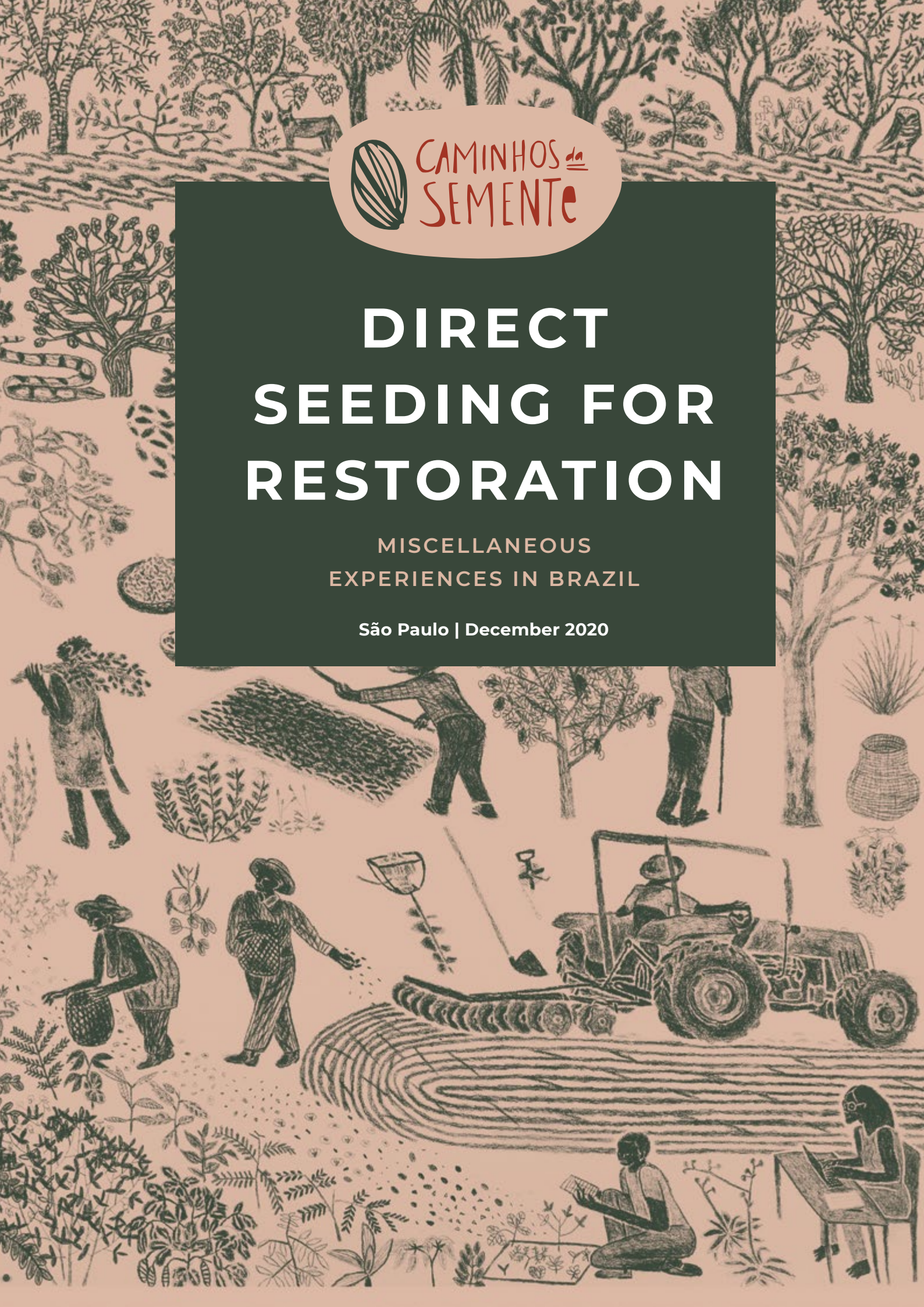

CAMINHOS da SEMENTE

DIRECT SEEDING FOR RESTORATION

MISCELLANEOUS EXPERIENCES IN BRAZIL

São Paulo | December 2020

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CAMINHOS da SEMENTE

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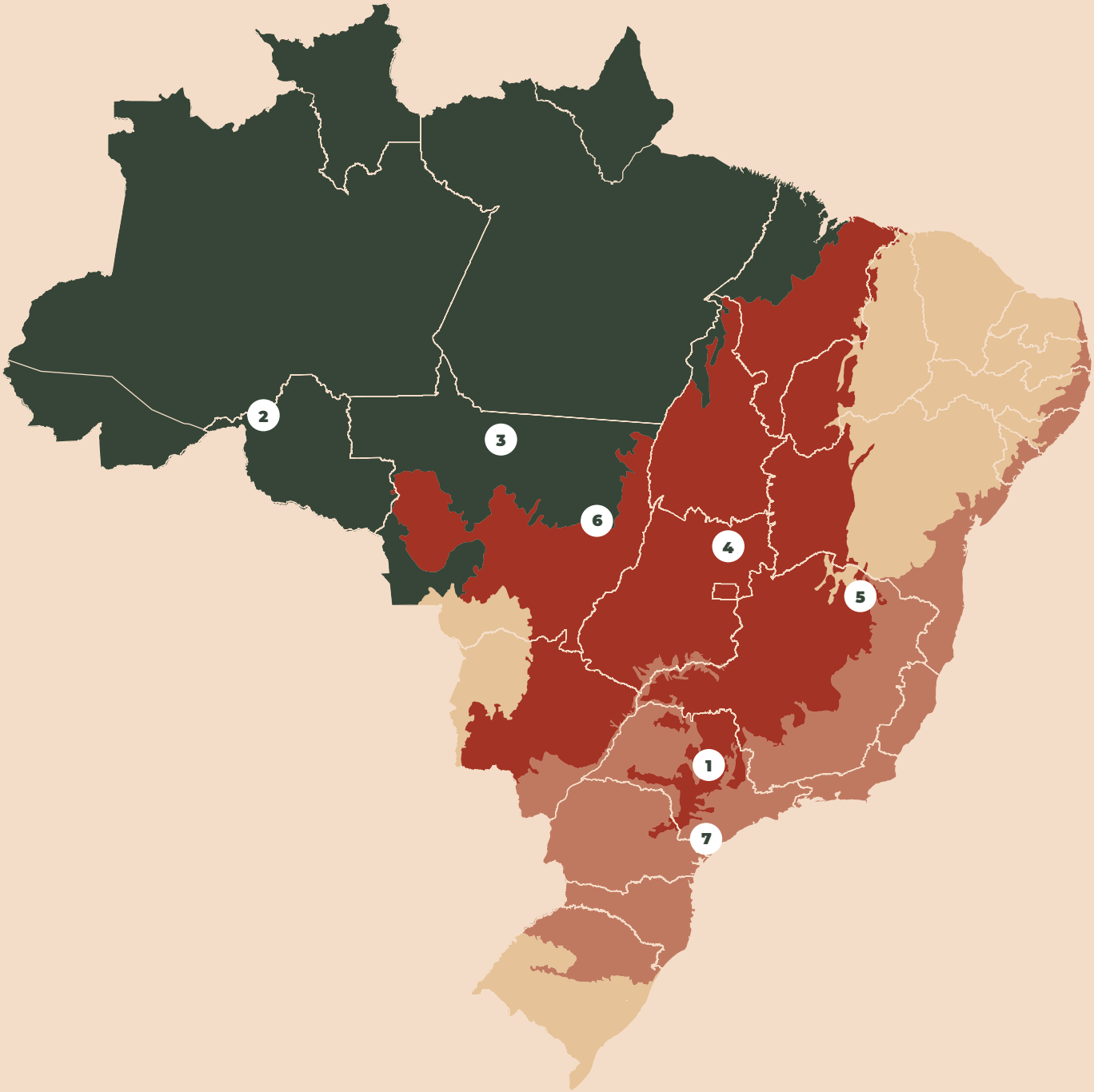
EXPERIENCES MAP



1. MONJOLINHO (SP)
2. JIRAU (RO)
3. PORTAL DA AMAZÔNIA/ IOV (MT)
4. PARQUE NACIONAL CHAPADA DOS VEADEIROS (GO)
5. RDS NASCENTES GERAIZEIRAS (MG)
6. BACIA DO XINGU/ISA (MT)
7. PARQUE NACIONAL DO RIO TURVO/INICIATIVA VERDE (SP)

SUMMARY

KNOWING IT FOR APPLYING IT

With its broad territorial extension and the world's greatest biodiversity, Brazil is recognized worldwide for its technical knowledge and its strategies for recovering native vegetation. The country has advanced in developing and implementing efficient ecological restoration methods that can positively impact the social sphere. The accumulated experience and the myriad of present and future innovations will be strategic in addressing climate change, water scarcity, loss of biodiversity, soil degradation, and many other contemporary environmental challenges.

Direct seeding is a method that consists of planting different life cycle seeds in high density, in order to trigger the ecological succession process. It is used in many countries to restore forest, savanna and grasslands ecosystems, and it has been implemented in Brazil over the last two decades, as the result of varied scientific and traditional knowledge.

International and domestic experiences prove that seeding can be made under different climatic, soil and terrain conditions, with technical adaptations. In addition to contributing to ecosystem services, ecological restoration with direct seeding is inclusive and generates social, economic and cultural benefits by broadly adding local knowledge and labor.

The Seed Paths Initiative (*Iniciativa Caminhos da Semente*) was launched in 2019, and is coordinated by Agroicone in partnership with Instituto Socioambiental (ISA) and Embrapa Recursos Genéticos e Biotecnologia Embrapa), with technical and financial support from the United Kingdom's Partnerships for Forests program (P4F). In order to expand restoration of native vegetation using direct seeding, the Initiative supports ecological restoration combined with socioeconomic benefits. In the first year of deployment, after developing an Action Plan prepared in a collaborative manner, dissemination and training actions were initiated, in addition to supporting the implementation of 35 new restoration areas with direct seeding in different environmental, social and institutional arrangement contexts.

This publication is part of the action for disseminating the experiences, and presents seven direct seeding implantation cases in three Brazilian biomes: Cerrado, Atlantic Forest and the Amazon[1].

[1] The original version in Portuguese features 14 experiences and is available on the caminhosdasemente.org.br platform

Photo: Nina Jacobi

Native seeds used for direct seeding in forest ecosystems such as jatobá, ipê, olho-de-cabra, tingui, cajazinho, sucupira, among others

The different contexts in which the planting was made reveal the potential for applying the method in Brazil, and it can also be used elsewhere around the world. The private, public and third sectors are portrayed in the experiences, presenting challenges and practical results that generate learning, allowing the recovery of native vegetation to expand in the country and worldwide.

Rural producers in São Paulo state can, for example, consider the experience in the Monjolinho farm, where reduced labor did not prevent the method's implementation. Innovation appears as a main element in cases where restoring native vegetation required active intervention in the Cerrado biome, covering large tracts of land in Brazil, including Midwestern region. The combination of research with demand for restoration in the Chapada dos Veadeiros national park in Midwestern Brazil was also an opportunity to perform one of the richest experiences in savanna environments, where the recovery process is carried out by planting grass, shrub and tree species. These life forms are important because they make up the structure of the cerrado stricto sensu and are responsible for ecosystem services such as water infiltration into the soil that feeds the water table, and for maintaining biodiversity.

Still in the Cerrado, another case has been transforming the lives of the Geraizeiros, a traditional community in Minas Gerais state. Families that live in the North of the state began to collect native seeds to recover the water resupply zones and the springs in their territory. Partnerships have also been established with local and foreign companies to address their environmental liabilities, providing young people with an opportunity to work in the region itself.

Also in the social sphere, family farmers in the Alta Floresta region in the Amazon area of Mato Grosso state, combine direct seeding with agroforestry and ensure greater food security and income generation for rural families, strengthening their autonomy.

In Vale do Ribeira, in São Paulo state, direct seeding was implemented on sloping land within the Rio Turvo state park. The involved organizations leveraged the potential for local natural regeneration and increased the richness of the local species with sowing, in addition to encouraging the creation of new seed collection groups.

Part of the inspiration for organizing new networks of collectors of native Brazilian seeds comes from Instituto Socioambiental (ISA)'s experience in fostering the development of the Associação Rede de Sementes do Xingu (ARSX), in Mato Grosso, the largest network for marketing Brazilian seeds. ARSX has already supplied seeds for restoring 6.6 thousand hectares by means of a "muvuca", as direct seeding is popularly known. Most of these areas were planted by ISA technicians, who have been working on the restoration of riparian forests on rural properties in the Xingu basin for 14 years. Such effect-seeking partnerships involve farmers, the third sector and academic organizations, bringing environmental solutions closer to agribusiness language and also involving the participation of indigenous collectors, farmers and urban collectors.

The partnerships also enable hydroelectric plants to innovate in the way of addressing their projects' environmental liabilities. The Jirau Hydroelectric Plant in Rondônia state is successfully restoring its Permanent Preservation Areas (APPs)[2] while contributing to structure work opportunities for families in the surrounding areas of its reservoir. The restoration method was established in partnership with Embrapa Recursos Genéticos e Biotecnologia through adaptive management based on monitoring results. This process has benefited the hydroelectric plant and the rural producers' cooperative that supplies seeds and seedlings and do the planting.

This publication's objective is to provide a better understanding of direct seeding, and thereby increase confidence in this method for restoring native vegetation. In each chapter, we describe the strategies adopted in each context and provide technical information applied to each case. The lessons learned in these examples enrich and broaden the method's perspectives, so that it contributes to Brazil's actions in the global effort to recover natural ecosystems. Likewise, other countries involved in the restoration agenda can take advantage of this successful Brazilian experience.

The diversity of direct seeding techniques and institutional arrangements described in the publication offer options that can be replicated, adapted or combined with other ideas so that direct seeding brings positive results for the entire ecological restoration chain.

[2] APPs (Áreas de Preservação Permanente) are areas established by law around natural or artificial bodies of water, which must have native vegetation and, when they do not, they must be restored. All rural properties in Brazil are required to maintain or restore APPs and there is currently great effort to comply with this legal requirement.

Adaptation capacity is a feature that can be found across restorers, researchers and also environmental agencies, companies, research institutions, third-sector organizations, collecting communities and other players involved in the stories.

The texts of each experience were prepared from interviews with people directly involved in the process and through scientific material prepared by the researchers involved. Thus, the work of the Caminhos da Semente initiative team provides accessible information to deepen knowledge about using the method. We adopted the strategy of inserting the names of "persons responsible for the experience" at the end of each chapter, as they are the people who played a crucial role in the process in each case, whether they were interviewed or not, recognizing those who worked to restore the native vegetation.

“Direct seeding for restoration: diverse experiences in Brazil” is a contribution to these times when the options for providing speed and scale for restoring ecosystems are becoming increasingly necessary. Associating the ecological impacts of restoration with socioeconomic benefits, in turn, is of paramount importance, as it expands the contribution to sustainable development. We hope that the experiences described here will collaborate to seed many, many other restorations across the biomes in Brazil and around the world.

FIND OUT MORE ABOUT EACH STORY

THE FOURTEEN EXPERIENCES HAVE POINTS IN COMMON AND ARE DIFFERENT FROM EACH OTHER.
WE USE THE ICONS BELOW, WHICH ARE HIGHLIGHTED IN THE CHAPTERS, TO FACILITATE THE PRESENTATION OF EACH CASE'S CONTEXT.

1. HECTARE BY HECTARE, THE LEGAL RESERVE[3] IS RESTORED WITH SEEDS

EXPERIENCES WITH DIFFERENT METHODS HAVE RESULTED IN A VIABLE DIRECT SEEDING MODEL FOR REDUCED LABOR CONTEXTS

São Carlos - São Paulo state

Vegetation type: transition between Atlantic Forest and Cerrado biomes (Seasonal Semideciduous Forest and Cerradão)

Photo: Marina Merlo

Eduardo Malta Campos, Eduardo Malta Campos Filho, Tomé: three generations at the legal reserve area of Monjolinho Farm

The willingness of landowners to restore the Legal Reserve (RL) often comes up against the costs of planting, maintenance and access to technical information. Eduardo Malta Campos, the person responsible for Agropecuária Cruzeiro, a division of the Santa Maria do Monjolinho farm in São Carlos (São Paulo state), made his first attempt at ecological restoration in 2000, when he planted 8,000 seedlings on 7 hectares of the RL, and 4,000 seedlings with the same method in the following year. For planting, the soil was prepared with troughs in line, spaced at every 3 meters, based on the technical indication at the time, and was assisted by the municipality for organizing a planting task force. The native seedlings were donated by the *Clickarvore* program and brought from a nursery 15 km away from the farm. However, after a few years, 70% of the seedlings were dead, and mortality reached 95% in some places.

The property has 56 hectares of RL and Permanent Preservation Areas (APP), as well as 35 hectares with preserved fragments of native vegetation located between the Semideciduous Seasonal Forest and the *Cerradão*. However, 21 hectares of degraded areas needed active restoration at the time. As the attempts with seedlings were not satisfactory, Malta accepted his son's recommendation to try direct seeding, an ecological restoration method that was being used successfully in the Y'Ikatu Xingu campaign in Mato Grosso state.

In early 2012, one hectare could be planted by two people in just one day, reducing labor costs. The restorers applied herbicide (Glyphosate) to dry the existing brachiaria grass and, after a month, meshed the area to prepare the soil and receive the seeds. Direct seeding was deployed the entire area,

[3] Legal Reserve (*Reserva Legal - RL*) is another legal requirement for maintaining or recovering native vegetation on rural properties in Brazil. It is a percentage of the property's area that ranges from 80% (in Amazon biome regions) to 20% in other parts of the country.

using a Vincon fertilizer spreader, ensuring homogeneous dispersion of native seeds and green manure using a tractor, thus eliminating the need for labor. Then, light harrowing was done to incorporate the seeds into the soil at a depth of about 3 centimeters. After three months, glyphosate was applied at half the dosage recommended on the package, to control reinfesting grass. When the planting process completed one year, selective weeding and manual sowing were also performed to repair planting faults. Seven years later, the area continues to develop satisfactorily, with a closed canopy.

"We have many good trees in the area and it is very nice to walk around in there", says Malta.

Since then, *muvuca*, as direct seeding is called in the Xingu region, has become the main method for restoring native vegetation on the farm. Each year, hectare by hectare, 7 hectares have already been sown. Throughout this period, the gained experience led to improvements in the planting method. To control grass, for example, using selective herbicides was incorporated into plantation stewardship, associated with green manure, such as pigeon pea (*Cajanus cajan*), pork beans (*Canavalia ensiformis*) and *Crotalaria sp.* "The plants grow protected as if they were in a natural nursery. The beans protect them in the cold season, and shade the seedlings from the sun to grow. In addition, we have already harvested beans for planting them in the following year and also for selling", explains Malta.

KNOWLEDGE THAT COMES FROM PRACTICE

The arrival of the first rains in November triggers the beginning of the planting season on the farm, but soil preparation begins well before that, in May, applying Glyphosate in the entire area. In this sense, two important recommendations regarding this stage of the process, in Malta's view, are to let grass dry since the beginning of the year and plant it as the rains begin.

After noting the success of direct seeding by haul, the Maltas began to enrich the previous planting of seedlings with *muvuca* in troughs between the lines and also to lead the natural regeneration of native species by controlling the grass with selective herbicide. direct seeding in troughs, without revolving the soil with harrowing, was found to be the most efficient system for the property. "It works very well, it does not expose the soil and does not lead to erosion. We only check if we need to apply the selective herbicide in the first year due to competition from the weeds, and do ant control, as necessary. For us, not needing to work on the area from the second year is one of direct seeding's major advantages", they claim

Mechanized planting was abandoned due to the difficulty of maneuvering the tractor in small areas and because the percentual amount of seed germination was higher when planting in troughs. "Manually it is very good, with regard to both the sowing depth domain and the spacing. We have two employees who work in the field with us and they are already doing great, the work is better than with the machine. This current system has shown to be quite adequate to our context", says Malta.

Technical details are also evaluated and improved every year. Spacing between rows, amount of green manure seeds and their influence on shading, choice of species, among other issues, are established again each year according to the obtained results. As the restoration areas are characterized as a transition between the Atlantic Forest and Cerrado biomes, the variety of species has increased over the years and, more recently, the species that have best adapted to the region are prioritized, while those that have not established themselves well are not sown again. Angico (*Anadenanthera colubrina*),

Photo: Nina Jacobi

Cajazinho (*Spondias mombin*) in a restoration area 2.5 years olds

jatobá (*Hymenaea courbaril*) and canafístula (*Peltophorum dubium*) seeds, for example, started being collected also on the property itself.

"We chose the seeds mostly because of the preference for certain fruit and timbers, but some did not come out. So we began acquiring the ones that germinated better and we went refining the choice according to what did well in the region. With each planting, we come out with a slightly better list"

explains Eduardo Malta Filho, a Instituto Socioambiental (ISA) biologist with experience in forest restoration with direct seeding and in forming seed networks, also a creator and partner of the *Caminhos da Semente* Initiative.

Among the other suggestions on how to achieve success in restoration, the Maltas also indicate high-density planting of native seeds and introducing green manure species in addition to anticipated land preparation, which is most efficient against brachiaria grass. It is also important to plan the planting considering its capacity for deployment and administration. "In Brazil, we are all still learning. I always make a comparison of what was the best technology in 2001 with what we are doing today, which is totally different. We have a lot to change and learn from the differences in each region and each one's efforts", they add.

In addition to the sale of green manure, the Maltas, who also have beef cattle, eucalyptus and sugar cane on the farm, are considering receiving a financial return from the sustainable exploitation of the good quality timber that is growing. Although the planting has no regular spacing, which would facilitate extracting the timber, the species' growth speed is high and the stem[4] is long, due to the high tree density resulting from the method. The projected timber volume and its market value are encouraging. However, the sector's legal uncertainty is a complicating factor. There is no legal procedure in São Paulo state for selling Legal Reserve timber. "As much as it has been provided for in national laws for decades, there still is no protocol for that", says Eduardo Filho. para isso¨, diz Eduardo Filho.

Persons responsible for the experience:
Eduardo Malta Campos - Fazenda Santa Maria do Monjolinho
Eduardo Malta Campos Filho - Fazenda Santa Maria do Monjolinho
Edinaldo Carneiro da Silva - Fazenda Santa Maria do Monjolinho

[4] The part of the trunk between the ground and the tree's first and strongest branches.

TECHNICAL SUMMARY

Planting year: 2017

Planted area: 1 hectare (the farm has 12.6 hectares under restoration with different methods since 2001)

Objetivo: recomposição da vegetação nativa em parte da Reserva Legal

Restoration system: Direct seeding in open troughs without removing the straw after drying in the area, 1.80m x 0.8m spacing

Native seed quantity: 45 kg/ha

Restoration costs: R$ 4,926/ha total cost; R$ 2,776/ha of which for native seeds, R$ 350/ha for green manure, R$ 1,000/ha for herbicide application for area preparation and stewardship, R$ 800/ha for climbing vines and ants

Results: after 2 years

- Richness: 26 native species

- Density of Regenerants (height < 2m): 5,440 trees/ha (*Dictyoloma vandellianum* was the most frequent one in this area, probably seeds from matrices remaining next to the area)

- Density of trees and shrubs (height > 2m): 6,000 trees/ha (reflection planting pigeon peas, which will disappear from the area after the third year)

Photo: Nina Jacobi

Eduardo Malta Campos Filho showing dossier height of up to 11 meters in a direct seeding area 7.5 years old

2. JIRAU USES A CONSORTIUM OF METHODS FOR RECOVERY IN THE AMAZON

AN ARRANGEMENT BETWEEN COOPERATIVE, ENTERPRISE AND RESEARCH RESULTS IN QUALITY AND EFFICIENCY IN RECOVERING DEGRADED AREAS AND GENERATES INCOME FOR COMMUNITIES

Lakeside of the Jirau Hydroelectric Power Plant Reservoir, Porto Velho/ RO |
Vegetation Type: Amazon Biome (Open Ombrophilous Forest)

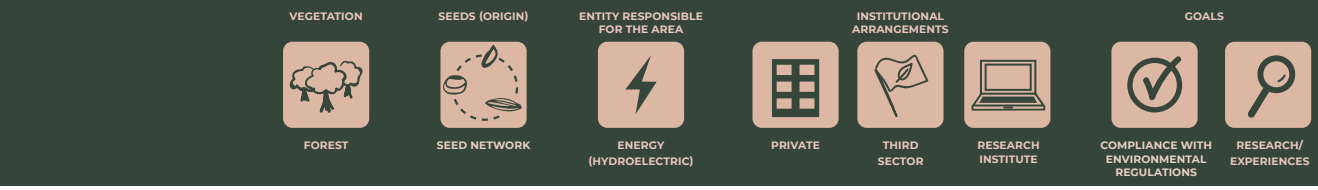


Photo: Acervo COOPPROJIRAU

Aerial view of the restored area close to Jirau Hydroeletric Plant

The Jirau Hydroelectric Plant (UHE Jirau) is located on the Madeira River in Rondônia state, and has approximately 18 thousand hectares of Permanent Preservation Areas (APPs). Since 2001, the Energia Sustentável do Brasil S.A (ESBR) company, which is responsible for the project, is transforming the need to restore approximately 2,700 hectares of this total into an opportunity for generating income and strengthen the communities that live in the surrounding areas. The action for recovering native vegetation on the reservoir's shores is deployed through a partnership with Empresa Brasileira de Pesquisa Agropecuária (Embrapa), who is responsible for the technical planning and monitoring of plantations made by Cooperativa de Produtores Rurais do Observatório Ambiental[5] Jirau (Coopprojirau).

The cooperative was created by Observatório Ambiental Jirau with the participation of communities within the project's Environmental Education Program, and brings together rural producers in development and income generation projects through training in technical assistance and productive organization, and its main activities are in meeting ESBR's demands for restoration.

Around 40 families from the districts of Jaci Paraná, Mutum Paraná, Abunã, Vila da Penha and others, began collecting seeds, produce seedlings and provide services to the hydroelectric project.

[5] https://www.coopprojirau.org.br/

Photo: Acervo COOPPROJIRAU

Seed preparation before manual planting

From 2011 to 2014, the first restoration stage, the areas were initially classified according to their potential for natural regeneration. In plots with low potential for natural regeneration, the adopted practice was planting seedlings at a 3 x 2 meter spacing; in areas with medium potential for natural regeneration, planting seedlings with a 5 x 5 meter spacing was adopted; and where the potential was considered high, the areas were only monitored for natural succession. In the assessment of these plantations, a great density of regenerants was observed in the areas, mainly species such as embaúba (*Cecropia purpurascens*), periquiteiro (*Trema micrantha*) and jurubeba (*Solanum grandiflorum*)[6], mainly coming from the dispersion of seeds brought by the fauna.

With Embrapa's monitoring, new experiences were carried out in 2014 with the intention of accelerating the area restoration process. Pioneering species were sown directly into the soil over approximately 5 hectares and resulted in germination and high-density establishment, reducing the occurrence of invasive grass species..

In 2015, another experience[7] was carried out with the following treatments: harrowing and chemical control of grass in the area; harrowing and chemical control of grasses plus direct seeding; harrowing and chemical control of grass plus planting of native seedlings, harrowing and chemical control of grass plus a consortium of seedlings and seeds. Although the results showed great variation across the locations, the treatment with chemical elimination of grass plus direct seeding resulted in a higher density of individuals (1.1 individuals/square meter), while the treatment associating planting of seedlings and direct seeding resulted in a greater diversity of species. Since then, the adopted model has been direct sowing of pioneering and secondary species associated with planting seedlings in 5 x 5 meter spacing in order to increase the species' richness, while also leveraging the potential for natural regeneration in the same area.

Embrapa assisted in training the cooperative members so that they could identify the species, collect, benefit from, and store native seeds. The collectors themselves, who were knowledgeable about the region's flora, began including the species that showed the best development in the plantations, according to each soil's situation.

About 120 species of seedlings are produced and 20 species are sown directly into the field, including pioneering and secondary ones.

Daniel Vieira, a researcher at Embrapa, explains that seedlings are important not only as a source of income for families, but also for adding species that do not colonize the areas under restoration, at least in the early years, and that also do not establish themselves well with direct seeding. "We plant seedlings in a low density, 400 per hectare, greatly reducing restoration costs. Gradually, new species are also being added to the sowing. So the model that has worked

[6] REZENDE, Gustavo Mariano; VIEIRA, Daniel Luis Mascia. Forest restoration in southern Amazonia: Soil preparation triggers natural regeneration. Forest Ecology and Management, v. 433, p. 93-104, 2019.

[5] REZENDE, Gustavo Mariano. Restauração florestal no sul da Amazônia: métodos para romper barreiras à regeneração natural. 2016

well is this combination of the three methods: planting seedlings, direct seeding and natural regeneration", he says.

Coopprojirau has already restored more than 600 hectares, in addition to working with smaller projects of other companies in the region. Longer-term contracts, such as for five years, have facilitated preparing the area and organizing the cooperative team to do the planting at the beginning of the rains, which is the ideal time for that. Consequently, the plantlet and seedling establishment results in the field have increased.

Maintaining planted areas included applying herbicide in a timely manner, that is, directed only at the clumps of exotic grass, eliminating them efficiently, which enabled reaching the ecological indicators agreed with the environmental agency in two years on average in the areas under restoration. Changes in Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais (Ibama) guidelines, effective in 2020, have restricted the use of the herbicide, which increases time and cost to achieve the same ecological indicators observed in the monitoring.

Experience acquired from the Embrapa technicians provided the cooperative members with an increase in the diversity of species they work with, as well as better results and expansion of knowledge in the field through adaptations in project execution through adaptive stewardship.

"We are always discovering something new. Each area is different and we observe which species we must deploy in each situation. This way, we will grow", say cooperative members Diego Solidera and Fagno Reis.

For the hydroelectric plant, forming and contracting a local cooperative at the expense of a private company to carry out the degraded area recovery project has a positive social and environmental impact on the project's surrounding communities. While the ecosystem is recovered and the environmental licensing conditions are met, local knowledge is valued, encouraging a positive cultural change with regard to the forest. "Success lies in the fact that both sides saw the opportunity to obtain good results in the partnership, and shows that projects like this can be replicated in other ventures", the ESBR representatives add.

Photo: Gustavo Mariano Resende

Direct seeding experimental area after 4 years

Persons responsible for the experience:

Veríssimo Alves dos Santos Neto - Energia Sustentável do Brasil SA (ESBR)

Michel Kazuo Takahashi Obara - Energia Sustentável do Brasil SA (ESBR)

Juliana da Silva Oliveira - Energia Sustentável do Brasil SA (ESBR)

Augusto Roberto Borges - Energia Sustentável do Brasil SA (ESBR)

Clariana Gonçalves Belém Mascarenhas - Energia Sustentável do Brasil SA (ESBR)

Fagno Reis - COOPPROJIRAU

Diego Solidera - COOPPROJIRAU

Daniel Luis Mascia Vieira - Embrapa Recursos Genéticos e Biotecnologia

Gustavo Mariano Rezende – Pesquisador CNPq

TECHNICAL SUMMARY

Planting date: 2018
Planted area: 6.2 hectares
Objective: to restore the APP of the Jirau UHE reservoir
Restoration system: stimulating natural regeneration with harrowing across the entire area, manual direct seeding by haul in the entire area and planting native seedlings with 5 x 5 m spacing
Number of native seeds: 8.09 kg/ha; 14 species
Restoration costs: R$ 10,000/ha (harrowing; seed collection, native seed sowing; seedling production; planting seedlings; 1 year maintenance and administration cost)
Results: after a year and a half: - Canopy coverage: 22% - Total richness: 32 species (regenerants sown via direct seeding and seedling planting) - Regenerant density: 4,600 trees/ha - Canopy height: 4.2 m

3. FAMILY FARMING IS DEVELOPING IN MATO GROSSO'S AMAZON REGION WITH NATIVE SEEDS

AGROFORESTRY SYSTEMS FOR ECOLOGICAL RESTORATION AND INCOME GENERATION PURPOSE HELP TO DIVERSIFY RURAL PROPERTY LANDSCAPES AND TRANSFORM THE FAMILIES' PARADIGMS

Nova Canaã do Norte/Mato Grosso state |
Vegetation Type: transition between Amazon and Cerrado (Seasonal Evergreen Forest)

Photo: Acervo Instituto Ouro Verde

Management of Agroforestry Systems aiming to diversify family agricultura producion in north Mato Grosso

Family farming represents 77% of agricultural establishments in Brazil and covers an 81 million hectare area, according to IBGE data (2017). A significant part of the farmer families in Northern Mato Grosso state came from the country's South, encouraged by the Brazilian government in the 1980s. At the time, deforestation was encouraged to enable colonizing the Amazon, implementing livestock and other agricultural systems.

Instituto Ouro Verde (IOV), which focuses on social participation, operates in the region by developing actions to improve and diversify the farmers' productive activities[8].

The basic work carried out by the organization seeks to strengthen groups of producers so that they can participate more actively in building innovative social and environmental solutions.

Strengthening these communities requires the appropriation of tools that enable producing and preserving their plots. For this reason, agroforestry, deployed with seedlings and seeds, is a priority for IOV projects. With nine-year financing from the Amazon Fund, 2,800 hectares of Agroforestry Systems (SAF) were implemented in more than 1,200 family farming properties through the Portal da Amazônia project.

[8] http://www.ouroverde.org.br/

The action aimed to serve two different fronts in 2010-2019: environmental adequacy of Permanent Preservation Areas (APPs) with direct seeding and SAF for productive purposes (orchards), and strengthening family farming in eight municipalities in the territory. The second phase of the project also included the implementation of agro-silvopastoral systems.

The main focus of the SAFs deployed in APP areas furthest from the farmers' homes was ecological restoration. In the areas closest to their homes, planting orchards aimed at diversifying production to generate income and for the families' own consumption. In areas outside the APP, silvopastoral systems (forest and livestock integration) and SAFs were used for extracting non-timber products (seed collection) and timber products for domestic uses (firewood, toolmaking and fence posts).

During the term of the financing, more than 1,500 SAF projects were implemented with the help of eight technicians and direct action of the families. The veterinarian Andressa Alves Olival, the institution's manager, emphasizes that the results of the project were also aimed at creating a space for community relations and adding values that would turn farmers into defenders of the forest.

Photo: Acervo Instituto Ouro Verde

Ecological restoration using Agroforestry Systems with direct seeding

Planting planning based on each farmer's preferences and commercial objectives is made in a virtual system created by the institute itself. The Agroforestry Planning System (SISAP) uses a database fed by technicians with scientific and empirical information from farmers and defines which species are needed to fill in the different life cycles and strata for ecological succession.

The implementation of SAFs boosted seed collection by the farmers themselves who collect them at the edge of the woods or in trees scattered outside and inside their properties. After the delivery of the seeds, the technicians reorganize the batches based on each project's planning, and the seeds return to the producers in greater diversity and quantity. The variety of species ranges from 50 to 100, and planting is usually done in line and manually, in areas averaging 1 to 3 hectares.

The choice of species also takes into account five different ecological functions: producing organic matter, attracting the dispersing fauna, attracting bees, soil decompression, and soil fertility. Cassava, a species that provides economic returns in the initial cycle of the plantation development, cupuaçu and acerola, whose fruit are collected in an intermediate cycle (5 to 10 years), and pequi, a species that generates economic return after 20 years on average, are common species in farmers' SAFs, mainly because they are easily marketed. Cattle producers also requested the inclusion of trees that produce fruit and leaves that are edible by animals, such as Ingá-mel (*Inga sp.*).

With the implementation of agroforestry, the IOV encouraged different production chains in the region, establishing producer markets and supporting the processing infrastructure created with incentives from the Fund itself.

In the case of native seeds, the "Rede de Sementes do Portal da Amazônia[9]" (Seed network Portal da Amazônia) was created for the ecological restoration chain.

[9] http://www.sementesdoportal.com.br/sementes/

Photo: Acervo Instituto Ouro Verde

Agrosilvopastoral system in the Portal da Amazônia region (Mato Grosso)

The focus on organizing collection among farmers started from the perception that planting would only be possible with seeds, since the cost of producing, transporting and planting seedlings would be very high in that region. When the chain was made official in 2010, collectors received training for improving the service and also for being paid for the sale of seeds.

ONE NETWORK AND MORE OPPORTUNITIES

The Seed network coordinator, agronomist engineer Anderson Rogério Lopes, is responsible for conducting training on seed collecting, processing and storage. The network, which was formalized as a cooperative, sells up to 200 species and has 120 collectors structured in different organized production groups located in the Apiacás, Carlinda, Colíder, Nova Canaã do Norte, Nova Guarita and Terra Nova do Norte municipalities.

In addition to being an income option for the involved farmers, helping to strengthen family farming in the region, the network has provided exchanges among families.

Collectors expand their knowledge of forest seeds, and even about agricultural seeds, and start to value standing trees near houses, pastures and coffee plantations, using these species also for medicinal and food use.

By operating as an integrated system, since it works in different links of the production chain where small producers are assisted in collecting native seeds, implementing agroforestry, as well as in marketing, the initiative increased income circulation and food security in the region. In the same vein, the IOV has also supported the implementation of a credit system and encouraged the creation of an agroforestry research center with the involvement of universities, for further improving the results.

Persons responsible for the experience

Andrezza Alves Spexoto Olival – Instituto Ouro Verde
Alexandre de Azevedo Olival - Instituto Ouro Verde
Renato Felito
Bruna Aparecida Scalsavara
Anderson Rogério Lopes - Rede de Sementes do Portal da Amazônia
Rede de Sementes do Portal da Amazônia
Ouro Verde Technical Team
Farmers and family farmers participating in the project (2010 to 2019)

TECHNICAL SUMMARY

Planting year: 2017
Planted area: 0.5 hectares
Objective: to recover degraded area through productive agroforestry
Restoration system: direct manual seeding of forest species lines and green manure lines. Between the lines, short-cycle agricultural species and fruit species seedlings were used.
Quantity of native seeds: 66 species, 13 kg/ha (highly diversified SAFs)
Restoration costs: R$ 2.600 (only seeds and seedlings included)
Results: species essential for improving soil conditions and stratifying vegetation in the system: pigeon pea, pineapple, banana, annatto, pinho cuiabano, pente-de-macaco and ingá.

4. RESTORING THE *CERRADO* IS ABOUT SOWING NATIVE HERBS, SHRUBS AND TREES

THE DIRECT SEEDING EXPERIENCE IN SAVANNA AREAS INCREASES THE KNOWLEDGE ABOUT RESTORATION IN ONE OF THE COUNTRY'S MAIN BIOMES

Chapada dos Veadeiros national park/Goiás state | Vegetation Type: Cerrado biome (Cerrado Restricted Sense)

Photo: Alexandre Sampaio

Claudomiro de Almeira Cortes colecting native grass seeds in 2014

In Brazil there are more than 330 federal-level Conservation Units (UCs)[10] that, despite protecting native ecosystems, also include plots of land degraded by agricultural and livestock use. Recovering these areas requires that part of the UCs' financial resources be directed to ecological restoration activities. However, the final budget generally makes it impossible to carry out these actions. Within this context, Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) has made experiences and implemented restoration methods in some UCs, supported by public tenders and through partnerships with academic research projects.

In 2009, in the Chapada dos Veadeiros national park (PNCV), one of the most important conservation areas in Brazil's Central Plateau, direct seeding experiences were carried out by the unit's environmental analyst Fernando Rebello, where only tree species were sown. Three years later, Alexandre Sampaio, an environmental analyst at ICMBio, in partnership with Professor Isabel Schmidt, from the University of Brasília (UnB) Department of Ecology and Daniel Vieira from Embrapa Recursos Genéticos e Biotecnologia, started new experiences also using species from the herbaceous-shrub stratum that are considered important for soil cover, water infiltration and for containing most of the Cerrado plants' diversity. Alexandre has an academic trajectory focused on finding cheaper and more effective restoration techniques, and seized the opportunity to deepen his research, taking into account the ecological aspects of this biome that is considered the world's most biodiverse savanna, which is essential for ensuring ecosystem services for Brazil .

[10] Brazilian National System for Protected Areas, known by Conservation Units, is managed by ICMBIO (https://www.icmbio.gov.br/)

As planting seedlings brings a high cost for restoring in the parks, in addition to the impossibility of large-scale restoration of the herbaceous-shrub layer with seedlings, Alexandre focused on some examples to set up the first ecological restoration experience in a restricted sense within the park.

"I already knew of initiatives with planting native grasses in other countries, which provided greater soil coverage and species diversity, and as I had also had contact with the experiences that the Instituto Socioambiental (ISA) is performing in the Xingu area, I was able to apply the knowledge in the Chapada", he says.

To adapt the technique that was already being deployed in Mato Grosso state, the team coordinated by Alexandre included seeds of shrubs and grasses that were native to the region. However, the practice proved to be more complicated than expected, due to little knowledge about the diversity and characteristics of the species in this stratum. The seed collection criteria established at the beginning included the choice of abundant species in sufficient quantity to establish themselves in the field, since the germination rate of the known grasses was low. Native species that occur along with invasive exotic grasses were also selected, that is, that had the ability to compete and, finally, species that provide good and quick ground cover, also aiming to make it difficult for the exotic grasses to return.

The first experiences, which took place on 13 hectares from 2012 to 2014, demonstrated that it is possible to restore the ground cover with a mixture of grasses, shrubs and trees that are native to the Cerrado[11].

The researchers also found information on dynamics and competition among the sown species, while during the entire process they refined their knowledge of the proportion of seeds in each stratum that should be used in sowing.

For example, the seed density per hectare used for tree species such as carvoeiro (*Tachigali vulgaris*) should be proportional to the expected number of trees in the field after sowing, so that the species does not dominate the sown area and does not prevent the establishment of some essential

Photo: Keiko Pellizaro

2.5 years area after direct seeding of Berrado native herbs, shrubs and trees in the National Park Chapada dos Veadeiros in Goias

grasses in the native vegetation, which would cause the savanna vegetation's structure to become uncharacterized.

Another important knowledge acquired with the initial experiences was in preparing the soil to deplete the exotic grasses' seed bank (using fire to reduce biomass, applied with the important help of the park brigade and successive harrowing), due to the prohibition to using herbicide in UCs. As he was aware of the strength of the exotic grasses in the Cerrado and the limitations for stewardship without using herbicides, Alexandre is in favor of the rational use of herbicide for combatting exotic grasses and regulating its use in UCs until less impactful solutions are discovered. "The advance of invasive grasses in protected areas is highly detrimental to the conservation of the Cerrado", he points out.

Part of the data generated during that first experiencing period enabled publishing the "Cerrado Restoration Guide –direct seeding"[12], in addition to several other

[11] SAMPAIO, Alexandre B. et al. Lessons on direct seeding to restore Neotropical savanna. Ecological Engineering, v. 138, p. 148-154, 2019.

[12] SAMPAIO, Alexandre Bonesso et al. Guia de restauração do Cerrado: volume 1: semeadura direta. Embrapa Cerrados-Livro técnico (INFOTECA-E), 2015.

Photo: Fernando Tatagiba

Seed dispersal using a limestone spreader at Chapada dos Veadeiros National Park in Goiás

scientific materials. The researchers also followed the vegetation dynamics process of species of the fast-growing herbaceous-shrub stratum, such as andropogon-nativo grass (*Andropogon fastigiatus*), capim fura-saco (*Aristida gibbosa*) and bitter grass (*Lepidaploa aurea*) and slow-growth species of the same strata such as capim brinco-de-princesa (*Loudetiopsis chrysothrix*) and capim-fiapo (*Trachypogon spicatus*), analyzing the soil cover's trajectory over two years[13]. As a general result, the research increased the visibility of the topic on the ecological succession of the Cerrado species in a restricted sense, which was an excellent gain for the restoration ecology area. .

A RESOURCE THAT GENERATES ENVIRONMENTAL AND SOCIAL GAINS

In 2015-2016, planting was financed with funds from an energy sector private company (Norte Brasil) that had legal forest restoration obligations, which enabled implementing direct seeding restoration in 90 hectares. This gain in scale of the restoration has maintained the analyst's optimism as it is a means of financing ecological restoration in UCs. In 2019, the team working in the park began a new task in restoring native vegetation in abandoned pastures within the UC, also financed by the licensing process for a power transmission line. About 70 hectares have to be restored within this project by a third-party company contracted through a public tender held by Transenergia Goiás.

In addition to biodiversity, another factor that makes the restoration of the Cerrado very important is the fact that the vegetation provides greater water infiltration in the soil in the resupply zones, increasing the volumes of water in the water tables. Eight of the twelve main Brazilian hydrographic basins have springs in the Cerrado, which is why the biome plays a major role in the country's water supply. Unlike most agricultural species, native species use water quite efficiently and are responsible for other environmental services such as carbon storage in the roots

One of the first challenges to the viability of ecological restoration in the Cerrado was the availability of seeds of grasses, shrubs and different trees that make up the biome. Initially, Alexandre collected seeds together with Claudomiro de Almeida Cortes and other park brigade members, an activity that encouraged the creation of a seed network in the region.

Claudomiro, the son of small farmers, used to work like his parents in slash-and-burn agriculture in gallery forests (Cerrado forest vegetation close to water courses) and it was with the experience inside the park that he started to learn about restoration. "When I was told to collect grass and shrub seeds, I thought it was strange, but after taking a closer look at the original Cerrado, the guidance made perfect sense", he explained.

The other farmers in the region were also surprised by the interest in planting grass seeds and did not understand much about the work of collecting seeds that Claudomiro carried out on the side of the road that connects the city of Alto Paraíso to the village of São Jorge (GO). Interest increased due to the growth in demand for these seeds, which also resulted in the generation of income for collector families.

[13] COUTINHO, André Ganem et al. Effects of initial functional-group composition on assembly trajectory in savanna restoration. Applied vegetation science, v. 22, n. 1, p. 61-70, 2019.

From 2012 to 2019, around 80 families were trained for collection. With the creation of the Associação Cerrado de Pé 2017, the activity is no longer informal. Since then, collectors have started to supply seeds not only for the park's restoration needs, but also for new initiatives via partnership with Rede de Sementes do Cerrado (RSC)[14] (Cerrado Seeds Network), which is responsible for providing commercial support, training collectors and for the activity's legal adequacy.

About 40 tons of native seeds have already been collected in ten years: 40% of grasses, 40% of trees and 20% of shrubs. With the improvement of processing techniques, the seeds have been delivered with greater purity to meet market requirements.

Some collector families belong to the traditional Kalunga community, a quilombola[15] group settled in the Cavalcante municipality, and the collectors also include families of small farmers, settlers, members of forest fire brigades and former prospectors, who have increased their sources of income with collection. Some, like Claudomiro himself, already make a living almost entirely from seed production. There are cases of families who decided to sow savanna where they used to have grazing land on their own properties to ensure more collection areas. "They used to see the Cerrado as an obstacle, they had to remove it, clean it, cut it down. Now they see it as an ally", says Claudomiro.

Photo: Mariana Siqueira

Seeds of herbs, shrubs, and trees native to the Cerrado sensu stricto, prepared with soil for dispersion

[12] http://www.rsc.org.br/

[15] Quilombolas are the descendants of escaped slaves during the slavery period in Brazil. They formed *quilombos*, or communities of escaped slaves. Many of their descendants live in those communities to date.

Just as the ecological restoration experience in the park has been replicated elsewhere, the association, along with Alexandre, has been training new collectors in other regions such as the North of Minas Gerais and the Federal District. In Claudomiro's view, the work only tends to grow because if the Cerrado is not restored today, water will be rare tomorrow.

"During the time I worked as a member of a fire brigade, I could see the decrease in the availability of water in springs and rivers, and it is clear that something needs to be done. There is no other way. So I am very excited about what I am doing", said the collector.

Persons responsible for the experience:

Alexandre Sampaio – ICMBio, Centro Nacional de Avaliação da Biodiversidade e de Pesquisa e Conservação do Cerrado

Isabel Belloni Schmidt – Universidade de Brasília, departamento de Ecologia

Daniel Luis Mascia Vieira - Embrapa Recursos Genéticos e Biotecnologia

José Felipe Ribeiro - Embrapa Cerrados

Claudomiro de Almeida Cortes – Associação Cerrado de Pé

Grupo Restaura Cerrado

Associação Cerrado de Pé/Rede de Sementes do Cerrado

TECHNICAL SUMMARY

Planting date: 2012 to 2020
Planted area: 183 hectares
Objective: research on restoration of savanna vegetation; restoration of exotic grass areas within the national park; support for seed collectors in the surrounding areas.
Restoration system: controlled burning, successive soil harrowing and leveling, followed by direct seeding by haul (manual from 2012 to 2014 and mechanized from 2015 to 2019)
Quantity of native seeds: 2012: 200 kg/ha; 2013: 333 kg/ha; 2014: 285 kg/ha; 2015: 166 kg/ha; 2016: 187.5 kg/ha (seeds from the herbaceous-shrub stratum with low processing); 2019: 74 kg / ha (seeds with higher purity)
Restoration costs: R$ 14,000/ha on average, including soil preparation: R$ 5,000/ha, seeds: R$ 4,000/ha, planting: R$ 3,000/ha, maintenance: R$ 2,000/ha (rounded figures adapted from an ecological direct seeding restoration experience in the Brasília National Forest)
Results: richness of established species in 2015-2017: - Planting in 2012: 24 species sown; 23 established species (11 trees; 3 shrubs; 2 herbs; 7 grasses) - Planting in 2013: 48 species sown; 41 established species (30 trees; 6 shrubs; 3 herbs; 2 grasses) - Planting in 2014: 30 species sown; 26 established species (13 trees; 6 shrubs; 2 herbs; 5 grasses) - Planting in 2015: 18 species sown; 18 established species (4 trees; 6 shrubs; 2 herbs; 6 grasses)

5. WATER, INCOME AND BIODIVERSITY: HOW ECOLOGICAL RESTORATION HAS CHANGED THE GERAIZEIRO TERRITORY

COMMUNITIES IN NORTHERN MINAS GERAIS STATE COMBINE TRADITIONAL AND SCIENTIFIC KNOWLEDGE AND INVEST IN RESTORATION FOR COMBATTING RURAL EXODUS

Comunidade São Modesto - RDS Geraizeiras/Minas Gerais state | Vegetation Type: Cerrado biome (Cerrado Restricted Sense)

Photo: Acervo Projeto Bem Diverso

Planting lines opened with hoes through joint efforts - In a water recharge area at RDS Nascentes Geraizeiras, at Minas Gerais

The *Geraizeiros* are a traditional people who preserve collective occupation of the land as a way of life and have a deep knowledge of the Cerrado and its species. Their main activities are agriculture, extraction and cattle breeding. The communities occupy the so-called *terras das Gerais*, plateau areas where the Cerrado vegetation cover prevails, and they traditionally live and cultivate in the valleys, on the banks of water courses.

In the Alto Rio Pardo region, in Northern Minas Gerais state, a transition area between the Cerrado and the Caatinga, these communities have been pressured by eucalyptus monoculture, mining, and irrigated agriculture since the 1970s. With governmental encouragement, large enterprises occupied the territory, but inadequate land use caused water scarcity - among other problems. Evapotranspiration in eucalyptus plantations, which is greater than that of the native vegetation, and the silting up of water courses, caused by carrying sediments from those plantations, are among the main reasons for the lack of water. As the region is included in semi-arid areas, with an average annual rainfall of 910 mm (as low as 404.8 mm in 2015), it is not possible that disorderly occupation and no territorial planning of forest monocultures can be sustained without affecting the springs and the water courses.

Confrontation with those companies' activities relied on a joint action by several segments of society, including rural

Photo: Acervo Projeto Bem Diverso

The harvesting of the lobeira fruit *(Solanum lycocarpum)*, by the seed collectors and ecosystem restorers of RDS - Nascentes Geraizeiras (MG)

worker unions, NGOs, social-technical networks, associations of the region's traditional people and communities, and many others, gathered in collective demonstrations, such as Movimento Geraizeiro, the Conferências Geraizeiras and Articulação Rosalino which, on some occasions, were supported by the Public Prosecutor's Office. But the confrontation also took place directly by the communities, mainly by women, since many men were not present, as they migrated seasonally to other regions to work in harvests. These movements led to the creation of the Reserva de Desenvolvimento Sustentável Nascentes Geraizeiras (RDS Nascentes Geraizeiras[16]), which was approved in 2014, with a total area of 38 thousand hectares.

After the delimitation of the territory, the search for solutions for the water shortage problem became the main focus of the reserve's communities' struggle. Part of the 33 communities, who are traditionally linked to rivers, have been supplied by water trucks in recent years, and many of the surrounding springs have dried up quickly. Within this context, the Bem Diverso project[17], a partnership between the Brazilian Agricultural Research Corporation (Embrapa) and the United Nations Development Program (UNDP), with funds from the Global Environment Facility (GEF), initiated direct seeding ecological restoration actions in order to help recover the vegetation in the reserve.

[16] Reserva de Desenvolvimento Sustentável is one category within the Brazilian System of Protected Areas (SNUC) that allows communities to use the natural resources following certain rules.

[17] http://bemdiverso.org.br/

A NEW WAY OF SEEING THE CERRADO

The *Geraizeiros* were already concerned with the restoration of the areas and planted seedlings to protect the rivers. However, with the project's support, they understood that, due to the characteristics of the Cerrado's terrain, it was also necessary to recover the soil cover with the biome's native vegetation, herbs, shrubs and also trees in the aquifer resupply areas. This way, the project participants also understood that the priority areas for planting were the "chapadas" (plateaus), where water infiltrates into the soil, increasing the volume in the water table that feeds the springs.

"We started this movement with a question: 'Where's the river that used to be here?' And it spread. During an expedition I made with the residents, we followed the water flow from a live spring and arrived at the plateau where there was a huge erosion. It was then that we realized where the work needed to be done", says Anderson Sevilha, a researcher at Embrapa, one of the main persons responsible for the actions at RDS Nascentes Geraizeiras.

The first experience with direct seeding took place in 2017, where the importance of the Cerrado for water

maintenance was considered. Convinced that restoration was necessary, 80 participants collected native seeds of 42 species and planted them two months later, in a second meeting. However, as this first batch of seeds had been mostly trees, Anderson organized a "Reading the Landscape" course, where the collectors, with the simple act of crouching and looking at the Cerrado from the bottom up, could perceive the different strata that make up the Cerrado vegetation in a restricted sense, and the typical phytophysiognomy in water resupply zones in the region. Collectors noted, in addition to the trees, the presence of grasses and shrubs, which are known by the popular name "Ramas do Cerrado", which have an essential ecological function in soil covering and water infiltration, preventing erosion and river silting.

A further 14 training courses were held through 2019, causing a change in the behavior of the Geraizeiros who were interested in learning the new collection method and activity. The youngsters were excited about the possibility of generating income from the sale of seeds, and began organizing a group of collectors, the Grupo de Coletores e Restauradores da RDS Nascentes Geraizeiras, which collected 2.5 tons of seeds in the first two years. In 2018, a company ordered seeds and, in the following year, they also sent them to Fundação Renova. External demand encouraged the improvement of seed collection and increased planting within the territory itself, which, according to the project's mapping, contains 8,000 hectares of degraded area.

Bem Diverso implemented the direct seeding method in 9 hectares that were transformed into demonstration units, two of which are in former mining sites and seven in plateaus. The plantations were made in a collective effort, manually, with hoes in open furrows, in addition to landscaping work for water infiltration, such as contour lines and infiltration basins, which were executed with the support of companies and local municipalities.

RESTORING RELATIONSHIPS

The youngsters became involved in monitoring the areas supported by the project's technicians and also strengthened relations with the communities' elders, who started to share their knowledge of the Cerrado throughout the process.

Photo: Nondas Ferreira da Silva

Jatobá-do-Cerrado (Hymenaea stigonocarpa) with 10 months on area under restoration at São Modesto community (MG)

"We go happily together to collect seeds and everything is an exchange. The elders are very wise, like José Arnaldo, who is always with us and we, as young people, are learning to listen. When we get close to them we always gain because they show us how to do it", says Fabrícia Santarem Costa, a 20-year-old restorer who has been leading the group's actions.

The generations have also come together to carry out planting efforts around houses. About 30% of the collected seeds are sent to community areas, the rest is sold to other enterprises that need to do ecological restoration. "The Geraizeiros seize the opportunity to plant native fruit trees such as cagaita (*Eugenia dysenterica*), mangaba (*Hancornia speciosa*), araticum (*Annona crassiflora*) and pequi (*Caryocar brasiliense*) which have high added value for them, in addition to contributing to biodiversity within the reservation", explained Nondas Ferreira da Silva,

a social and environmental technician from the Bem Diverso project.

As the creation of the collection group is recent, while improving management has been the focus of the project, which, among other actions, is legalizing the issuance of invoices to boost native seed sales across Brazil. The good outlook has made young people consider working within the restoration chain as an opportunity to improve the quality of life for their families without the need to leave the territory, reducing rural exodus in the reserve.

For example, Marcos Henrique Santos Costa, from the Roça do Mato community, says that he used to look at a seed and consider it worthless. But, with the collection work, he began to realize the importance that a seed has, since it can germinate elsewhere and give rise to a tree and, therefore, he feels very gratified.

In Anderson's view, the most relevant point in the reserve's ecological restoration has been the communities' involvement. The gain is focused on increasing the number of people involved, whose commitment will also ensure the preservation and expansion of areas undergoing restoration.

"We are also restoring our cultural identity and reconnecting people with the territory", he pointed out.

Moving forward, young people see the creation of a reference center within the Reserve with space for developing capacities related to restoration and also handicraft activities, fruit pulp production and community-based tourism. In Fabrícia's words, whatever is necessary will be done. The important thing is to prepare the communities.

Persons responsible for the experience:

Anderson Cassio Sevilha – Embrapa Recursos Genéticos e Biotecnologia – Projeto Bem Diverso, Brasília (DF)

Daniel Luis Mascia Vieira – Embrapa Recursos Genéticos e Biotecnologia – Projeto Bem Diverso, Brasília (DF)

Alexandre Bonesso Sampaio – ICMBio, Brasília (DF)

Mauro Braga Costa Pereira – ICMBio, Rio Pardo de Minas (MG)

Neuza Maria Gonçalves Pereira – ICMBio, Rio Pardo de Minas (MG)

Allyne Mayumi Rodolfo – ICMBio, Rio Pardo de Minas (MG)

Adenilson de Freitas – Emater MG, Regional Salinas (MG)

Nondas Ferreira da Silva – Projeto Bem Diverso, Rio Pardo de Minas (MG)

Renan Augusto Miranda Matias – Projeto Bem Diverso, Brasília, DF

Valdinei Moreira – Escola Família Agrícola Nova Esperança, Taiobeiras (MG)

Valdir Silva (in memoriam) – Comunidade São Modesto, Montezuma (MG)

José da Silva – Comunidade Roça do Mato, Montezuma (MG)

Fabrícia Santarem Costa – Comunidade Roça do Mato, Montezuma (MG)

Marcos Henrique Santos Costa – Comunidade Roça do Mato, Montezuma (MG)

José Arnaldo Gonçalves Mendes – Comunidade São Bartolomeu, Montezuma (MG)

Antonio Brito (Seo Curiango) – Comunidade Vale de Salinas, Montezuma (MG)

Antonio José Agostino – Comunidade de Água Boa II, Rio Pardo de Minas (MG)

Vladimilson Ferreira (Di) – Comunidade Água Boa II, Rio Pardo de Minas (MG)

Neusita Agostinho – Comunidade Água Boa II, Rio Pardo de Minas (MG)

Neli Gonçalves – Comunidade Vale do Guará, Vargem Grande do Rio Pardo (MG)

Neucy – Comunidade Catanduva, Vargem Grande do Rio Pardo (MG)

Sueli Ribeiro de Oliveira – Comunidade Catanduva, Vargem Grande do Rio Pardo (MG)

Claudiney Prates Rocha – Comunidade Riacho D'Antas, Rio Pardo de Minas (MG)

Sebastião Ramos Lima (Bia) – Comunidade Riacho de Areia, Santo Antonio do Retiro (MG)

Grupo de Coletores e Restauradores da Reserva de Desenvolvimento Sustentável Nascentes Geraizeiras, Alto Rio Pardo (MG)

Cooperativa de Agricultores Familiares Agroextrativistas de Água Boa II – Coopaab, Rio Pardo de Minas, (MG)

Escola Família Agrícola Nova Esperança – EFA Nova Esperança, Taiobeiras (MG)

Sindicato dos Trabalhadores e Trabalhadoras Rurais de Rio Pardo de Minas, Rio Pardo de Minas, MG

Centro de Agricultura do Norte de Minas – CAA-NM, MG

TECHNICAL SUMMARY

Planting date: area 1: 2017; area 2: 2018

Planted area: area 1: 1.5 hectare; area 2: 2 hectares

Objective: restoration of resupply areas (Chapadas) degraded by eucalyptus planting and uprooting in the RDS Nascentes Geraizeiras

Restoration system: manual planting in furrows spaced by 2m; 6m and 12m.

Furrows opened with hoes. Grass seeds sown between the lines.

Quantity of native seeds: area 1: 36 kg/ha, 18 tree species; area 2: 50 kg/ha (24 kg/ha of Aristida sp.), 27 species

Results:

Area 1, after 14 months:

- Vegetation cover increased from 30% to 78%

- Exposed soil reduced from 65% to 22%.

- Native grass is responsible for the largest increase in total plant cover.

Area 2: Density of trees of any size – 1,000 trees/ha

6. MUVUCA ENSURES LARGE-SCALE RESTORATION IN MATO GROSSO FARMS

THE PARTNERSHIP BETWEEN ISA AND RURAL PRODUCERS IS CONSIDERED A SUCCESSFUL MODEL FOR ADDRESSING DEMANDS RELATED TO ENVIRONMENTAL COMPLIANCE

Querência and Santa Cruz do Xingu/Mato Grosso state | Vegetation Type: transition between the Amazon and the Cerrado (Seasonal Evergreen Forest)

Photo: Luciano Langmantel Eichholz

Area of permanent protection (APP) at Paranotapa Farm (MT), with an emphasis on urucum (*Bixa orellana*) and Solanum sp. performing the role of canopy occupation after 28 months of implanting direct seeding

Recovering native vegetation on agricultural properties is one of the legal obligations imposed by environmental agencies on rural producers for environmental compliance of their properties. However, technical and financial challenges hamper compliance with legislation. In recent years, different sectors of society have come together to find practical solutions that enable the properties' environmental adequacy under the Native Vegetation Protection Law (Law No. 12.651/12), while collaborating with natural resources conservation. Some initiatives, including that of Instituto Socioambiental (ISA), show efficient results that have been used as a model for implementing ecological restoration in different parts of Brazil. In Mato Grosso, the country's leading state in grain production, which is committed to restoring 2.3 million hectares by 2030, in accordance with international agreements (Brazil is committed to restoring a total 12 million hectares), rural landowners who have partnered with ISA are satisfied with the results of planting actions in their farms' degraded areas.

foto: Luciano Langmantel Eichholz

Area of permanent protection (APP) at Paranotapa Farm (MT) after 15 months of implantation of direct seeding

The state was one of the first places where muvuca (a mixture of native forest seeds with different life cycles, green manure seeds and homogenization material) was disseminated with direct seeding. Through the Institute's work, 6,600 hectares were implemented by 2020.

The "Y'Ikatu Xingu" (Save the Good Water of the Xingu) campaign initiated in 2004 marks the beginning of this dialogue process in the region. On occasion, rural producers, indigenous communities, family farmers, technicians and researchers came together and pointed to a way to recover the springs within the farms, which would favor not only the properties' environmental adequacy, but also the preservation of the waters that flow within the "Xingu indigenous territory", a protected area bordering agricultural production lands.

Fokko Schwabe was one of the first producers in the region to learn about the technique from a training course held by ISA and, since then, he has started to encourage the participation of more rural producers for implementing it on a large scale. Fokko has an agronomic engineering degree and is also a soybean producer in the Santa Cruz do Xingu municipality in Mato Grosso state. Despite having no areas to restore on his property, he was aware of the environmental liabilities of the region's farms and understood the challenges that producers faced to recover them.

The opportunity for a solution came with the "Carbono das Nascentes do Xingu" project funded by the cosmetics company Natura, which plans to capture carbon in forest restoration areas for 30 years. To encourage planting in those areas, the company, with ISA's support, entered into a partnership with Associação Xingu Sustentável (AXS), made up of rural landowners and founded by Fokko, who mediates the restoration plantations with Xingu Consultoria Ambiental (Xica), the executor, and therefore reach the results described in the project.

The entire process is monitored by ISA, which makes and jointly signs field measurements every five years. Mechanized planting was deployed in all areas, using equipment available in the region and not requiring producers to hire temporary labor. This way, rural producers registered the properties' Permanent Preservation Areas (APP) and Legal Reserve (RL) in the project. In the first five years, they managed to capture almost 10,000 tons of CO_2 (Carbon Dioxide) in 180 implemented hectares, an amount that exceeds the expected figures for this phase. By 2046, the project is expected to capture 61,533 tons of CO_2 in the Amazon region.

With the experience, producer Fokko and executor Xica's owner Cassiano made some changes in the planting system. When facing difficulties in transporting the machines to the field, for example, they adapted a soybean planter, reducing its width so that it could get through the gates in ranchers' properties. They also used the fertilizer

Photo: Guilherme Henrique Pompiano do Carmo

Permanent protection area (APP) at Vitória Farm (MT), 2 years after implanting direct seeding

box to sow large, hard seeds such as cashew and jatobá. A rice planter box was installed to sow the smaller seeds and, later, they installed another box for even smaller seeds, while also having greater control over the sowing depth of each group of seeds.

For Fokko, direct seeding ecological restoration disseminated from ISA initiatives is a success, and has made Mato Grosso a reference in this matter. In addition to the successful application of project resources and the recovery of native vegetation, the producer also points out the benefit of recovering water quality and restoring the fauna. As he noted, the vegetation attracted more birds and wild animals, which brought other seeds and enriched the areas with species that had not been sown.

The producer also points out that the method is an inexpensive, effective system that fosters the resumption of important environmental services, expanding the view on the importance of recovering degraded areas. “But engagement is essential for good results. It is the responsibility of those who take care of the area, for example, to control invasive plants and to fence it off so that cattle does not enter”, he points out.

PARCERIA DE SUCESSO

Other producers in Mato Grosso, such as Vilson Tisoti, from the Mato Grosso state municipality of Querência, also joined and approved the ecological restoration with *muvuca*. On the 600-hectare property where he produces soybeans and corn, native species are growing in the APPs implemented in late 2017.

Without knowing the method in advance, Vilson was impressed with the results that appear already in the early years. “Formation and growth were quick. Within two years there were already species standing four meters high. It was a higher development compared to that of the other methods I had tested”, he assessed.

The partnership started with the producer’s initiative to learn how ISA could help him solve the environmental adequacy issues required by the state Environment Secretariat (SEMA) to meet the state's Environmental Regularization Program (PRA). After talking with the technicians, Vilson, in return, prepared the area and made the machinery available for sowing.

ISA was responsible for purchasing the seeds required for planting the APP's 11 hectares and for implementing and technical monitoring, which was funded by "Projeto Amazônia Live - projeto socioambiental do Rock In Rio", which aimed to restore native vegetation in APPs and other social and environmental relevance areas in the Xingu basin. This way, the producer addressed his property's environmental liability.

"I couldn't have done it without this partnership. That is why I consider the Institute's role here in the region to be essential and I recommend that everyone try to find out more about this work".

In addition to fostering ecological restoration on the properties, ISA's work helped to create the Associação Rede de Sementes do Xingu (ARSX)[18], an institution that was born in response to growing demand for native seeds in the region and has generated income for a number of indigenous communities, family farmers and urban collectors in the Xingu-Araguaia Basin. Since its creation in 2007, 249 tons of seeds have been marketed, generating an income of more than R$ 4 million for these communities. In all, 568 collectors from 21 municipalities, 14 rural settlements and 17 indigenous villages make up what is considered Brazil's largest network. As of 2020, ARSX also began offer complete native vegetation restoration with direct seeding, or how they called it, muvuca.

[18] https://www.sementesdoxingu.org.br

Persons responsible for the experience:

Eduardo Malta Campos Filho – Instituto Socioambiental
Osvaldo Luis de Sousa
Luciano Langmantel Eichholz – Instituto Socioambiental
Natália Guerin
Junior Micolino da Veiga
Rodrigo Gravina Prates Junqueira – Instituto Socioambiental
Heber Queiroz Alves - Instituto Socioambiental
Lara Aranha da Costa – Instituto Socioambiental
Guilherme Henrique Pompiano – Instituto Socioambiental
Seed collectors and the Rede de Sementes do Xingu team
Fokko Schwabe
Vilson Tisoti – Fazenda Vitória

TECHNICAL SUMMARY

Planting date: área 1: dezembro de 2017; área 2: janeiro de 2012
Planted area: area 1: 11 hectares; area 2: 9.6 hectares
Objective: area 1: environmental adequacy in the APP area; area 2: restoration of riparian forest and carbon capture by the Carbono Socioambiental do Xingu project.
Restoration system: direct seeding by mechanized haul
Quantity of native seeds: area 1: 55 species, 74.9 kg/ha; area 2: 40 species, 107 kg/ha
Restoration costs: area 1: seeds R$ 2,300/ha; area 2: seeds R$ 1,046/ha
Results: - Area 1 (after 2 years): density of trees of any size - 15,000 trees/ha; richness - 30 species; - Area 2 (after 13 months): density of trees of any size - 10,200 trees/ha; richness - 22 species.

Photo: Guilherme Henrique Pompiano do Carmo

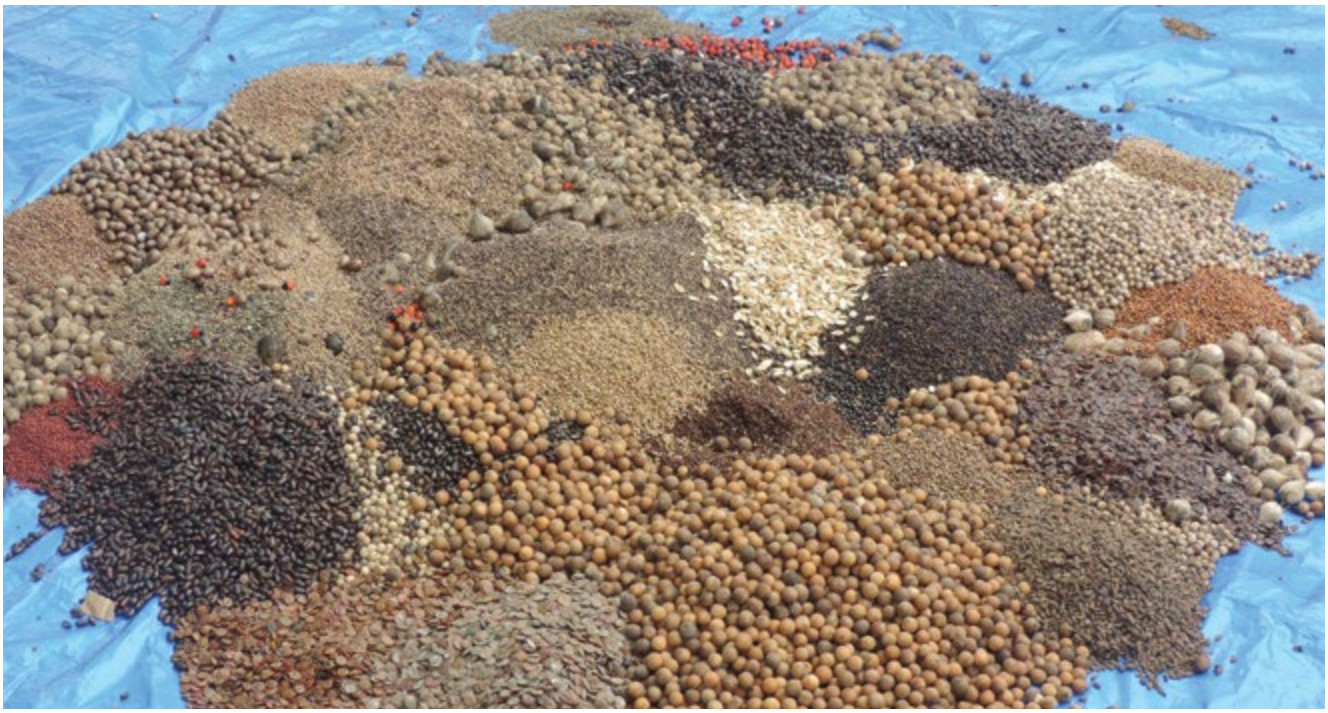
The Permanent Protection Area (APP) landscape view at Vitória Farm (MT), after 2 years of implementing direct seeding

7. A START TO DIRECT SEEDING IN THE ATLANTIC FOREST IN SOUTHERN SÃO PAULO STATE

ORGANIZATIONS DO THE PLANTING AND ENCOURAGE THE CREATION OF NATIVE SEED COLLECTION GROUPS, LEVERAGING THE POTENTIAL FOR NATURAL REGENERATION IN THE RIBEIRA VALLEY

Rio Turvo state park/São Paulo state | Vegetation Type: Atlantic Forest biome (Dense Ombrophylous Forest)

Photo: Edézio Miranda



Seed mixture containing 63kg of seeds from 25 native species harvested by the Barra do Turvo collectors (SP), mixed with green manure seeds

The Ribeira valley located in the São Paulo state's Southern region, concentrates important remnants of continuous Atlantic Forest vegetation, and is considered a World Natural Heritage Site by the United Nations Educational, Scientific and Cultural Organization (Unesco). It extends from the coastal plain to the plateau, and consists of formations of Dense and Mixed Rain Forest inhabited by Caiçara, Indigenous, and Quilombola rural communities, as well as family farmers. To preserve the valley's vegetation, the São Paulo state government deployed two main actions: it established the Jacupiranga state park (PEJ), in 1969, and, later, ordered the establishment of Mosaico de Unidades de Conservação do Jacupiranga (MOJAC) in 2008, dividing the old park. The new configuration consisting of three state Parks, four Environmental Protection Areas (APA), five Sustainable Development Reserves (RDS) and two Extractive Reserves (RESEX) was established in order to manage and organize the occupation of the territory, associating conservation areas and rural communities. Conservation Units (UCs) were instituted by the National Conservation Units System (SNUC) in 2000 and were an important milestone for protecting and valuing livelihoods in protected areas.

The Rio do Turvo state park, which covers 73,000 hectares across the Cajati, Jacupiranga and Barra do Turvo municipalities, was indicated as one of the priority areas for ecological restoration due to the region's history of inappropriate land use. The Iniciativa Verde[19] Non-Governmental Organization (NGO) is primarily responsible

[19] https://www.iniciativaverde.org.br/

Photo: Edézio Miranda

Soil preparation with a harrow on an inclined field, highlighting the preserved vegetation near the restoration area

for deploying forest restoration projects in the park and, therefore, has invested in partnerships that foster innovative solutions that can be applied in the region and that also benefit local communities.

One of these partnerships is with the *Caminhos da Semente* Initiative with Instituto Socioambiental (ISA) support, and resulted in direct seeding of 1.15 hectares, an area implemented in 2019 that is considered by organizations as a great start for this type of work in the region.

The activity involved mobilizing the surrounding communities for supplying seeds and directly purchasing from Rede de Sementes do Vale do Ribeira (Seed Network of the Ribeira valley), providing a new dynamics for the local players.

Heading the NGO's projects, the agronomist Roberto Resende invested in adapting the mechanized seed planting methodology and in fostering a new activity, in addition to producing seedlings, that could generate income for the communities. For five years, Iniciativa Verde has bought seedlings for doing restoration in the park, but with the implementation of direct seeding, it has also already ordered seeds and encouraged fresh work from nurseries.

Planting was made by haul in a total area with the aid of a limestone spreader. When preparing the area, the team observed difficulties in carrying out the activities in a mechanized way due to the slope of the terrain. "We have different conditions here than in agriculture practiced in Mato Grosso, for example. Even so, our goal is to be able to propose this method without losing scale or increasing costs", Roberto comments in reference to the way ISA deploys restoration actions in the Xingu region.

For future planting, the strategy is to apply a semi-mechanized system in troughs, which makes the use of heavy machinery unnecessary.

"We also want to encourage networking to increase seed production. We don't consider the activity a competitor to seedling production, but rather a complementary one. We have great potential for collecting seeds in the Atlantic Forest", he says.

[24] https://www.iniciativaverde.org.br/

Another interesting adaptation in the planting operation in the Rio do Turvo Park was the decrease in the diversity of sown species. The technicians used only 25 native species in the seed mixture due to the region's high potential for natural regeneration, which happens mainly due to the seeds' dispersion, since there are large forest fragments. Species such as guapuruvu (*Schizolobium parahyba*), assa-peixe (*Vernonia sp.*) and crindiúva (*Trema micrantha*) were found in the first monitoring even without having been sown.

As the organization's operation is mainly funded by carbon-related projects contracted by companies, institutions and even individuals to offset greenhouse gas (GHG) emissions from any given human activity, Iniciativa Verde has also innovated by offsetting carbon footprint in areas restored with direct seeding. In general, the market uses the quantification of the planted seedlings in carbon offset planning as a standard, and not the restored area. Roberto explains that the organization's technicians consider that

Photo: Edézio Miranda

Urucum (*Bixa orellana*) next to a olho-de-cabra (*Ormosia arborea*) 3 months after direct seeding

in direct seeding areas there are 1,667 trees per hectare, the common density found in seedling plantations. But the first observations, three months later in the area implemented in 2019, indicate higher densities: around 30 thousand tree seedlings in each hectare.

However, it is important to emphasize that self-thinning is natural in the direct seeding ecological succession process, reducing the number of trees/ha as they develop. Thus, carbon capture calculations need to be performed in the years following implementation with that method, taking into account the basal area and wood density of each species. Therefore, direct seeding restoration can work well to restore in seeking to quantify carbon.

"For ecological purposes in general, the best metric is a restored area and not planted trees and, fortunately, this change in mentality is already taking place in environmental agencies and in the carbon market. Society is learning more about restoration ecology - and direct seeding contributes a lot to this learning", says Laura Antoniazzi, from the Caminhos da Semente Initiative, a partner in the action.

Persons responsible for the experience:
Roberto Resende - Iniciativa Verde
Pedro Barral - Iniciativa Verde
Amanda Sellarin Alves - Iniciativa Verde
Jeferson Silva Cabral - Iniciativa Verde
Angela Maria dos Santos Dias - Iniciativa Verde
Cesar Camargo - Iniciativa Verde
Isaac de Oliveira Passos - Iniciativa Verde
Edézio Miranda - Agroicone/ Iniciativa Caminhos da Sementes
Juliano Silva do Nascimento - Instituto Socioambiental

TECHNICAL SUMMARY

Planting date: December 2019
Planted area: 1.15 hectares
Objective: Implementing the area under restoration as part of the deployment of the state park's stewardship plan; compensation for greenhouse gas emissions.
Restoration system: direct seeding by mechanized haul
Quantity of native seeds: 54.7 kg/ha; 25 species collected in the region.
Results: after 3 months: - Richness: 14 species - Density of trees of any size - 30,000 trees/ha

DIRECT SEEDING FOR RESTORING WITH SOCIAL AND TECHNOLOGICAL INNOVATION, INSTITUTIONAL ARTICULATION, AND INCLUSION

The seven experiences presented in this publication bring innovations for direct seeding, ensuring more security for those interested in applying the method as a solution for recovering degraded areas. It is recommended for different biomes, private properties or public areas, with greater or lesser availability of machinery or labor, in areas with low or high potential for natural regeneration, direct seeding can be implemented seeking to either strictly recover native vegetation or to recover with agroforestry systems.

The method is adaptable to the terrain, climate, vegetation, level of degradation and social and economic context of the area to be restored, and it is possible to use mostly mechanized operations, facilitating its adoption in agribusiness. The planting process can be easily understood by the owners and employees of the rural property and the seeds are relatively easily acquired, transported and stored.

It is also possible for direct seeding to be adapted to the social and environmental context of the area where it will be applied, and it provides those who implement the method with constant learning, which is part of process improvement. In Brazil, the method is applied in Permanent Preservation Areas (APPs) and Legal Reserves (RL) of rural properties of small, medium and large producers, hydroelectric plants, as well as degraded areas in Conservation Units (UCs), bringing results that add increasingly higher security regarding the effectiveness of ecological restoration with seeds.

Using this input can be considered a factor for bringing together restoration technicians and farmers already used to sowing other crops. The rapport yielded good discoveries such as the use of selective herbicide for narrow leaves, improving the control of exotic grasses, and the understanding of the ideal sowing depth for native species, which is similar to the incorporation depth of the corn crop seed. With the use of this and other already consolidated local knowledge, rural producers understood more easily how it is technically possible to recover native vegetation with seeds. In the same sense, aggregating technicians and researchers from different disciplines was essential to test some differences during the process, for example, in choosing the mix and the ideal quantity of each species sown, so that the method would provide better efficiency in each location.

Photo: Nina Jacobi

Zé da Lena (José Severino da Silva) teaching about the seed processing process

Partnerships between the different sectors, as well as the quality of the institutional arrangement, are identified as key factors for the success of direct seeding and restoring native vegetation in each case. The projects had a strong common connection between the productive sector, which is responsible for environmental liabilities, the application and technical assistance and the scientific research, as well as the participation of funders, articulators, organizations defending the environment and citizenship, in addition to environmental regulatory and supervisory bodies.

As demonstrated, when each actor is invited to participate in the arrangement, recognizing their role in the restoration chain, projects flourish and impact territories in a broader manner.

Some technical aspects proved to be very important for the success of the restoration. They include accurate assessment of ecological processes verifying the potential for natural regeneration, soil type, original phytophysiognomy (reference ecosystem) and ideal period for planting. We also highlight efficient soil preparation for reducing reinfestation of invasive exotic grass species, increasing the success in establishing the sown species. Plantation planning months in advance so that soil preparation and species composition activities are optimized is also very important for better results to be achieved.

Under the ecological aspect, the high density of sowing leads to densifying trees in a similar way to natural secondary vegetation in forest environments, with rapid coverage and transformation of the degraded area. The use of short-cycle species, green manure and annual and semi-perennial herbs and shrubs enable accelerated system recovery. In savanna environments, sowing includes herbs, grasses, shrubs and trees in high density, respecting the representativeness of the savannas' growth types. In both forestry and savanna restoration, seeds of species from

different successional groups are used, which cover the soil from the first year and structure the vegetation for decades awaiting the colonization of additional regional diversity species.

Seed collectors are essential for offering seeds in sufficient quantity and diversity for large-scale ecological restoration. To start seed production, it is necessary to know how to identify the species. In this sense, the populations that live in regions with preserved native vegetation and use plants for different purposes are essential because they already know how to identify many species.

It is the knowledge of these people, based on traditional knowledge, that enables producing seeds for expanding ecological restoration. In addition to this point, when dealing with seeds, in practice, collectors do conservation in their territories, expanding restoration's role in education and social transformation aspects.

We recognize the role of seed collectors for the restoration chain and we highlight the names of some of the protagonists of this story: Eliane Righi, a collector at the Bordolândia sustainable settlement project in Bom Jesus do Araguaia (Mato Grosso state), and the coordinator of the group of collectors in the settlement and one of the prominent collectors in the Associação Rede de Sementes do Xingu (ARSX), for encouraging women's autonomy through work within the Network; Claudomiro de Almeida Cortes, who fostered the creation of the Associação Cerrado de Pé, a partner of the Rede de Sementes do Cerrado (RSC), presenting the possibility for many families to collect herbs, shrubs and trees that are native to the Cerrado, with their pioneering example in the Alto Paraíso de Goiás municipality in Goiás state; and José Severino da Silva, better known as Zé da Lena, who has been collecting seeds for 19 years in the Laranjal Paulista region in São Paulo state and in the surrounding municipalities and, as an autonomous collector, has a lot of stories to tell about the decision to make a living out of this work.

Photo: Nina Jacobi

Direct seeding on a permanent protection area (APP), winged seed species being dispersed manually - at Adolfo (SP)

Photo: Nina Jacobi

Mixture of seeds and sand just before sowing

Challenges

The history of ecological restoration and, especially, of direct seeding, is just beginning. There are many challenges to making the method more efficient and more comprehensive in terms of species and environmental situations. For example, one challenge is adapting machinery and manual planting to adjust sowing depth and consider seeds with different shapes. In the phase of land preparation, there is need for improving control of invasive plants and prepare the soil in degraded and sloping areas. With regard to seeds, it is necessary to develop methods for storing recalcitrant seeds so that they can be used synchronously with planting time and also treatments and types of seed protection, in order to increase the germination ratio in situations of extreme humidity and temperature conditions found in degraded areas.

We hope that this publication will contribute to engaging more people and organizations in developing and expanding direct seeding. It is certainly possible to say that direct seeding goes hand in hand with an innovative and inclusive restoration chain. In a fair way, this chain can generate work and income, qualify, restore connections with nature, help to value the territory and the local ecosystem, and still value and democratize science. The method, together with others already established and under development, will help in recovering degraded areas in Brazil, contributing to its central role in the global social and environmental agenda.

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Supported by

The knowledge generated in Brazil has provided advances in developing solutions for ecological restoration that positively impact the social sphere. Direct seeding is a method for recovering native vegetation that consists of high-density seed sowing that triggers the ecological succession process, brings satisfactory ecological, financial, and social and cultural results, contributing to addressing contemporary environmental challenges. We present seven native vegetation restoration experiences in which the method is used in different ecosystems and contexts. Generating confidence in direct seeding efficiency and applicability is the objective of the Caminhos da Semente Initiative, which, since 2019, has supported innovative and inclusive actions for restoring native vegetation.

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ISBN: 978-65-992253-2-1