusion of people in situations of social vulnerability.

In Maranhão, 82% of horticulture farms occupied areas smaller than 5 hectares and 56.4% had less than 1 hectare in 2017. In Pará, in that same year, these figures were 73.8% and 44.6%, respectively. Approximately 90% of these farms in Maranhão and 87% in Pará[6] were family farms, and most of them fit into the Pronaf B support line, which caters to less capitalised producers[7].

As the vegetable cycle is short, the same area can be used for different crops, which improves the management of economic risks (there is no dependence on a single product) and makes it possible to take advantage of seasonal market opportunities. In addition, horticulture contributes greatly to the food security of producers' families, since part of the harvest can be used for their own consumption.

In order to estimate the potential of horticulture to promote the productive inclusion of people in situations of social vulnerability, we projected three hypothetical scenarios of growth of demand and production of vegetables in the two states studied, over a ten-year horizon. In these scenarios, increases in production, the number of farms, the number of jobs (direct and indirect) and the total income generated in the sector were considered.

Horticulture situation in Pará and Maranhão States

	Pará	Maranhão
Number of horticulture farms	8,429 (2.5% of the Brazilian total)	8,934 (2.7% of the Brazilian total)
Main products	coriander, maxixe, lettuce, cabbage, okra, spring onion, cucumber, green corn, pepper, chicory and cariru	green corn, lettuce, coriander, okra, spring onions, maxixe, tomato ('piled') and kale
Farm size	73.8% of farms have up to 5 ha	82% of farms have up to 5 ha
Participation of horticulture in state agricultural revenue	3.6%	2.1%
Region with the highest production	Northeast Pará	North Maranhão

Source: Agricultural and Livestock Census 2017

6
IBGE– Agricultural and Livestock Census 2017.

7
Family producers who hold the Pronaf Aptitude Declaration (DAP) or the Family Agriculture Register (CAF Pronaf) classified under Group B, with annual gross family income of up to BRL23,000.

Estimates of socioeconomic impacts of promoting horticulture in the states of Pará (PA) and Maranhão (MA)

Scenarios	**Base Case Scenario** Current situation of production of 6.6 kg per capita in Para and 4.2 kg per capita in Maranhão		**Scenario 1** State production and consumption grow and reach the average consumption of the North region, 10.7 kg per capita for Pará, and of the Northeast region, 19 kg per capita for Maranhão		**Scenario 2** State production and consumption grow and reach the national consumption average of 22 kg per capita		**Scenario 3** State production and consumption grow and reach the average consumption of the South region, of 29 kg per capita	
States	**PA**	**MA**	**PA**	**MA**	**PA**	**MA**	**PA**	**MA**
Production (tonnes) [i]	54,963	29,225	16,916	111,810	118,510	135,725	170,024	187,239
No. of farms [ii]	8,429	8,934	3,018	33,272	21,147	40,389	30,339	55,718
Income (BRL million) [iii]	187.6	95.36	67.85	358.69	475.36	435.41	681.99	600.67
Production costs (BRL million) [iv]	74.95	31.87	23.07	121.95	161.62	148.04	231.88	204.23
Number of jobs [v]	15,889	15,047	8,535	80,208	59,793	97,364	85,784	134,318
Poverty reduction (%) [vi]	-	-	0.60%	5.20%	4.10%	6.40%	6.00%	9.00%

Source: Prepared by the author based on data from the 2017-2018 Household Budget Survey (POF) and the IBGE's 2017 Agricultural Census and on input and product matrices developed by the Superintendence for the Development of the Amazon (Sudam).

(i) The numbers presented from Scenario 1 through to Scenario 3 represent the increase in production over the Base Case Scenario.

(ii) The numbers presented from Scenario 1 through to Scenario 3 represent the increase in farms compared to the Base Case. No productivity gains are foreseen, only the increase in the number of farms is considered. The average income per farm used in the estimate is the same as that observed in the 2017 Agricultural Census.

(iii) Total income of all farms. Income per farm was calculated as the ratio between the value of production and the number of farms, with values from IBGE's 2017 Agricultural Census adjusted for January 2022 by the IPCA. Also considered were the effects of the expansion of horticultural production on other agricultural activities, such as reduced input prices. An additional 1% impact under income from farms.

(iv) The cost of production (sum of the values of all the inputs and services used in vegetable production) was estimated at 34% of the value of the average income per farm. Figure was based on " Instituto Escolhas. The challenges and potential of urban and peri-urban agriculture in Belém. Sao Paulo: 2022".

(v) It represents an increase in the number of direct and indirect jobs. We considered 1.68 jobs per farm in Maranhão and 1.89 in Pará, and a ratio of two direct jobs for each indirect job.

(vi) 70% of the jobs generated would go to people experiencing poverty, and each job would lift three individuals out of poverty. To estimate poverty reduction, the initial levels of the proportion of people living in poverty and the number of people living in poverty in each state were used.

The following factors should be considered when fostering vegetable production in the states of Pará and Maranhão:

• Encouraging production models that do not use chemical inputs and that employ sustainable and regenerative techniques such as nutrient recycling, soil conservation, crop rotation and agroforestry systems.

• Focus on employment and income generation for people in poverty (regardless of whether they already have access to land).

• Guaranteed access to land. The models forecast an increase in the number of farms, which can only be done by increasing access and/or converting degraded or under-utilised areas into horticultural areas. The municipality of Cachoeira do Piriá alone, in Pará, has 97,000 hectares of pasture and a cattle stocking rate of only 0.5 head per hectare, indicating high degradation and under-utilisation of pasture.[8] The municipality is located in a horticulture producing region, Northeast Pará and has the lowest GDP in the state.

• Guaranteed access to technical and social assistance to improve production systems and access to markets, resources, services and social policies for beneficiary workers.

• The promotion of production in urban areas, peri-urban areas and areas close to urban centres. Short sales cycles for supplying cities can reduce costs, increase access to fresh and healthy food and contribute to the promotion of food security for city dwellers.

8
Mapbiomas Data, Collection 7 and IBGE – Municipal Livestock Survey 2021.

Family farming of organic products. Photo: Amanda Caroline da Silva

II. Forest Recovery

The second bioeconomy activity analysed by the study was forest recovery, which also holds great potential for absorbing rural and poverty-stricken labour. There is room for intense labour employment, from seed collection and seedling production to planting, maintenance and monitoring of the activity.

The organization of the forest recovery chain is also strategic for the regeneration and conservation of biodiversity, being a fundamental part of the Brazilian contribution to the world's efforts to mitigate the climate crisis. With such a goal, the country stated among its targets in the Paris Agreement the recovery of 12 million hectares of forests until 2030.

So far, however, only 79.13 thousand hectares have been recovered . This figure shows that there is an institutional and investment opportunity context that is very favourable to the development of forest recovery, which also offers the possibility of developing other economic activities associated with it, such as the sustainable management of timber and non-timber products and the sale of environmental services provided by the forest.

Between 1985 and 2021, Pará totalled more than 17 million hectares of native forests converted into agricultural and mainly livestock use. In Maranhão, during the same period, around 5.8 million hectares of forest were transformed for agricultural use.

This study simulates three forest recovery base case scenarios in order to estimate the potential for productive inclusion of poor workers in the states of Pará and Maranhão.

9
Agreement signed by 195 countries at the 21st United Nations Framework Convention on Climate Change, held in 2015 in Paris, with national targets to contain global warming up to 2°C and efforts to not exceed 1.5°C by the end of this century.

10
Data from **the Restoration Observatory** (accessed in December 2022). According to the Observatory, another 11 million – in general, areas abandoned after deforestation – are in the process of natural regeneration.

11
Biomas, Collection 7 (Accessed in October 2022.)

SCENARIO 1 – FOREST RECOVERY IN PUBLIC FOREST AREAS WITH RECENT DEFORESTATION (2019-2022)

A frequent target of illegal deforestation, the public forests considered here are part of the National Register of Public Forests (CNFP)[12]. In this type of area deforested between 2019 and 2022, there is enough space for forest recovery in Maranhão and Pará, amounting to more than 915,000 hectares.

Recently deforested Public Forest Areas in Maranhão and Pará

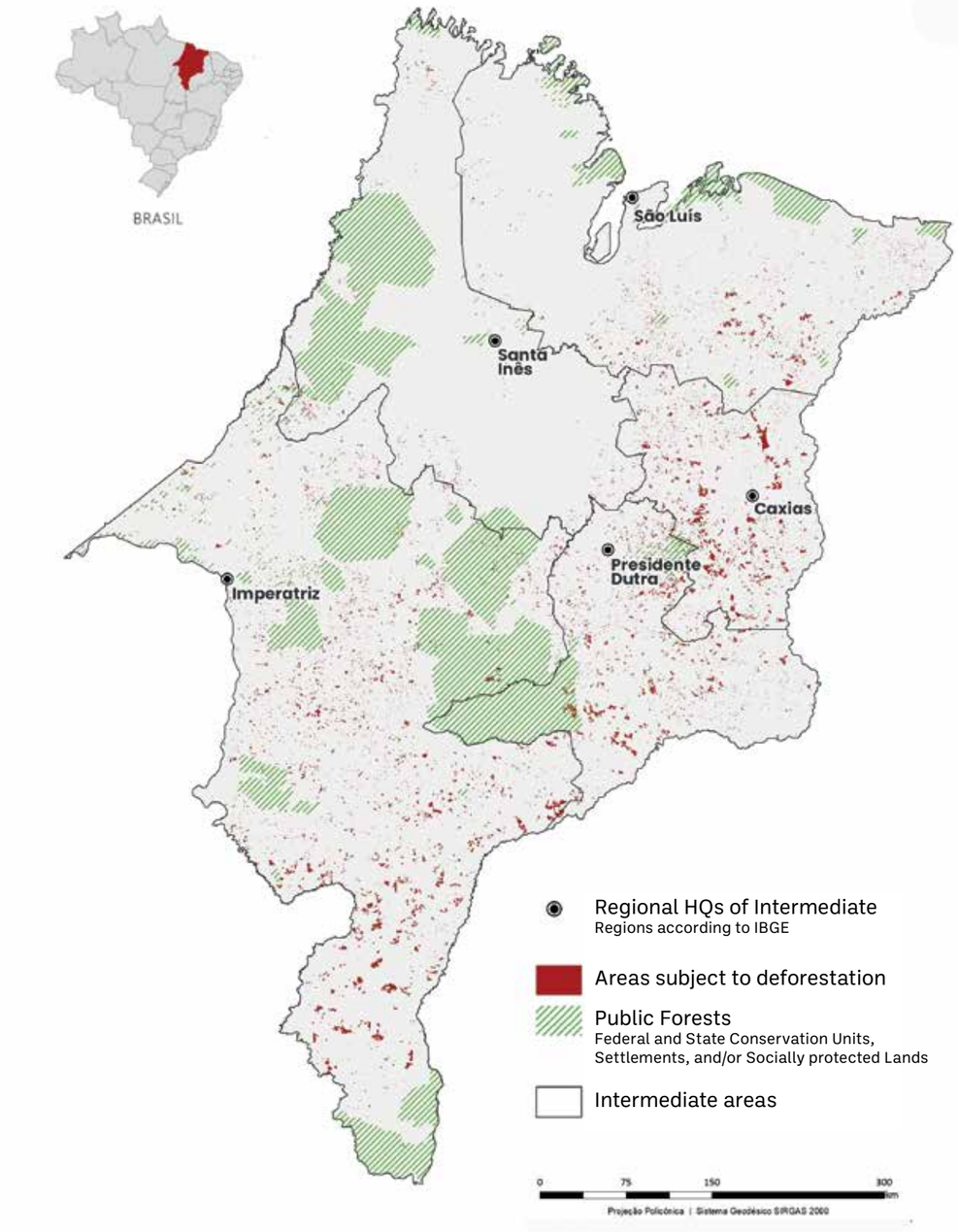
States	Public Forests Area (ha)	Area of public forests deforested between 2019- 2022 (ha)
Maranhão	4.8 million	31,610
Pará	81.8 million	883,986
Total	86.6 million	915,596

Source: Prepared by the authors based on data from the CNFP and the Project for Monitoring Deforestation in the Legal Amazon (Prodes), of the National Institute for Space Research (Inpe).

12
According to **the National Register of Public Forests**, created by the Public Forest Management Law (**Law No. 11,284/2006**), and regulated by Decree nº 6.063/2007 and the Resolution of the Brazilian Forestry Service nº 2/2007, there are three types of Public Forests: type A, with specific destination and dominiality; type B, located in areas collected by the Public Power, but which have not yet been designated; and type C, in areas of undefined dominiality (vacant lands). (Accessed in November 2022.)

MARANHÃO

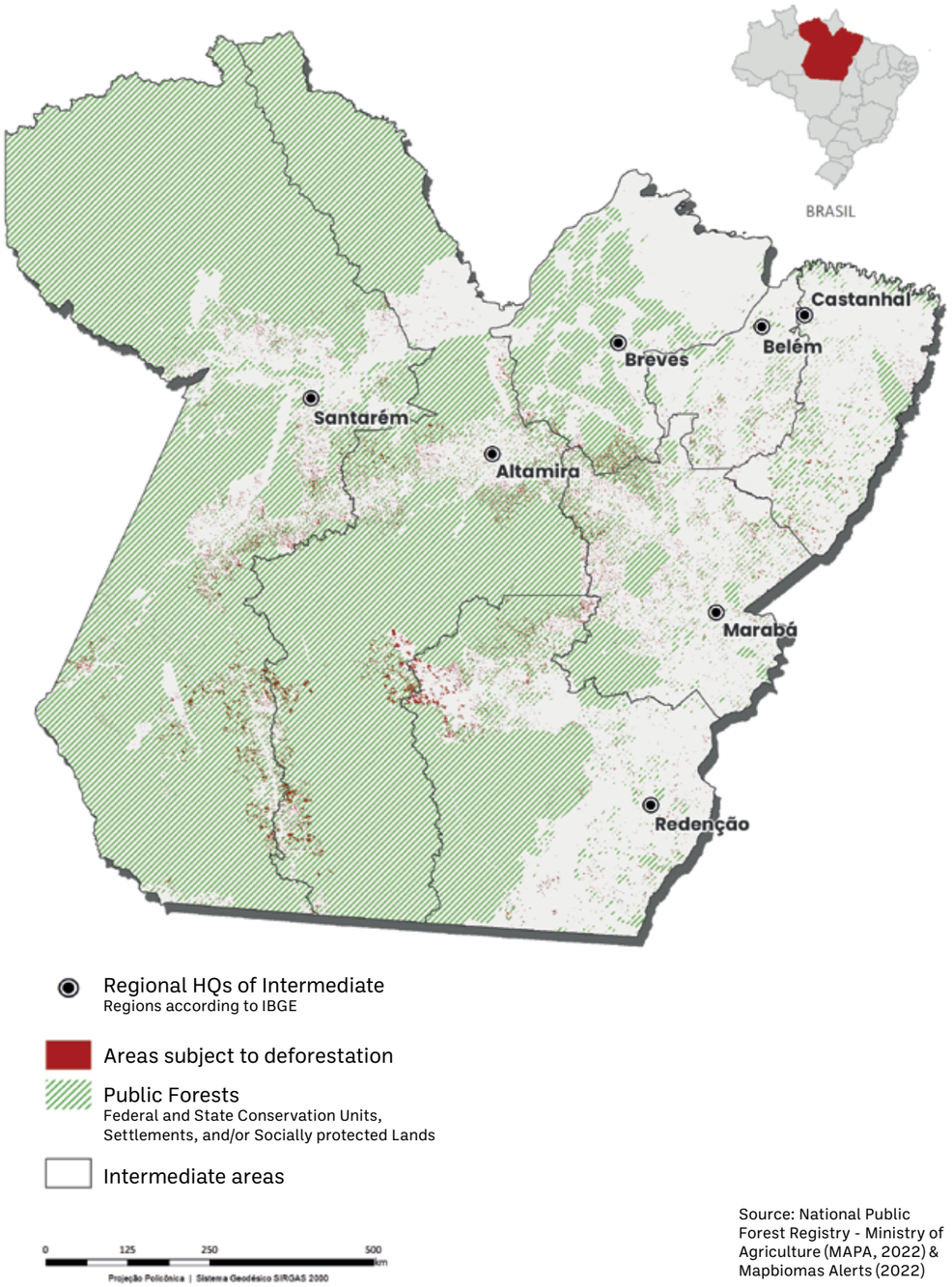
Alert for areas with risk of deforestation



Source: National Public Forest Registry - Ministry of Agriculture (MAPA, 2022) & Mapbiomas Alerts (2022)

PARÁ

Alert for areas with risk of deforestation



Source: National Public Forest Registry - Ministry of Agriculture (MAPA, 2022) & Mapbiomas Alerts (2022)

SCENARIO 2 - FOREST RECOVERY IN DEGRADED AREAS OF NON-DESIGNATED PUBLIC FORESTS

The Non-Designated Public Forests (type B of the CNFP) are those that have not yet had their use defined by the public authorities - for example, they have not become Conservation Units, Indigenous Lands or public rural settlements. This type of Public Forest suffers even more from deforestation, illegal occupation and land grabbing than the Earmarked Public Forests.

The study identified, by means of image processing, areas in Non-designated Public Forests with a greater degree of degradation than those that suffered recent deforestation (Scenario 1).

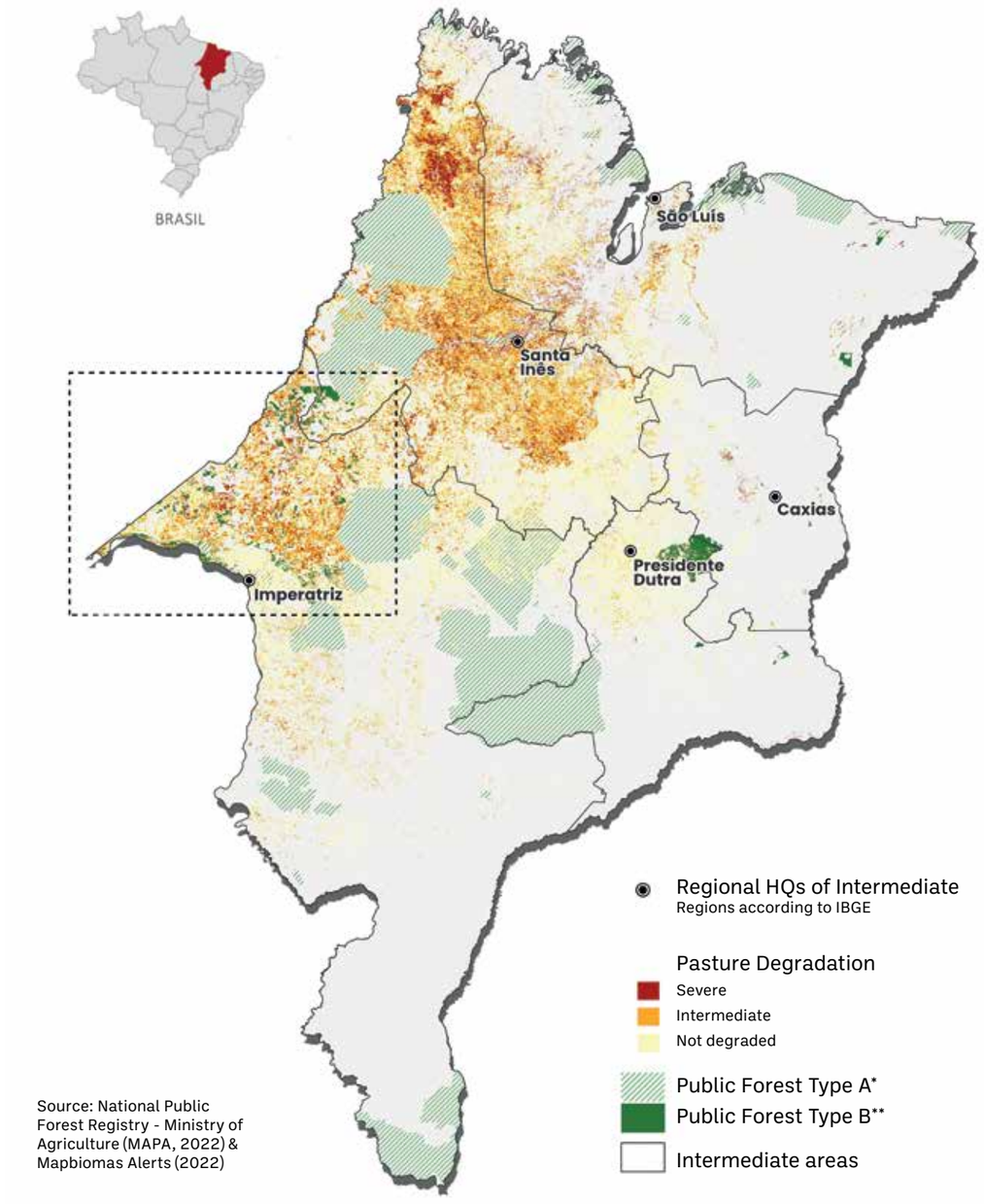
Degraded Areas in Non-Designated Public Forests, 2022

Type of degradation	Maranhão (ha)	Pará (ha)	Total (ha)
Moderate	16,395	464,244	480,639
Severe	4,702	69,955	74,657
Total	21,097	534,199	555,296

Source: Prepared by authors, based on CNFP and MapBiomas data.

MARANHÃO

Pasture degradation levels in Public Forests, 2022



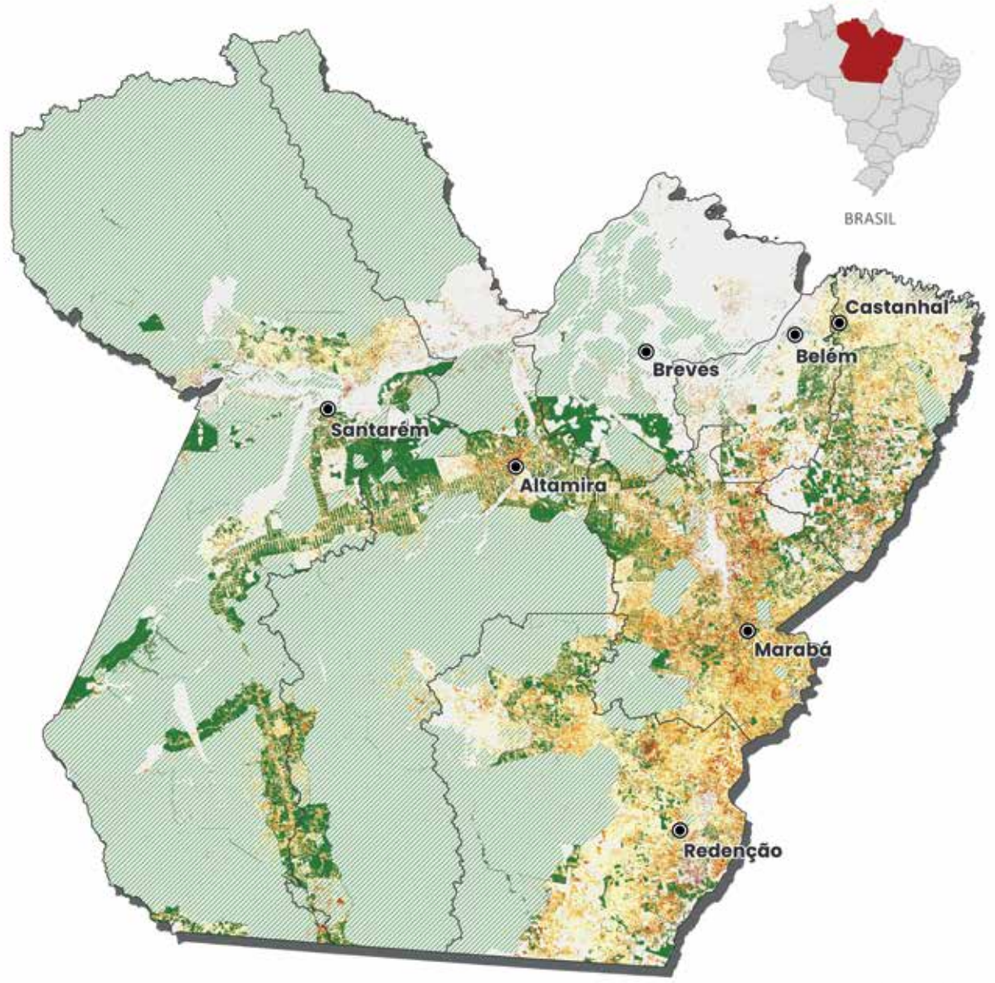
Source: National Public Forest Registry - Ministry of Agriculture (MAPA, 2022) & Mapbiomas Alerts (2022)

** Public Forests TYPE A - forests with a specific destination and domain such as Nature Conservation Units, Indigenous Lands, Public Rural Settlements, Military areas and other forms of destination provided by law. They are destined for protection and conservation of the environment and for use by traditional communities.*

*** Public Forests TYPE B - forests located in areas reclaimed by the Government, but without defined purposes.*

PARÁ

Pasture degradation levels in Public Forests, 2022



Source: National Public Forest Registry - Ministry of Agriculture (MAPA, 2022) & Mapbiomas Alerts (2022)

** Public Forests TYPE A - forests with a specific destination and domain such as Nature Conservation Units, Indigenous Lands, Public Rural Settlements, Military areas and other forms of destination provided by law. They are destined for protection and conservation of the environment and for use by traditional communities.*

*** Public Forests TYPE B - forests located in areas reclaimed by the Government, but without defined purposes.*

The recovery of public forest areas as an opportunity

Public Forest areas already recovered by the public authorities, whether destined or not, may be the object of public programmes for forest recovery and mobilisation of the labour force in poverty. Federal and state governments and their social and environmental agencies can make efforts in this direction, considering their respective areas of degraded Public Forests, their poverty-stricken labour force and the mobilisation of public and private resources[13].

The allocation of these areas, however, must consider the uses already provided for by law[14], the socio-environmental and economic vocations of the territories and the presence of human groups such as, for example, indigenous peoples and traditional peoples and communities.

One such example is that of the Civilian Conservation Corps (CCC), created in the United States in 1933, during the Roosevelt era, when the country was experiencing the Great Depression. The Corps employed thousands of young people in building forest conservation infrastructure, planting native vegetation, controlling forest fires, and controlling erosion and flooding. Current US President Joe Biden plans to resume the programme, with appropriate adaptations. The purpose of the now-called "Civilian Climate Corps" is to employ young Americans in projects to preserve and restore public lands, and to increase reforestation and carbon sequestration[15].

Another experience in this sense is that of the Green Belt Movement (GBM), founded in Kenya in 1977 by professor and activist Wangari Maathai. The initiative mobilised women from rural regions of the African country to recover large areas of forest, as a response to water and food shortages in their territories[16].

13
Forest concessions for forest recovery purposes may be an interesting tool for this purpose. They allow governments to grant Public Forest areas to the private sector to stimulate the development of economic activities that generate income while preserving the forest as it stands.

14
Public Forest Management Law, nº 11,284/2006.

15
The New Yorker. "**The Civilian Climate Corps is a Big-Government Plan that all Americans can Embrace**". March 2021. Available **here**.

16
The Green Belt Movement.

SCENARIO 3 – FOREST RECOVERY IN PRIVATE AREAS OF DEGRADED PASTURE WITH LOW BOVINE STOCKING RATE

17
The stocking rate corresponds to the ratio between the number of bovine animals and the size of the pasture area per municipality, based on data from the IBGE Municipal Livestock Survey of 2021 and Mapbiomas data for the same year.

This scenario assumes the fact that the recovery of degraded pastures generates two effects: improves the quality of the pasture, reducing the area necessary to behave the herd, and at the same time releases land for the increase of production and for the forest recovery.

Based on the calculation of the bovine stocking rate in all the municipalities of Pará and Maranhão[17], the study identified as degraded pasture areas those with stocking rates lower than or equal to 1.5 heads of cattle per hectare.

When forecasting the recovery of degraded pastureland, the study recalculated the use of these areas, considering cattle farming with an increase in the herd and the allocation of space for forest recovery.

Example:

Consider a 100-hectare pasture that holds 30 heads of cattle. Its stocking rate of 0.30 heads per hectare would be within the low stocking rate criteria (less than or equal to 1.5). With the recovery of this pasture and an increase in the stocking rate to 1.51, this herd of 30 animals would occupy only 19.87 hectares. The difference between 100 hectares (original pasture) and 19.87 hectares (pasture required after recovery) is 80.13 hectares, an area that could be destined to increase herd and forest recovery.

For the study, proportions equivalent to 25%, 50% and 75% of use of these areas for forest recovery were considered.

Degraded pasture private area (ha) and percentage that could be allocated to forest recuperation

(% destined for forest recovery)	Private degraded pasture area in Maranhão (ha)	Private degraded pasture area in Pará (ha)	Total
25%	629,602	1,496,015	**2,125,617**
50%	1,259,204	2,992,030	**4,251,234**
75%	1,888,806	4,488,045	**6,376,851**

Source: Prepared by the authors using the Pesquisa da Pecuária Municipal (PPM), IBGE, and MapBiomas, Collection 7.

Estimates of socio-economic impacts of promoting Forest Recovery in the states of Pará and Maranhão

Scenarios	Forest recovery opportunity area (ha)		Revenues (BRL billion)[i]		Investment (BRL billion)[ii]		Direct Jobs[iii]		Poverty reduction[iv]	
States	MA	PA	MA	PA	MA	PA	MA	PA	MA	PA
Scenario 1 – Forest recovery in public forest areas with recent deforestation (2019-2022)	31,610	883,986	0.06	1.69	0.1	3.83	5,709	159,648	0.35%	7.49%
Scenario 2 - Forest recovery in degraded areas of Non-designated Public Forests	21,097	534,199	0.04	1.02	0.1	2.31	3,810	96,476	0.23%	4.52%
Scenario 3 - Forest recovery in private areas of degraded pasture with low bovine stocking rate - 25% of available area	629,602	1,496,015	3.86	9.58	5.2	12.1	113,706	270,180	6.98%	12.67%
Scenario 3 - Forest recovery in private areas of degraded pasture with low bovine stocking rate - 50% of available area	1,259,204	2,992,030	4.18	10.21	7.1	16.7	227,412	540,361	13.96%	25.34%
Scenario 3 - Forest recovery in private areas of degraded pasture with low bovine stocking rate - 75% of available area	1,888,806	4,488,045	4.51	10.84	9	21.3	341,118	810,541	20.94%	38.01%
Joint scenarios										
1 , 2 and 3 (25%)	682,309	2,914,200	3.96	12.3	5.4	18.3	123,225	526,305	7.56%	24.68%
1 , 2 and 3 (50%)	1,311,911	4,410,215	4.29	12.93	7.3	22.9	236,931	796,485	14.54%	37.35%
1 , 2 and 3 (75%)	1,941,513	5,906,230	4.61	13.56	9.2	27.5	350,637	1,066,665	21.52%	50.02%

Source: Prepared by the authors.

(i) Revenue from the wood production area, where forest production is divided into 50% natural regeneration (passive restoration or regeneration conduction), 30% densification/ enrichment and 20% full area planting (direct seeding or seedling planting) - calculations according to Instituto Escolhas. (**How much does Brazil need to invest to recover 12 million hectares of forests?** Sao Paulo, 2016. Available here.) In the case of scenario 3, the forecast of revenue from pasture recovery (and consequent increase in beef production) is also included – according to CARLOS, S. M et. al. **Costs of recovering degraded pasture in Brazilian states and biomes**. Sao Paulo: Bioeconomy Knowledge and Innovation Observatory, Fundação Getulio Vargas, 2022. In addition to the revenue reported, there is great economic potential in non-timber forest product chains and in payments for environmental services (PES) that have not been calculated.

(ii) Adopted the same parameters used by Instituto Escolhas. (**How much does Brazil need to invest to recover 12 million hectares of forests?** Sao Paulo, 2016. Available here.) - with values extrapolated by the IPCA -, for the disbursement per hectare resulting from labour, materials, machinery and equipment, as well as technical assistance. For pasture recovery, the parameters are equal to those present in Carlos et al (CARLOS, S. M.; ASSAD, E. D.; ESTEVAM, C. G.; LIMA, C. Z.; PEACOCK, E. M.; PINTO, T. P. **Costs of recovery of degraded pastures in Brazilian states and biomes.** Sao Paulo: Bioeconomy Knowledge and Innovation Observatory, Fundação Getulio Vargas, 2022.).

(iii) Total direct jobs. For the calculation of jobs, a rate of 18.06 direct jobs per 100 hectares was used. Considering the relationship obtained by Brancalion et al. (BRANCALION, P. H. S. et al. **"Ecosystem restoration job creation potential in Brazil"**. People and Nature, v. 4, n. 6, Dec. 2022, p. 1401-678. Available at: https://doi.org/10.1002/pan3.10370 (accessed in March 2023), according to which vegetal restoration creates 42 jobs (direct and indirect) for every 100 hectares restored and that 43% of these jobs are direct jobs.

(iv) We consider that 70% of the direct employment generated will be destined to people living in poverty. In addition, besides the worker hired for forest recovery, another two people from his family will no longer be poor. Finally, to estimate the effects on the poverty indicator, the current poverty rates and numbers of people living in poverty in Maranhão and Pará are used.

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