

**NEW GENERATION PLANTATIONS IN PRACTICE**

**INTEGRATING HIGH-PRODUCTIVE  
FORESTRY WITH FOREST RESTORATION  
FOR BIODIVERSITY PURPOSES**



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GOAL: To share the lessons learned at the ecological restoration program of Fibria Celulose S.A.



- 1. OVERVIEW OF THE COMPANY**
- 2. OVERVIEW OF THE LANDSCAPE AND NATIVE FORESTS MANAGEMENT**
- 3. THE ECOLOGICAL RESTORATION PROGRAM**



**The Company**

## **FIBRIA'S LONG TERM SUSTAINABILITY OBJECTIVES AND TARGETS**

- 1 - Optimize the use of natural resources**
- 2 - Help to mitigate the effect of greenhouse gases**
- 3 - Protect biodiversity**
- 4 - Boost eco-efficiency**
- 5 - Strengthen the interaction between the company and society**

## **NEW GENERATION PLANTATIONS PRINCIPLES**

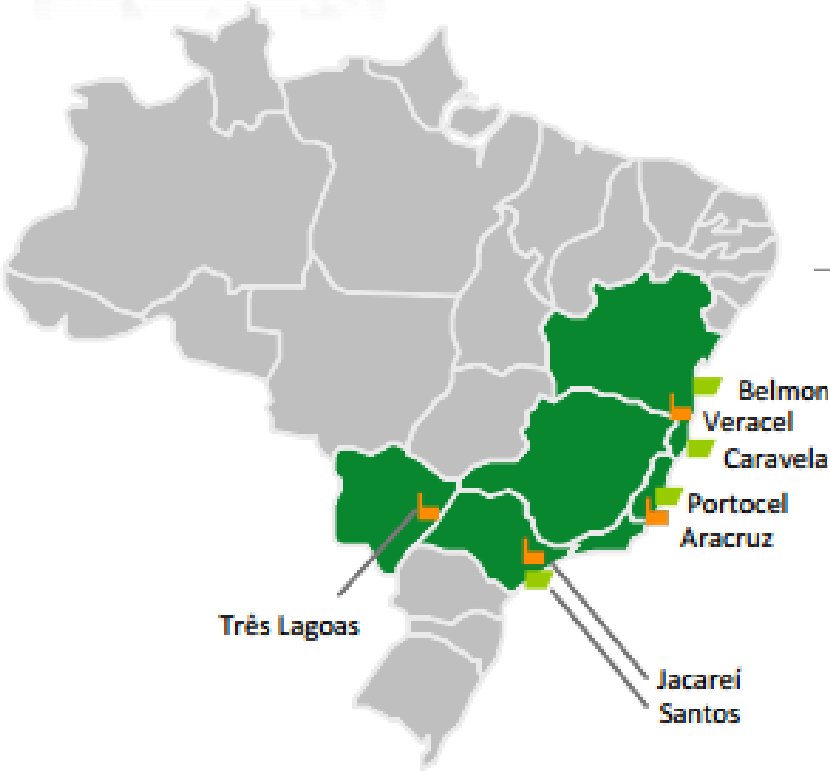
*newgenerationplantations.org*

Plantations should:

- Contribute to economic growth and employment**
- Maintain ecosystem integrity**
- Protect and enhance high conservation values**
- Be developed through effective stakeholder involvement processes**



Fibria Celulose S/A (Fibria), global leader of market pulp industry, is a Brazilian company that produces bleached pulp exclusively from renewable eucalyptus plantations in Brazil.



■ Port Terminal

■ Pulp Unit

Aracruz – 2,340 th t/year



Três Lagoas – 1,300 th t/year



Jacarei – 1,100 th t/year

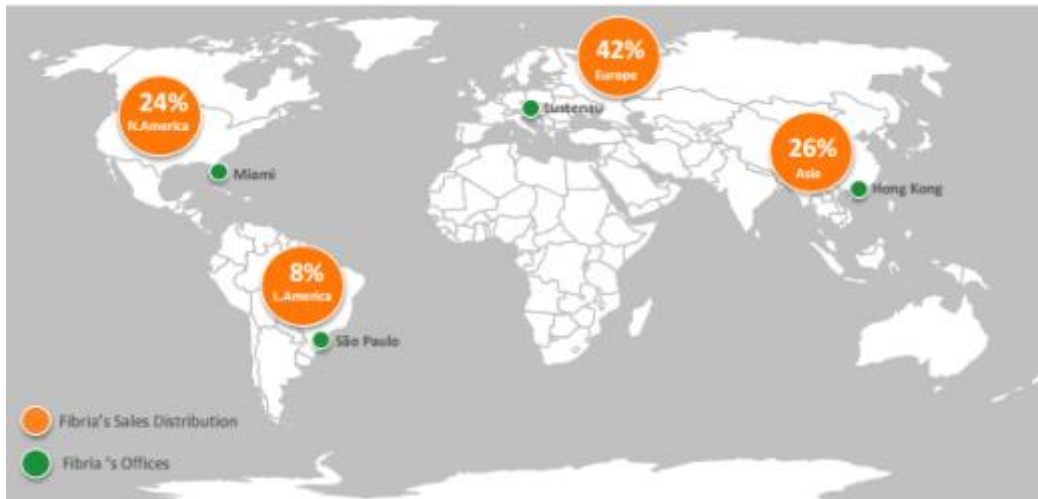


Veracel – 560 th t/year

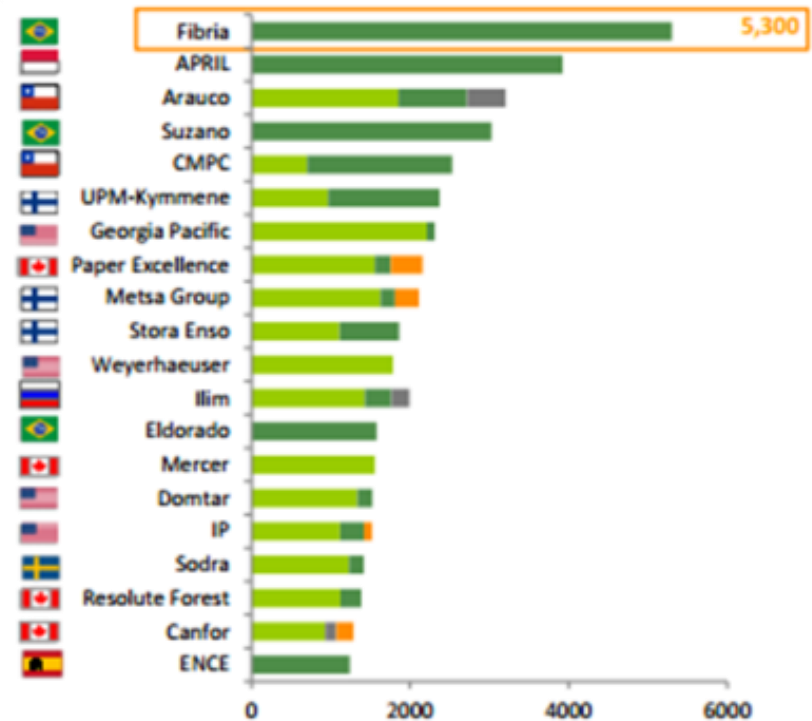


# WORLD PRESENCE AND LEADERSHIP POSITION

## OWNERSHIP STRUCTURE



## Market Pulp Capacity Ranking 2014<sup>(2)</sup> (000t)



# FORESTS: THE CORE OF THE BUSINESS



*~ 1 million hectares of managed land*

# INNOVATION AND SUSTAINABILITY IN THE FOREST

**Fibria's leadership in forest technology is the result of over 35 years of studies and research.**

- Generating and selecting clones with greater productivity and adaptability
- Integrating forest health practices, such as monitoring and biological control of pests
- Developing and applying knowledge on eucalyptus nutrition
- Developing and applying knowledge on soil, water and biodiversity conservation





# DEVELOPMENT OF EUCALYPTUS CLONING



Fibria was the pioneer in the use of commercial clones for the production of high yield forests

# EXPRESSIVE GAINS IN FOREST PRODUCTIVITY AND QUALITY

1970

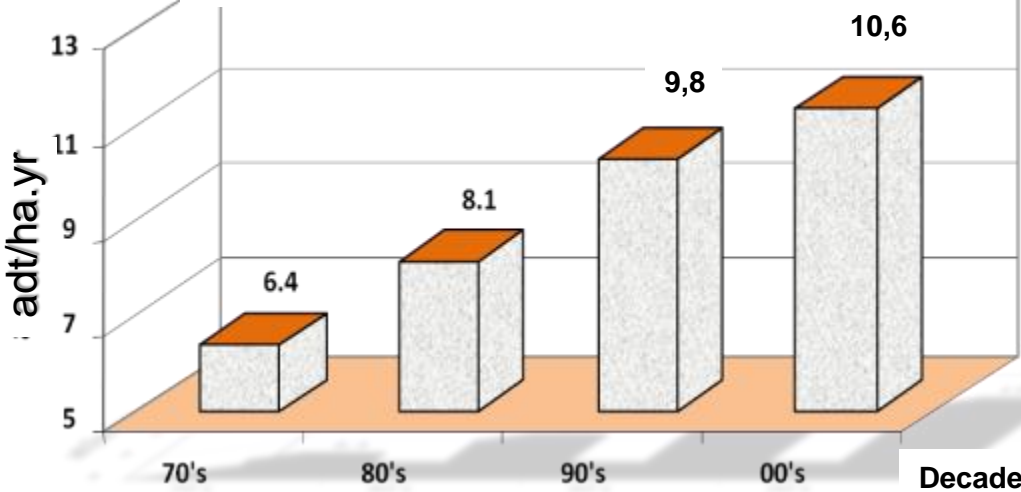


*Under the same climate conditions!*

2014



Pulp tons per ha per year



## CLASSICAL BREEDING

New elite clones at each breeding cycle bringing more productivity and better wood quality

*1 year and 9 months*

Current elite clone

New elite clone

Fibria's Forest Average Yield:  
**41m<sup>3</sup>/hectare/year**

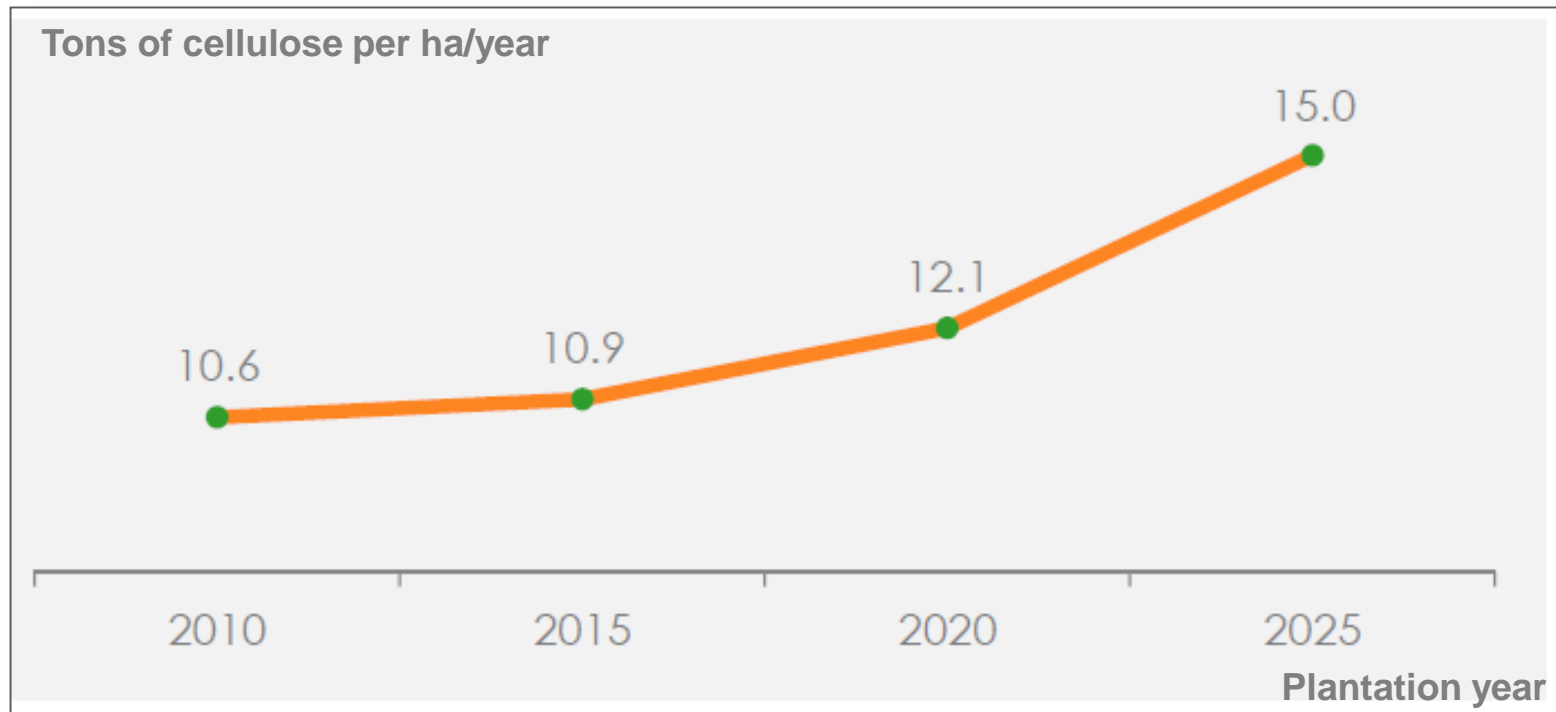
## FOREST MANAGEMENT

- Fertilization based on geochemical balance
- Minimum soil preparation
- Integrated forest protection system (pests, diseases, fire)



# 2025 TARGET: TO REDUCE BY ONE-THIRD THE QUANTITY OF LAND NEEDED TO PRODUCE PULP

Goals established in Mean Annual Increment of Pulp



**LONG TERM SUSTAINABILITY OBJECTIVE:  
OPTIMIZE THE USE OF NATURAL RESOURCES**



## The Landscape and Native Forests

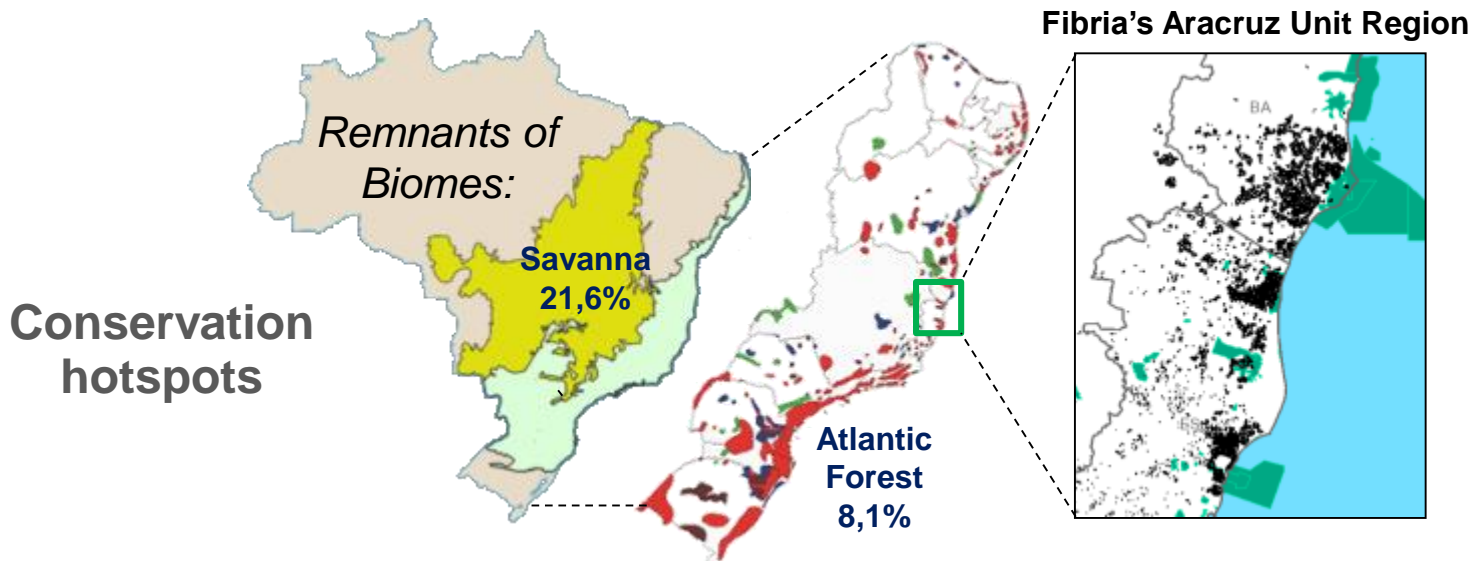
# THE LANDSCAPE

Landscapes where Fibria operates are dominated by degraded pastureland with patches of secondary and anthropized forests, tree plantations, agricultural crops and urban areas.



## Native forest coverage:

- Brazilian's forest law: 20%
- Field reality: 8% (Atlantic Forest), 21% (Savanna)
- Fibria's areas: 35%



# FIBRIA'S FOREST MOSAIC

~ 340.000 ha (35% of the company's managed land) are conservation areas interweaved with eucalyptus plantations



Native forests interweaved with eucalyptus plantations, aiming to provide ecosystem services and biodiversity conservation.

The matrix (eucalyptus plantations) is dynamic (harvested at each 6 years) but permeable to forest species.

# LANDSCAPE DYNAMICS

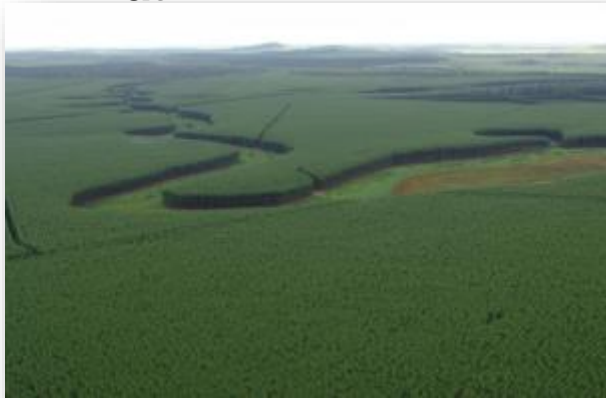




# HABITATS IN THE LANDSCAPE

Fragmented landscape with 60% to 10% of natural habitat represented by many small and medium size fragments, unconnected or poorly connected, with eventual corridors alongside rivers and roads.

**Matrix:**



**Native Forest Fragments:**



**Corridors:**



# NATURAL ECOSYSTEM AREAS

Climax or late successional forest fragments are scarce and isolated, but they have an overwhelming diversity with a high presence of endemic and threatened species.



The medium expected tree richness is 240 ssp/ha

Inside Fibria's areas, biodiversity database accounts for:

- 738 species of birds
- 133 species of mammals
- 76 species of reptiles
- 2,192 species of plants

159 vulnerable or endangered species  
(IUCN and National lists)



*Bradypus torquatus*



*Amazona aestiva*



*Tapirus terrestris*



*Callicebus personatus*



*Glaucis dornnii*

# BIODIVERSITY CONSERVATION PRACTICES

*Fauna and flora monitoring*



*High Conservation Areas Assessment and Management*



*Landscape planning*



*Environmental Education*



*Development of multiple uses of natural forests*



*Protection of natural forests from hunting, fire and degradation*



*Native forests restoration*



# The Ecological Forest Restoration Program

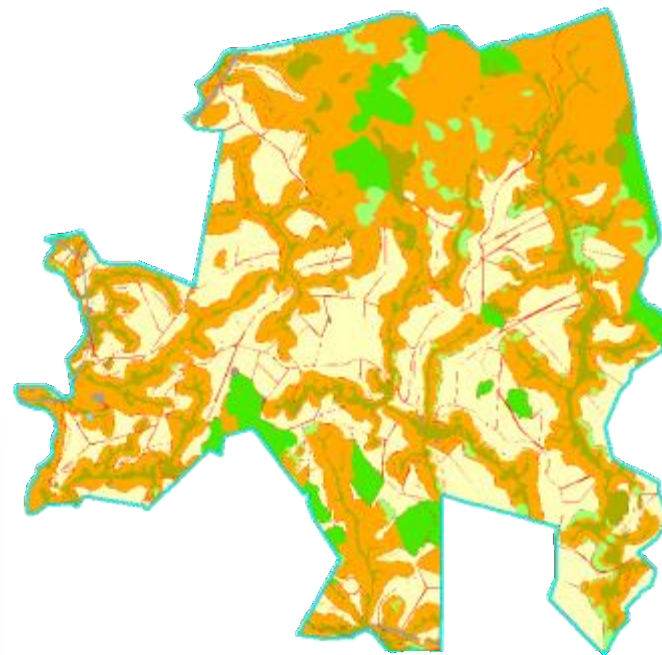
# ECOLOGICAL FOREST RESTORATION GOALS




## Enhance biodiversity and ecosystem services flows in the landscape

- Compliance with law
- Enhancing landscape connectivity
- Rebuilding forest fragments in open degraded pastureland



QUANTITY ≠ QUALITY



-  Eucalyptus plantation
-  Nature conservation areas
-  Degraded areas destined to ecological restoration

## LONG TERM SUSTAINABILITY TARGET:

To restore 40,000 ha until 2025



**PACTO**  
PELA RESTAURAÇÃO DA  
MATA ATLÂNTICA

# ECOLOGICAL RESTORATION AREAS

Areas set aside for ecological restoration are mainly on newly acquired land, where the former owner did not comply with legal requirements of protected areas keeping them as pasturelands.



They are scattered in the landscape, predominantly dominated by invasive alien grasses, with drastically reduced seed banks and compacted soils.



**Since 2010, Fibria has been planting native trees for conservation purposes at a rate of about 2,000 ha a year**

# FIBRIA'S RESTORATION DECISION KEY

Characterization of conservation areas devoid of native vegetation

Estimated number of natural regeneration saplings

HIGH



ASSISTED NATURAL  
REGENERATION

LOW



NATIVE TREE  
PLANTING

# TREE PLANTING OPERATIONS



Manual soil preparation



Mechanized ripping in rows



Seedling planting with hydrogel



Chemical weed control  
(herbicides)



Manual weed control  
(around seedlings)

> US\$ 5,000 /ha  
Standard cost of planting  
operations plus 4 years of  
maintenance



# Evolution of vegetation coverage in a Fibria's ecological restoration plantation area in Bahia State, Brazil

2010



2011



2014



60 days



300 days



3 years



# Native seedlings plantations are intended to restore the ecological processes of natural succession and autoregeneration of native forests.

Assisted natural regeneration site  
12 months



Native seedlings plantation site  
15 months



# DEVELOPMENT OF NATIVE SPECIES PLANTATION METHODS USED IN RESTORATION

90's and 00's

Mimicking natural succession

Pioneer, secondary and climax species planted in a mix  
Exotic species were planted to play the role of pioneers

High mortality rate of indigenous species and dominance of alien species

2010

Filling & Diversity Groups

*Groups interspersed, with at least 40 different species (10 FG and 30 DG) at any particular restoration site.*

High mortality rate of diversity species, resulting in areas spotted with clearings

2014

Coverage Species

Restriction of species list to those with high survival rates, rapid growth and good canopy cover. At least 5 ssp /site.

Good results so far, areas far away from forest fragments are expected to need enrichment planting

# FILLING & DIVERSITY SPECIES GROUPS IN THE FIELD

From 2010 to 2013, about 7.000 hectares were planted following this model.

## FILLING GROUP-FG:

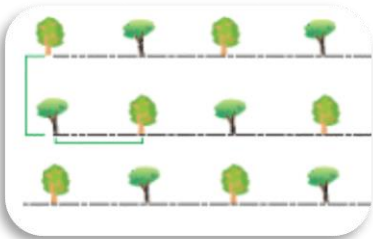


27 fast growth (usually short lived), that would provide a quick canopy closure of the planted area

## DIVERSITY GROUP-DG:



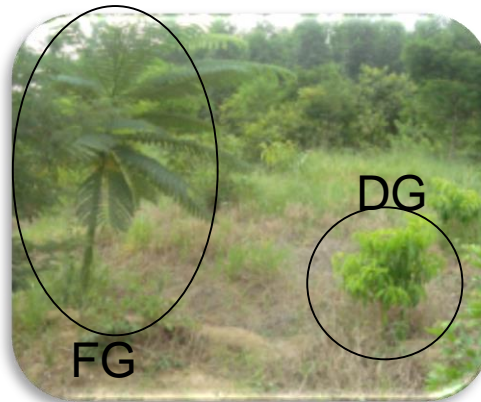
203 other species that would gradually replace the FG ones in a mimicry of natural ecological succession.



Seedlings from groups interspersed in a 3x2m or 3x3m arrangement



Big challenge: seedlings supply chain (seeds suppliers & nurseries)



***Invasive grasses persisted even with periodical chemical weed control, preventing natural regeneration.***

# COVERAGE PLANTING MODEL

The species list is restricted to 17 species that are proved to have:

- High survival rates
- Rapid growth
- Good canopy cover

Species	Family
<i>Acnistus arborescens</i>	Solanaceae
<i>Apeiba tibourbou</i>	Malvaceae
<i>Bauhinia forficata</i>	Caesalpinaceae
<i>Byrsonima sericea</i>	Malpighiaceae
<i>Croton floribundus</i>	Euphorbiaceae
<i>Guazuma ulmifolia</i>	Malvaceae
<i>Heliocarpus americanus</i>	Malvaceae
<i>Inga edulis</i>	Mimosaceae
<i>Inga striata</i>	Mimosaceae
<i>Joannesia princeps</i>	Euphorbiaceae
<i>Schinus terebinthifolius</i>	Anacardiaceae
<i>Senna appendiculata</i>	Fabaceae
<i>Senna macranthera</i>	Caesalpinaceae
<i>Senna multijuga</i>	Caesalpinaceae
<i>Solanum mauritianum</i>	Solanaceae
<i>Sparattosperma leucanthum</i>	Bignoniaceae
<i>Trema micrantha</i>	Cannabaceae

## Goals:

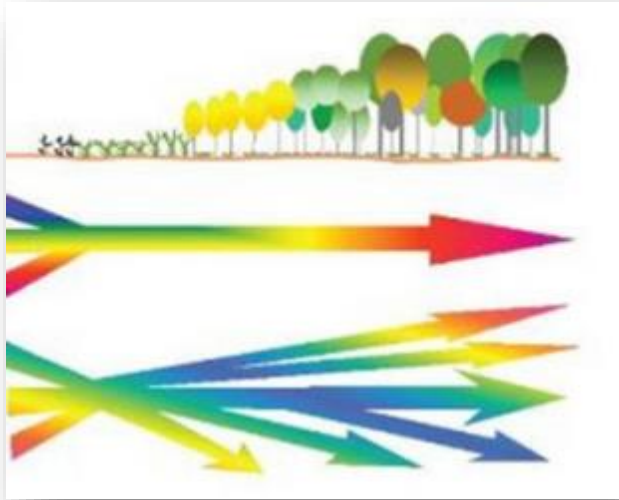
- **Control of invasive grasses by the establishment of a canopy cover**
- **Build conditions (microclimate, soil) to the establishment of natural regeneration**
- **Reduction of restoration costs due to:**
  - Simplified seedlings logistics
  - Higher survival rates: less replanting
  - Lesser needs of chemical weed control.



# ECOLOGICAL PATH OF RESTORATION AREAS

Biodiversity restoration in tropical forests takes a long time (> 100 years)...

...but we need to make decisions about management operations today.



## Indicators of positive ecological path of restoration areas:

- Closed canopy coverage
- Reestablishment of natural regeneration capacity
- Absence of problem / invasive species



7 months plantation  
suffered cattle invasion

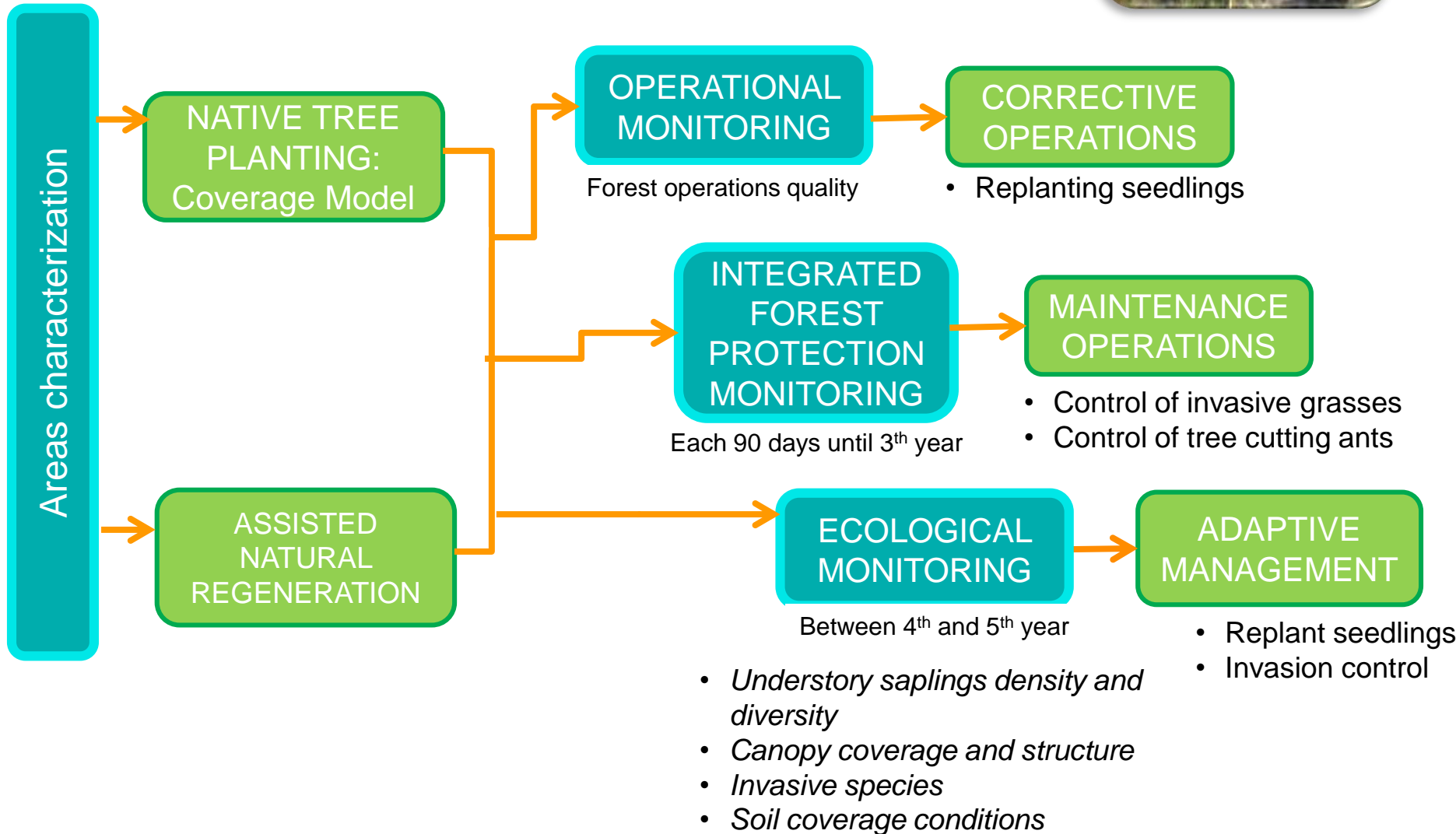


7 years plantation with  
alien tree invasion



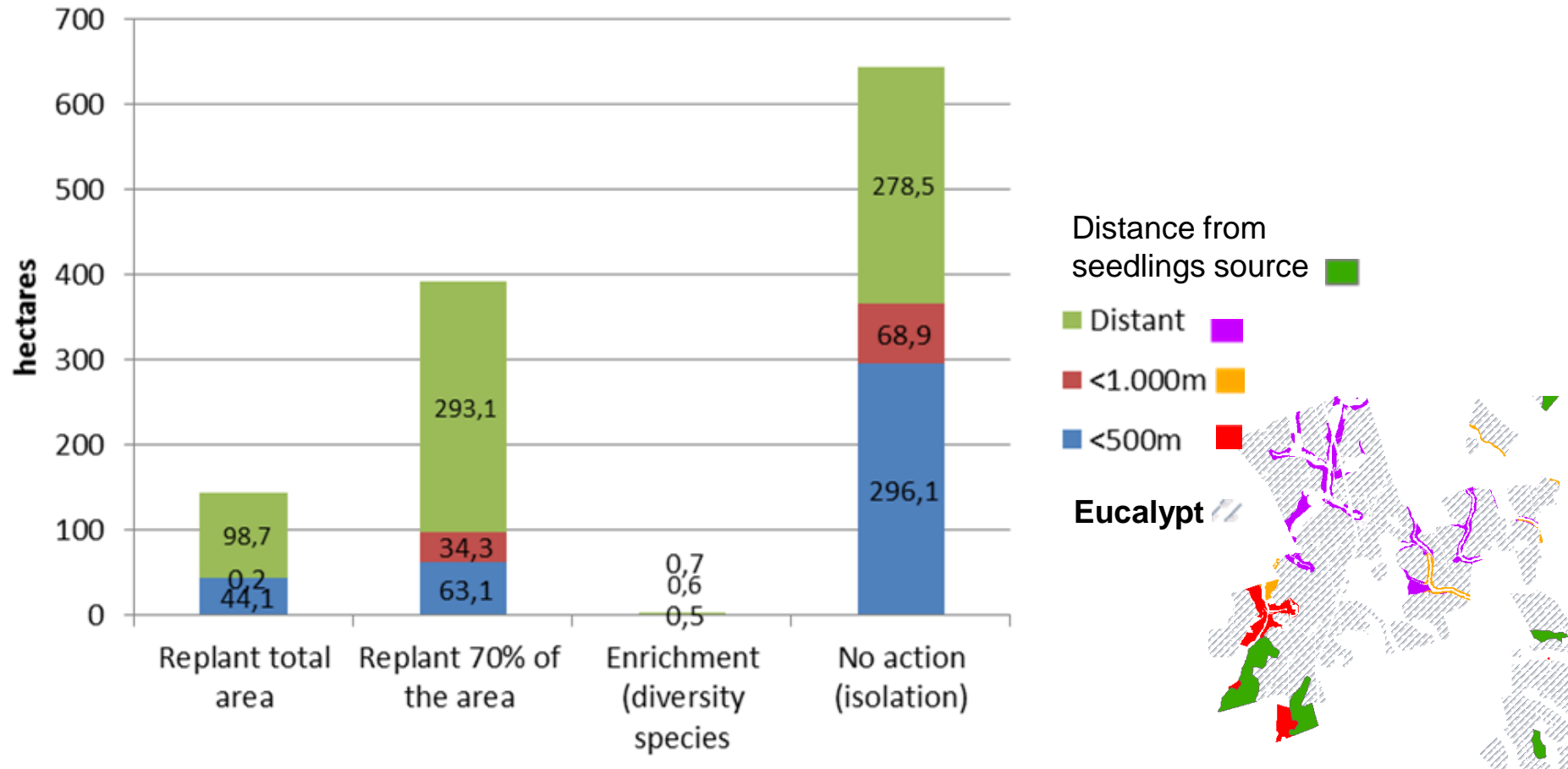
2,5 years plantation in a  
positive ecological path

# MONITORING RESTORATION



# ADAPTIVE MANAGEMENT

*Adaptive management prescribed to areas planted in 2010 after the ecological monitoring 2014, by distance from seedlings source (forest fragments > 3ha)*

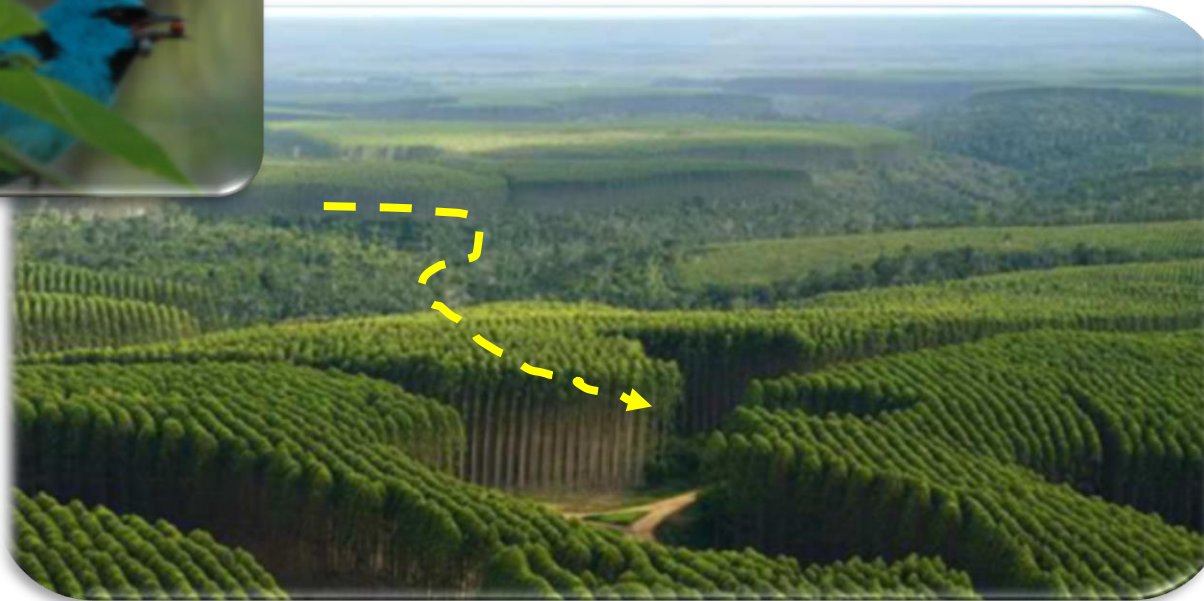


**Seedlings plantation was prescribed when the density and/or diversity of understory saplings is very low, indicating that the natural regeneration process (essential to natural succession) is not functional yet.**



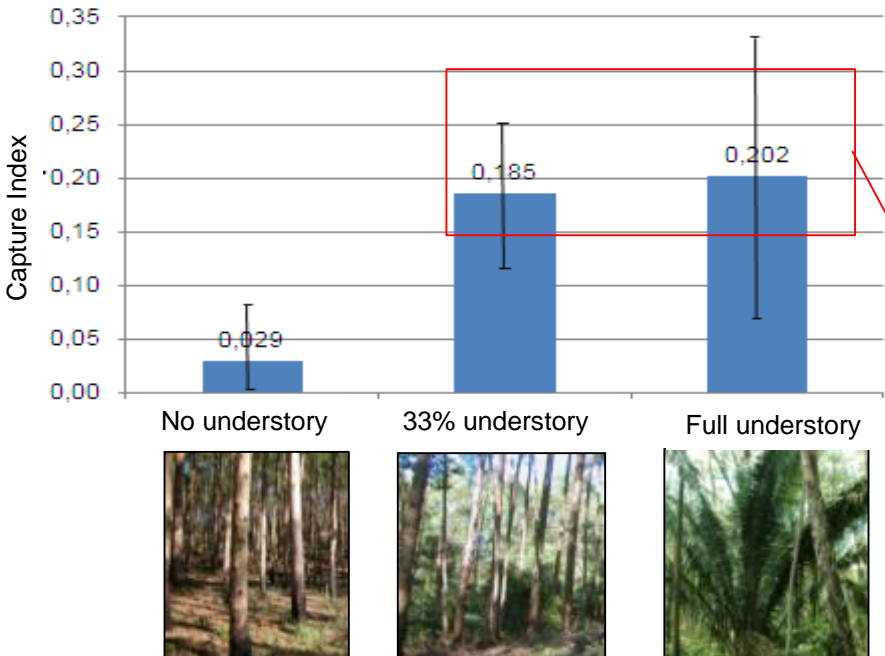
# LANDSCAPE APPROACHES TO FOSTER NATURAL REGENERATION

*Enhance seed rain at restoration sites*



- Planting “coverage” species strongly attractive to fauna (*which brings in seed rain*)
- Enhance surrounding landscape connectivity through the matrix

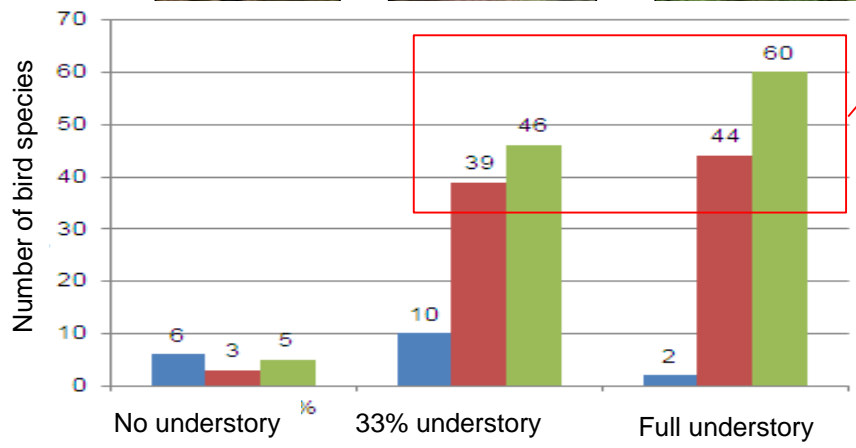
# MANAGEMENT OF SURROUNDING LANDSCAPE CONNECTIVITY: LESSEN UNDERSTORY CONTROL UNDER EUCALYPTUS PLANTATIONS NEAR RESTORATION SITES



Study with mistnets: Effect of understory at eucalyptus plantations on forest bird communities

No significant differences in birds quantity

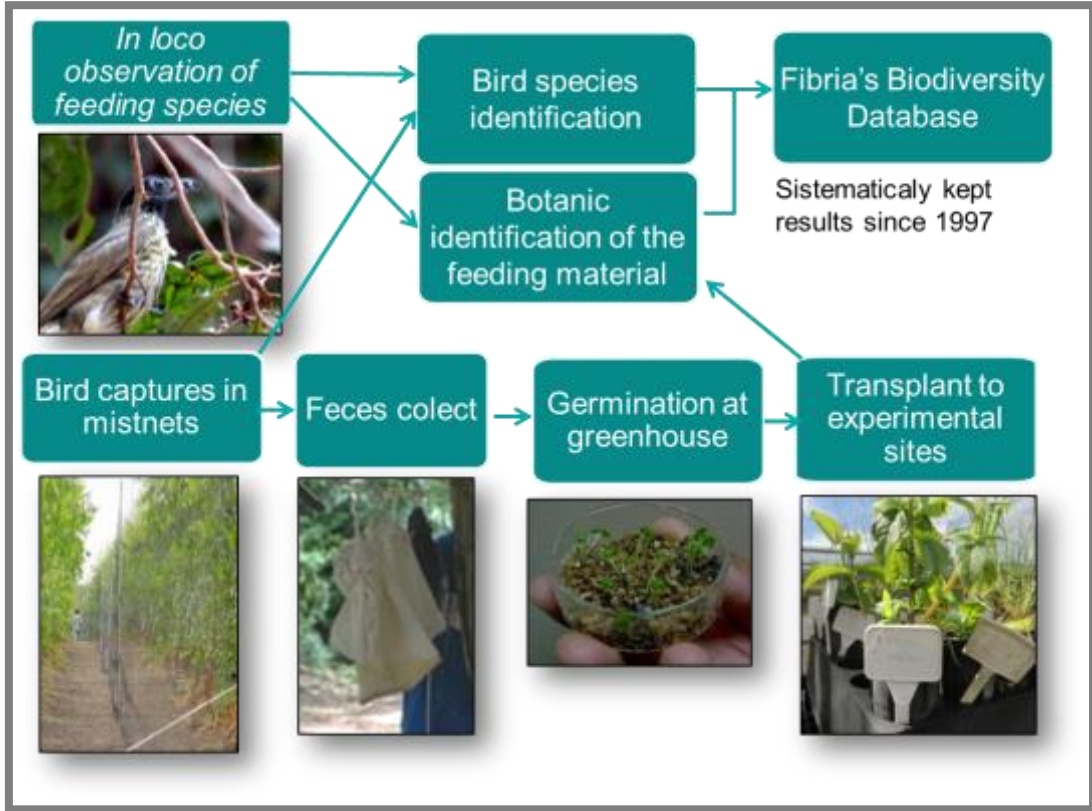
Similar species composition



Birds habitat  
 ■ Open  
 ■ Edge  
 ■ Forest interior



# USE OF COVERAGE SPECIES STRONGLY ATTRACTIVE TO FAUNA: PLANT SPECIES WITH ABUNDANT FRUGIVORY BY BIRDS THAT TRANSITS BETWEEN MATURE FOREST AND RESTORATION SITES



Study on birds frugivory:  
sistematically kept results  
since 1997

<b>Birds registered</b>	<b>646</b>
Plant species identified	92

6 plant species recomended  
as functional species



*Trema micrantha*



*Tapirira guianensis*



*Cecropia hololeuca*



*S. terebinthifolius*



*Xylopia sericea*



*Schefflera morototoni*

# ONGOING RESEARCH ON RESTORATION



## Coverage plantations

2014

- 2,24 ha
- 13 treatments



1,5 anos

## Carbon efficient models

2013

- 1,3 ha
- 5 treatments



## Wood models

2011

- 16,9 ha
- 8 treatments



## Agroforestry (food & wood)

2014

- 6,5 ha
- 27 treatments

# LESSONS LEARNED AND CHALLENGES AHEAD

- **Focus on few functional tree species.**
- **It costs too much not to select the seedlings parents. Classical breeding programs of functional species are needed.**
- **Understand and use landscape fluxes to help restoration**
- **Cost-effective monitoring indicators are crucial**
- **Native species plantations can be improved by the use of other components (cover crops, fast wood trees)**
- **Ecological restoration should also have economical function**



# Thank you!



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