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MONITORING PROTOCOL
FOR FOREST RESTORATION PROGRAMS & PROJECTS

2013

PRESENTATION

Since its establishment in 2009, the Atlantic Forest Restoration Pact has excelled in bringing together talent and efforts originally dispersed throughout different sectors of Brazilian society, with the purpose of integrating hard-earned knowledge and experience in the restoration of ecosystems that constitute the Atlantic Forest biome. Because of this collaborative effort, we have developed a collection of publications; including a book of theoretical and practical references, two maps indicating potential areas for restoration, and a database available for online consultation.

The Monitoring Protocol for Forest Restoration Programs & Projects presented here is an addition to our previous publications, reinforcing what we call the "Pact toolbox". We produced this publication with the aim of expanding both the scale and the quality of forest restoration in one of the global hotspots of biodiversity, choosing the format of a technical manual, to be utilized as a reference for guiding the monitoring and evaluation of forest restoration projects in the field.

The adoption of a common monitoring protocol, with criteria and indicators that were standardized by leading national specialists as well as validated by projects developed by Pact members, is an essential factor for ensuring cross-compliance with restoration goals and objectives. It is also essential for organizing data collection and comparison, thus contributing to the improvement of knowledge and to the adoption of better restoration practices.

This publication will also strengthen our commitment to share the experiences and results of Pact beyond biome and national boundaries since, thanks to the support of new and former partners, it is published in Portuguese, English and Spanish. Electronic distribution of the document through ecological restoration networks will benefit the work of stakeholders involved and will help disseminate information about the Pact.

This protocol would not have been possible without the generous dedication of members of the Technical-Scientific and the Restoration Economy work groups, as well as many other collaborators, Pact members or not, who through meetings and workshops analyzed and expanded the proposal.

We would also like to thank the various institutions listed at the end, which have believed in and supported the Pact, either financially, or through their invaluable technical, scientific and logistical support.

Beto Mesquita
General Coordinator of the Atlantic Forest Restoration Pact
under the auspices of Conservation International

This protocol was created through the collaboration of professionals from the following institutions:

Association for Protection of the Atlantic Forest in the Northeast of Brazil, Association for the Preservation of the Upper Itajaí Valley, BioAtlantic Institute, Biosfera Environmental Consultant Firm, Brazilian Agricultural Research Corporation - EMBRAPA, Brazilian Institute of Environment and Renewable Natural Resources - IBAMA, Northeastern Center for Environmental Research - Cepan, Center for Extension in Environmental Education and Conservation - USP, Center for Tropical Research - UCLA, Conservation International - Brazil, Conservation Organization in the Bahia Southern Lowlands, Coordination of Biodiversity and Natural Resources - SMA/SP, Copaiba Environmental Association, Department of Agriculture, Environment and Tourism of Guapiara - SP, Department of Environment and Water Resources of the State of Espirito Santo, Department of Environment and Water Resources of the State of Parana, Department of Environment of the State of Rio de Janeiro, Department of Environment of the State of Sao Paulo, Eco Atlantica, Environmental Group of Bahia, Environmental Institute of Parana, Fibria S/A, Flora Brasil, Floresta Viva Institute, French National Center for Scientific c Research - CNRS, German Society for International Cooperation - GIZ - Brazil, Golden Lion Tamarin Association, Institute for Applied Economic Research - IPEA, Institute for Ecological Research - IPE, Institute for Social and Environmental Studies in Southern Bahia, Institute Friends of the Atlantic Forest Biosphere Reserve, Institute of Agricultural and Forest Defense of the State of Espirito Santo, International Institute for Sustainability, Klabin, Laboratory of Ecology and Forest Restoration - ESALQ-USP, Laboratory of Landscape and Ecology Conservation - USP, Laboratory of Forestry and Forest Research - CCA/UFSCar, Laboratory of Tropical Silviculture - ESALQ- USP, Luiz de Queiroz College of Agriculture - ESALQ/USP, Mater Natura Association, Ministry of the Environment – Department of Biodiversity and Forests, National Bank for Economic and Social Development - BNDES, Natural Heritage Association, Natureza Bela Association, Northeast Ecological Society, Oikos Institute of Agroecology, Programa da Terra - PROTER, Public Prosecutor's Office of the State of Bahia, Rio de Janeiro State Company of Water and Wastewater, Sao Paulo Agency for Agrobusiness Technology, Society for Wildlife Research and Environmental Education, Socio-environmental Institute, SOS Mata Atlantica Foundation, State Environment and Water Resources Institute of Espirito Santo, State Environment Institute of Rio de Janeiro, State Forest Institute of Minas Gerais, State Forest Institute of Sao Paulo, Suzano, Taki Ambiental, TerceiraVia Association, Terra Institute, Terra Institute for Environmental Preservation, The Nature Conservancy, Vale S/A, Veracel Celulose, Viveiro Bio Flora and WWF-Brazil.

CONTENTS

This document is a product of the Technical-Scientific and Restoration Economy Work Groups established via the Atlantic Forest Restoration Pact.

Technical-Scientific Work Group:
Ricardo Ribeiro Rodrigues (coordinator), Aurélio Padovezi, Fabiano Turini Farah, Letícia Couto Garcia, Lucas Dias Sanglade, Pedro Henrique Santin Brancalion, Rafael Barreiro Chaves, Ricardo Augusto Gorne Viani, Tiago Egydio Barreto.

Restoration Economy Work Group:
Bernardo Strassburg, Carlos Alberto de Mattos Scaramuzza.

Document Coordinator:
Ricardo Augusto Gorne Viani (UFSCar-CCA/Araras)

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Introduction

Ecological restoration is the process of assisting the recovery of a degraded, damaged or destroyed ecosystem (Society for Ecological Restoration International Science & Policy Work Group 2004). If taking a contemporary more wide-ranging perspective, ecological restoration encompasses not only ecological processes, which deal with the recovery of biodiversity in ecosystems, but also the socioeconomic aspects related to restoration (Nair & Rutt 2009, Calmon et al. 2011). Furthermore, in view of the importance to project success of effective management at each step of the restoration process, as well as the pressing need to replicate successes, it is imperative that restoration programs make use of the various pre-existing project management tools when both planning and conducting restoration activities.

These three dimensions of restoration: ecological, socioeconomic and project management, are fundamentally related to each other and can be viewed as a triangle with the Ecological Dimension on the uppermost point (Figure 1). Viewed from this perspective, any activities concerning a particular dimension will have a direct or indirect influence on the others, and consequently upon the entire restoration process. In addition, whilst the primary goal of restoration may be ecological, any successes would be unlikely to sustain themselves without a joint approach that also includes socioeconomic and managerial aspects. Only through tackling these fields in tandem can any successful application of restoration ecology methods and concepts in field projects be consolidated over the longer term.

This Monitoring Protocol sets out the subsequent dimensions, criteria and indicators that should be employed when monitoring forest restoration programs and projects registered under the Atlantic Forest Restoration Pact. It seeks to provide a detailed reference regarding how these aspects should be checked, measured or qualitatively evaluated throughout the course of these programs and projects.

1

Introduction

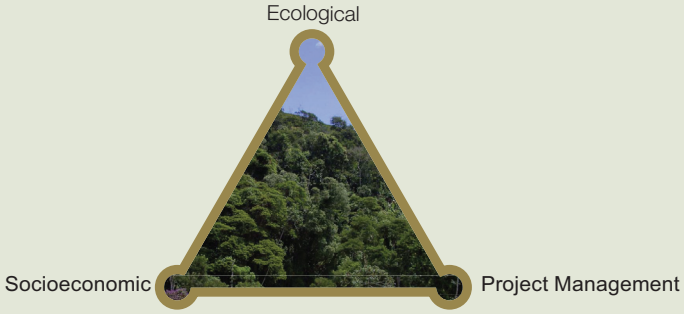

FIGURE 1
Relationships between the three different dimensions of ecological restoration and the integrity of ecosystems. Adapted from Della Sala *et al.* (2003).

Each recommendation included in this protocol was discussed and approved at the "2nd Workshop on the Monitoring Protocol for Restoration Programs and Projects", held in Campinas (São Paulo State) in March 2013. This workshop had the participation of 27 institutions, from several Brazilian States, including government bodies, companies, universities and NGOs, all of whom are signatories to the Pact and are working towards the restoration of the Atlantic Forest.

This Monitoring Protocol will be constantly evaluated and refined over the years via its adoption and regular usage by several Pact members. In view of this, the precepts and directions proposed in this document are considered provisional, and may be modified as further knowledge and experience is gathered concerning their application in the field. In summary, this Monitoring Protocol should be used as a guide that may be applied in part or in whole by the user, dependent upon the ultimate objectives of the monitoring and restoration program being evaluated

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Monitoring protocol structure

The evaluation system of the monitoring protocol is structured hierarchically into the levels of dimensions, criteria, indicators and metrics described below, these being adapted from pre-existing environmental certification protocols. The chart thus provides a coherent and consistent framework to help achieve, at each level mentioned, the desired standard of ecological restoration in the Atlantic Forest.

D DIMENSIONS

A fundamental starting-point. Within the context of ecological restoration, dimensions provide the primary conceptual structure for project monitoring and evaluation. The dimensions correspond directly to the three principles of ecological restoration introduced in **Figure 1**.

C CRITERIA

A means of judging a principle; effectively an evaluation component. A criterion may be understood as a principle of "second order", adding meaning and functionality to a principle without being a direct measure for performance.

I INDICATORS

Indicators are project variables that are used to evaluate the condition of a specific criterion. Indicators must only convey information, and must not be mistaken as conditions with which meet the criteria.

M METRICS

Metrics are methods of verifying, measuring or evaluating an indicator.

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Monitoring protocol structure

To facilitate understanding of this protocol and avoid misinterpretations, a glossary was compiled defining all of the main technical terms used in the text, presented in Annex 1. Words included in the glossary are italicized the first time they appear in the text. To aid data collection, field spreadsheets for each principle were designed and are presented towards the end of this document in Annexes 2-6.

The following sections lay out the principles for ***monitoring*** the three dimensions of ecological restoration, each with their respective criteria, indicators and metrics. It must be emphasized that the criteria and indicators pertaining to the Socioeconomic and the Project Management dimensions are to be evaluated primarily within restoration programs, whilst the monitoring of principles and indicators concerning the Ecological Dimension are to be evaluated in restoration projects.

Restoration programs are defined for the purpose of this Monitoring Protocol as ***"a set of restoration projects that are designed to deliver a central objective, sought either by a single institution or by a set of partner institutions that operate within the same region."*** ***Restoration projects*** are conceived here as being ***"spatial units undergoing ecological restoration"***.

This protocol was developed for usage mainly within the Atlantic Forest, by essence a tropical forest biome. Therefore, all the subsequent evaluations proposed and mentions of the word 'restoration' refer specifically to tropical forest restoration.

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The ecological dimension of forest restoration

Forest restoration must restore ecological processes through use of the regional diversity of native species and ensure the self-sustainability of ecosystems during the restoration process.

3.1. THE IMPORTANCE OF ECOLOGICAL MONITORING FOR FOREST RESTORATION

Monitoring is an essential step in assessing the accomplishments of a restoration process; initially through the evaluation of the methods used, and then via subsequent assessment of whether the restoration site is following a desired ecological pathway. Forest restoration activities would be incomplete without subsequent feedback concerning what had occurred after intervention. Ecological monitoring is thus an essential part of the restoration process. It must be stressed that only monitoring data can provide the ability to assess with precision the need for any corrective actions throughout the restoration process. In other words, areas undergoing restoration may follow quite different ecological trajectories, either following some course of forest succession, or entering various possible stable states from which the site may remain stagnant, regress, or even return to the pre-intervention state of degradation. Monitoring results can therefore provide directives and recommendations regarding any possible ***adaptive management*** solutions that could be adopted to deflect ecosystem development from these pathways, increasing the efficiency of ecological processes in restoration and reducing their costs. Additionally, the monitoring of results permits an empirical assessment of restoration methods, thus enabling managers to define which method would be the most efficient for specific situations, and thus increasing their chances of success in future projects.

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The ecological dimension of forest restoration

3.2. MONITORING PROTOCOLS FOR THE ECOLOGICAL DIMENSION OF FOREST RESTORATION: A HISTORICAL BACKGROUND

Certain indicators are used to assess whether the particular goals of each restoration step are being reached. Simply put, the indicators are frequently rated on vegetation structure, diversity or composition. With the increasing knowledge and experience that came from the practical usage of this monitoring process, both the monitoring protocols and their indicators needed to undergo adjustments.

In the first version of this protocol, monitoring efforts were focused on indicators of vegetation structure, composition and diversity. However, as experience was gained over time, we identified the need to include operational and emergency issues as monitoring indicators of restoration projects, for instance, evaluations to inform decisions about the initial control of competitors, of leaf-cutting ants and of other issues not included in the previous protocol. In this way, important data collected in newly implemented restoration projects, such as the spread of super dominant invasive herbaceous species, the presence of leaf-cutting ants, or the nature of the edaphic conditions need to be periodically monitored. This is necessary so that the ecological trajectory variables, such as ***natural regeneration*** and diversity of species found in the restoration area can be further evaluated and interpreted. The Ecological Dimension of the monitoring protocol was therefore revised, and is now divided into two phases: Phase I being focused on the successful establishment of tree seedlings with the subsequent development of a canopy structure and Phase II being focused on the evaluation of the ecological trajectory (figure 2).

3

The ecological dimension of forest restoration

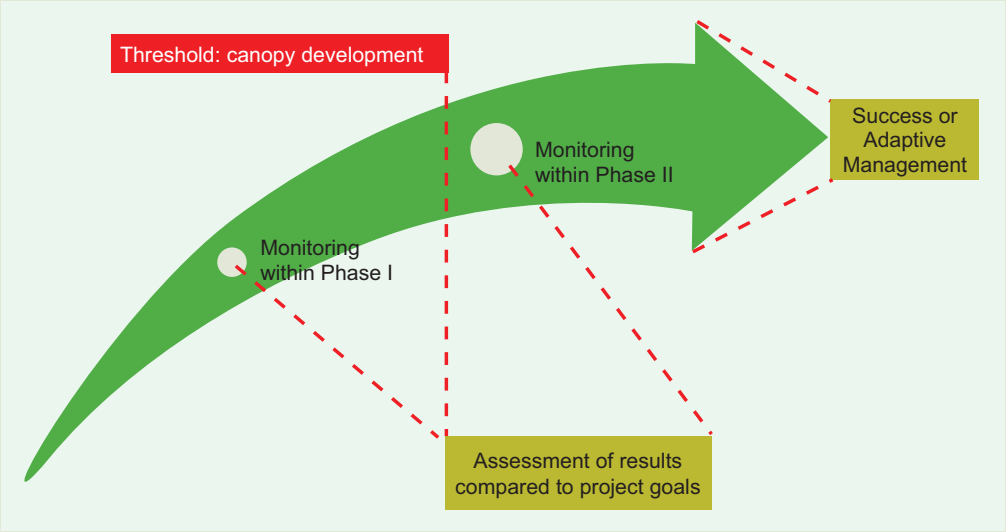

FIGURE 2
Schematic drawing of the Ecological Dimension monitoring phases: a key chronology to follow when implementing the monitoring indicators proposed in this protocol. Monitoring Protocol for Atlantic Forest Restoration projects affiliated to the Pact (2013).

3.3. CRITERIA, INDICATORS AND METRICS OF THE ECOLOGICAL DIMENSION MONITORING

The Ecological Dimension monitoring occurs over two different phases. The Phase I (or Canopy Development) objectives the evaluation of forest cover formation within the restoration site, and Phase II (or Ecological Trajectory Monitoring) has the goal of ensuring that a natural succession is occurring in the restoration zone, thus establishing that forest development is following the desired trajectory.

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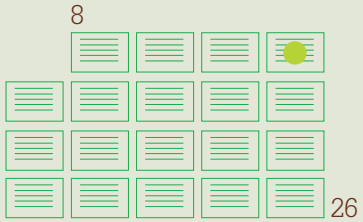
The ecological dimension of forest restoration

The Phase I was developed to assist the project manager in identifying possible filters that might prevent the restoration area reaching a forest cover of **70%**, thus ensuring proper canopy development. In this scenario, canopy cover is the primary indicator that needs to be assessed. In relation to restoration planting, for instance, canopy development depends on the presence, ***density*** and spatial distribution of tree species that show both good growth and ground cover capabilities in the short term. It is thus important to assess whether the restoration planting contains species with good canopy development and whether species with such potential are developing properly in the area. In cases where the minimum forest cover is not achieved, the application of this protocol may suggest which barriers (or filters) are preventing the rapid covering of the area and restricting the initial success of the restoration project. Subsequently, it is possible to address the problems found through the adoption of forest restoration operational procedures.

The restoration zone must be monitored in **Phase II** preferably after reaching a canopy cover of **at least 70%**, since at this stage, the monitoring objective is to evaluate the developing forest through indicators that characterize its future ecological trajectory, primarily based on the structure and composition of the regenerating plant community, and thus ensuring the re-establishment of ecological processes in the areas being restored. However, the joint execution of Phases I and II, performed by bringing forward the application of indicators from Phase II, is possible if there is a specific need or interest in making early decisions.
The criteria, indicators and metrics to be evaluated within the Ecological Dimension are presented below (Table 1).



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The ecological dimension of forest restoration

TABLE 1

Criteria (C, Dark Green), Indicators (I, Rose) and Metrics (M, Light Green) for monitoring the Ecological Dimension of Forest Restoration Projects.

C riteria
I ndicators
M etrics

PHASE I - CANOPY STRUCTURE	
ITEM	**DESCRIPTION**
C 1. StructureI	Vertical and horizontal distribution of the plant community undergoing restoration.
I 1.1. Canopy cover[1]	Percentage of land shaded by the canopies of non-invasive tree species.
M 1.1.1. Percentage of transects shaded by the canopies of non-invasive tree species.	Sum of the proportions of sampling transects shaded by the canopies of non-invasive tree species (m) in relation to total length of the transect.
I 1.2. Cover of super dominant and/or invasive herbaceous species	Amount of land covered by super dominant and/or invasive herbaceous species.
M 1.2.1. Percentage of land covered by dominant invasive herbaceous species	Visual estimate of the percentage of land covered by dominant invasive herbaceous species.
C 2. Tree and shrub species composition	Plant species composition in the restoration zone.
I 2.1. Identification of planted native tree species used for shading	Identification of the planted species providing most shade in each plot.
M 2.1.1. Identification of tree species shading the greatest ground area in the restoration project (for projects with direct sowing or planting of seedlings)	Identify and list, by visual observation, tree species that provide the greatest individual shading coverage in the restoration zone – the filling species.
I 2.2. Invasive tree species	Presence of invasive tree species.
M 2.2.1. Composition and density of invasive tree species	List invasive tree species and their densities (plants per hectares, considering plants with height > 50 cm). Consult local State records to identify species as invasive.

[1] Canopy Cover is a compulsory indicator for Phase I. In case of an unsatisfactory result, the other indicators will help to recognize barriers to canopy formation and guide adaptive management actions. Although the method suggested is a direct measure of canopy cover, the use of remote sensing mechanisms for the monitoring of this indicator is welcome if available.

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The ecological dimension of forest restoration

PHASE I - CANOPY STRUCTURE		
	ITEM	DESCRIPTION
C	3. Edaphic	Soil properties within the restoration zone.
I	3.1. Chemical and physical analyses of soil properties:	Soil nutrient availability, organic matter content, pH, heavy metal presence (when needed) and texture (percentage of sand, silt and clay)
M	3.1.1. Chemical and texture analysis of the soil	Collection of soil samples and expedition for laboratory for chemical and texture analysis.
I	3.2. Soil compaction	Degree of soil compaction
M	3.2.1. Soil mechanical resistance to penetration	Verifying the occurrence of compacted layers and/or any mechanical impediment to root development by visual observation or by use of an impact penetrometer.
I	3.3 Soil conservation	Degree and practices of soil conservation
M	3.2.1. Presence of laminar, rill or gully erosion	Visual assessment of the presence of laminar, rill or gully erosion in the restoration area.
M	3.3.2. Absence of good agricultural practices related to soil conservation	Visual assessment of the presence of bare (conventional tillage with turned-over earth) and the absence of cultivation in levels.
I	3.4. Other edaphic filters	Visual evaluation of other soil properties, inherent to the area and not included in the previous indicators that might limit plant growth.
M	3.4.1. Visual assessment of soil limitations for development of forest cover	Visual assessment of the presence of rock outcrops, gravel, waterlogging, etc. in the restoration project area.
C	4. Degradation factors	Presence of degradation factors in the restoration site.
I	4.1. Occurrence of fire	Fire occurrence after the implementation of restoration practices.
M	4.1.1. Visual assessment and verification of recent occurrences of fires	Visual survey and historic record of fires in the area occurring after the implementation of restoration practices.

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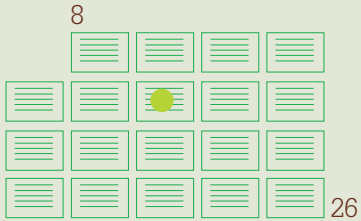
The ecological dimension of forest restoration

PHASE I - CANOPY STRUCTURE	
ITEM	**DESCRIPTION**
I 4.2. Presence of cattle and other domestic animals and isolation of the area from grazing	Evaluation of cattle presence (and other domestic animals) in the restoration area, and of the standard of fencing if applicable.
M 4.2.1. Visual assessment and historical evaluation of the presence of cattle and other animals	Survey of both past and current presence (animal sightings, damaged plants, footprints, feces, etc.) of cattle and other animals (horses, pigs, buffalo, etc.) within the restoration area.
I 4.3. Attack of leaf-cutting ants and other herbivores	Damage caused by leaf-cutting ants and other herbivores to native shrubs and trees within the restoration zone.
M 4.3.1. Visual assessment of damage from leaf-cutting ants and other herbivores	Visual assessment of any damage from leaf-cutting ants and other herbivores (e.g. hare, defoliating caterpillars etc.) to native shrubs and trees within the restoration zone.

PHASE II - ECOLOGICAL TRAJECTORY	
ITEM	**DESCRIPTION**
C 1. StructureI	Vertical and horizontal distribution of the plant community undergoing restoration.
I 1.1. Density of small sized woody plants.	Number of small-sized specimens of non-invasive shrubs and trees per area.
M 1.1.1. Amount of specimens of non-invasive species per area.	Count of non-invasive individuals per area with height (H) ≥ 0.5 m and DBH<15 cm.
I 1.2. Density of large size woody plants.	Number of large size individuals of non-invasive shrubs and trees per area.
M 1.2.1. Amount of woody plants of non-invasive species per area.	Count of individuals of non-invasive individuals per area with DBH ≥ 15 cm.



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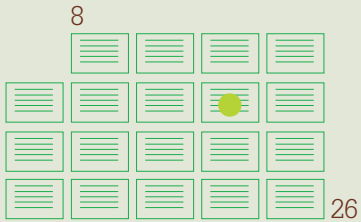
The ecological dimension of forest restoration

PHASE II - ECOLOGICAL TRAJECTORY	
ITEM	**DESCRIPTION**
I 1.3. Basal area	Sum of cross sectional basal areas
M 1.3.1. Sum of the basal areas of non-invasive specimens.	Sum of cross sectional basal areas, obtained via measuring all branches of plants, including at least one branch with CAP ≥ 15 cm.
I 1.4. Canopy cover [2]	Proportion of land shaded by the canopy.
M 1.4.1. Percentage of transect covered by the canopy projection of the planted trees.	Sum of the proportions of transect segments shaded by canopy (m) in relation to total length of the transect.
C 2. Composition of shrub and tree species.	Quantitative and qualitative description of species that compose the plant community undergoing restoration.
I 2.1. Number of non-invasive species per restoration project.	Number of (1) regional and (2) exotic species and morphospecies.
M 2.1.1. Total number of regional species and morphospecies	Count of regional species and morphospecies present in the restoration zone.
M 2.1.2. Total number of exotic species and morphospecies	Count of exotic species and morphospecies present in the restoration zone.
I 2.2. Invasive tree species	Abundance of invasive trees within the restoration zone.
M 2.2.1. Composition and density of invasive tree species	List to be compiled of any invasive tree species present, with their respective densities. Species surveys from the State of origin or a neighboring State must be consulted.

[2] Canopy Cover in Phase II is to be evaluated only if other monitoring indicators within this phase register unsatisfactory results. If the Canopy Cover indicator reveals values that are lower than those recommended as the initial threshold of Phase II, a fresh assessment of the indicators in Phase I is recommended in order to identify core problems and apply adaptive management actions.



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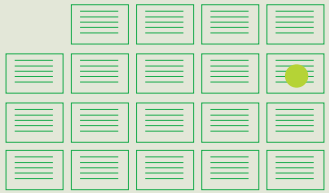
The ecological dimension of forest restoration

3.4. METHOD FOR MONITORING THE ECOLOGICAL DIMENSION

Monitoring of the ecological dimension of forest restoration projects in Phase I should start immediately after the implementation of restoration activity. Monitoring frequency in Phase I will depend on the progress of the plant community in the restoration area and must be carried out until the restoration area achieves a forest cover of at least 70%. This level of cover needs to be achieved in the shortest time possible, promoted through actions that control competitors and by the fertilization of planted or natural regenerating seedlings. Ensuring rapid canopy development does much to reduce restoration costs, since maintenance is the activity that involves both highest costs and highest risk of failure in ecological restoration projects.

Monitoring of the Ecological Dimension in Phase II should start once the restoration area has achieved a forest cover of 70%. The monitoring frequency should be judged by the project manager in accordance with specific restoration monitoring objectives and the relevant management targets set for the region. In each restoration project, the environmental assessment should be carried out in sample plots that vary in number according to the size of the total project area (table 2).



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The ecological dimension of forest restoration

TABLE 2
Number of monitoring plots to be used when evaluating the ecological principle following the Monitoring Protocol for Atlantic Forest restoration projects affiliated to the Pact (2013).

PROJECT AREA (ha) = A	NUMBER OF PLOTS
A ≤ 0,5	Discard project for monitoring purposes
0,5 < A ≤ 1	5
A > 1	5 + (1 per additional hectare)*

*limited to a maximum of 50 plots, regardless of project area.

The project manager should decide if sample plots will be permanent or not, according to the objectives of the restoration project and of the monitoring. It is also possible to establish a mix of permanent and non-permanent plots. When monitoring involves periodic evaluations focused on scientific research or forest carbon surveys, the use of permanent plots is recommended, as well as for projects with funding from banks and official agencies, as this will ensure greater control of the monitored area. Permanent plots should have georeferenced landmarks on their vertices (or at the centre in the case of circular plots), made of either wood stakes, galvanized iron pipes or rigid PvE tubing (¾" or "1") at about 1.2 m height. Additionally, it is important to record in the monitoring report whether there was any allocation of permanent plots and which particular plots these would be.

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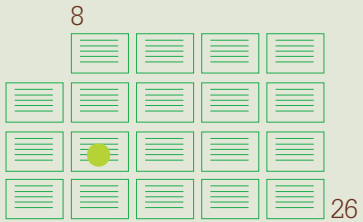
The ecological dimension of forest restoration

The plots must be distributed as randomly as possible in the monitoring area, avoiding unnecessary grouping as much as possible. The distance between plots can be systematic (fixed) according to the number of plots needed for the project and the extent of the area (Table 2). However, it is necessary to pick plots randomly with respect to their distance from the edge of the restoration area, so that sampling can encompass a range of zones both near to and far from the border. This randomization process is required since restoration in most cases occurs within narrow riparian areas that are subject to substantial edge effects and the purpose of monitoring is to evaluate the restoration effort within this context.

A sketch should thus be prepared that represents the distribution of field plots for every project. Each plot should have its location coordinates and orientation within the field properly obtained with a GPS device. The coordinates of each plot, whether permanent or not, need to be recorded in **UTM** format along with the **datum** used (e.g. SAD69, SIRGAS2000 etc.).

Each plot should encompass a fixed area of 100 m^2, the shape being either rectangular (a 25 m x 4 m design outlined by tape - Figure 3a) or circular (diameter 11.3 m). For rectangular plots, the length should be oriented towards a standardized position, **which must not** be in the same direction as any planting or seeding rows (if they exist). It is recommended that the plots be allocated facing magnetic north, established through either magnetic compass or GPS.



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The ecological dimension of forest restoration

Establishing plots of circular shape helps to reduce the over or underestimation of specimens and other parameters, as the plots are not aligned in parallel to any eventual plantation rows. This point however rests on an assumption that the plot locations be sufficiently randomized in relation to the edge of the restoration area. First, the distance of the plot center from the border of the restoration area should be selected randomly. In this case, the use of a compass to guide the direction of measurement from the edge is optional. Upon reaching the set distance, the outline of the circular plot (of 100 m²) should then be outlined by tape, based upon a radius of 5.64 m (Figure 3b).

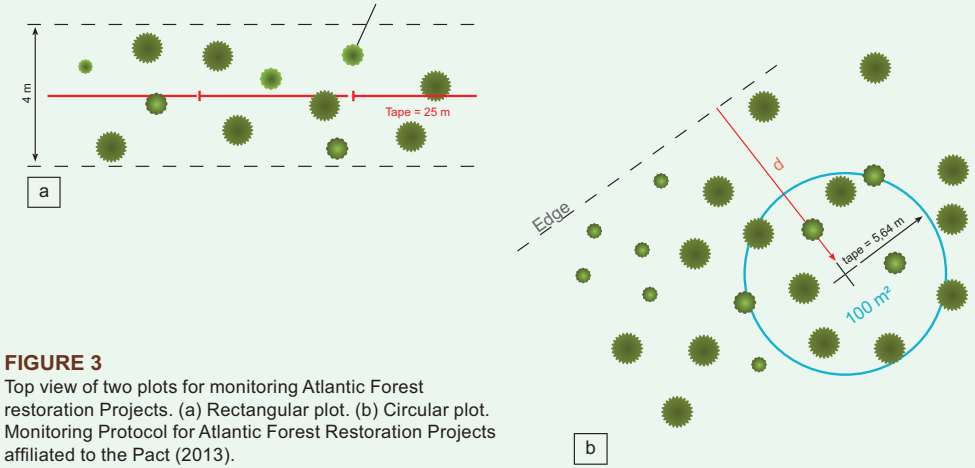

FIGURE 3
Top view of two plots for monitoring Atlantic Forest restoration Projects. (a) Rectangular plot. (b) Circular plot. Monitoring Protocol for Atlantic Forest Restoration Projects affiliated to the Pact (2013).

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The ecological dimension of forest restoration

PHASE I

In Phase I, the monitoring plots are used to evaluate the forest cover by shrub and tree species (indicator 1.1). These plots should preferably be rectangular. Accordingly, the forest cover will be estimated based on the percentage of the outlining tape covered by the canopy of non-invasive tree species (figure 4). Concerning measurements of canopy land cover and species composition (indicator 2.1), visual observation and recording of the species with the greatest canopy projection must be made throughout the entire restoration project and not only within plots.

This observation can be made concurrently with the evaluation of other indicators in the same plot, possible simply via a walk across the restoration project area. The lists of species with the greatest canopy coverage must contain 5-10 species per project, arranged in descending order of individual tree canopy size. At the evaluator's discretion, field measurements of canopy size can be made on species with greater canopies, thereby generating quantitative data with the aim of evaluating the best regional species for providing canopy coverage.

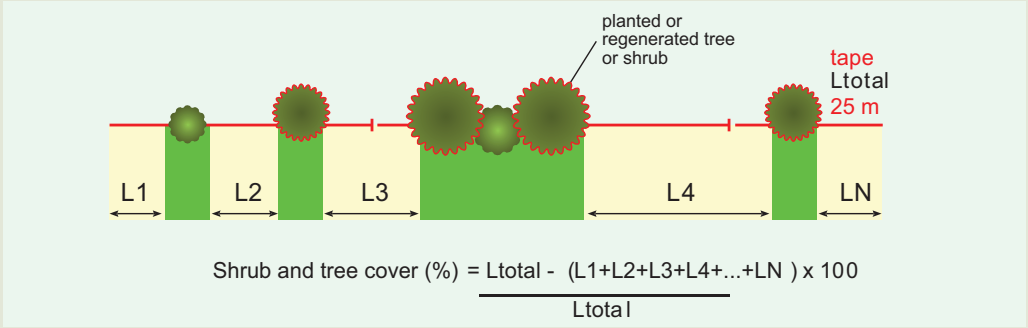

FIGURE 4
Scheme for estimating canopy cover in rectangular monitoring plots. Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact (2013).

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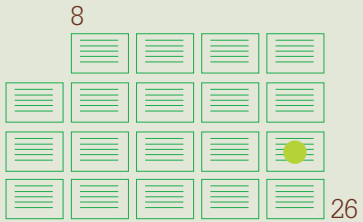
The ecological dimension of forest restoration



Also in Phase I, all individuals of invasive tree species with height ⩾ 50 cm within each plot must be accounted for and identified taxonomically. Invasive tree species of a specific region are determined as those which appear on officially published lists; either the State or region where the project is located or from the nearest region. A high density of invasive trees would signal the urgent need for corrective actions to eliminate these species from areas under restoration. At this stage (Phase I) there is no evaluation indicator for regional tree species; however, this survey could be carried out optionally in accordance with the procedure described in Phase II (accounting for regional species richness). Moreover, although the area covered by non-invasive (native plus exotic trees) tree species is considered in Phase I, it is essential that restoration projects should prioritize the coverage of the area with native species from the region.

The other indicators of Phase I are estimated in each plot or in the project area as a whole, visually or through specific techniques. These indicators are optional, and do not need to be applied necessarily. However, in cases where the area has not reached the expected forest cover for Phase I (at least 70%), it is important to evaluate all indicators in order to diagnose possible operational failures in the implementation and management of the area during the forest restoration process.

The coverage of project area by dominant, invasive herbaceous species (indicator 1.3) is evaluated and categorized visually. There are three possible categories: **free area**, where the coverage is between 0-15%; **area with medium infestation**, where coverage is between 15-50%; and **area with high infestation**, where the coverage by these herbaceous species exceeds 50%. These values may be obtained for each individual monitoring plot, but the important task is to provide a single representative value for the entire restoration project. The key purpose of this indicator is to generate information that can be relied upon when assessing the need for controlling these competitors.

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The ecological dimension of forest restoration

Soil chemical and physical characteristics (indicator 3.1.) must be evaluated through the analysis of soil samples sent to specialized laboratories. The standard recommended procedures for the collection of soil samples (see http://www.agencia.cnptia.embrapa.br/Repositorio/coleta_amostras_solo_000fhtbvqw702wyiv80v17a09ztd08zh.pdf) and the properties to be measured (macronutrients content, pH, soil organic material, cation exchange capacity, base saturation, soil texture and eventually micronutrients) are those commonly used for soil analysis for crop production. The collection of soil samples is not necessary within all plots, although it is necessary to obtain a significant amount of samples to monitor the project accurately. Soil samples obtained from the plots may compose a single representative sample of the restoration project, except in cases where numerous distinct characteristics of soil texture, colour, moisture, etc. have been previously identified within the boundaries of a restoration zone. In these cases, the recommendation is to separate the samples for each soil type identified. Any interpretation of soil analysis data should be made whilst taking into account the peculiarities of vegetation and soil formation in the region.

Soil compaction (indicator 3.2) is to be evaluated through the visual observation of compacted soil layers, poor development of vegetation covering the soil, or where possible through an impact penetrometer. These observations should be made within each sampling plot or within a randomly selected proportion of the plots. When utilizing an impact penetrometer, the value of 2.5 MPa (25 kgf/cm^2) should serve as a reference level, above which the root development of many tree species would be harmed. However, regional peculiarities in soil and vegetation formation must also be considered when interpretation soil compaction data. It is worth noting that soil compaction is a major barrier to successful plant growth in areas undergoing restoration. Thus, the evaluation of compaction is important, and where compaction is diagnosed corrective actions of decompaction (via the usage of tiller implements, sub-soil disking, etc.) are highly recommended.

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The ecological dimension of forest restoration

Soil conservation (indicator 3.3) and the indicators pertaining to Degradation Factors (Criterion 4) are qualitative indicators that must be assessed visually, not just within the monitoring plots but throughout the whole restoration area. Photographic and written records are recommended. These should describe any problems that were diagnosed during the monitoring of the restoration process. All data collected in Phase I must be recorded within a specifically designed worksheet (Annex 1).

PHASE II

In phase II, all planted/seeded or regenerating trees within the monitoring plots (that meet the specifications below) are to be recorded. Regenerating trees are defined as those originating from natural regeneration (i.e. not planted or sown by the restoration practitioner) with a minimum 0.5 m height. Individuals are then further categorized into two size classes defined by trunk diameter at breast height (DBH): (1) DBH < 15 cm with height (H) $\geqslant$ 0.5 m and (2) DBH $\geqslant$ 15 cm, with no need to measure specimen height. If practical, an additional recommendation is to subdivide the trees assigned to class 1 into sub-classes (e.g. 1A: 0.5 to 1.5 m and 1B: > 1.5 m). These additional data are useful to gauge more accurately information on the natural regeneration of the restoration area. When a clear distinction is possible between planted/seeded and regenerating specimens, each specimen will be assigned to one of these two categories. A measured plant is probably a regenerating tree when 1 - located outside the planting row (in sites sown or planted in rows); 2 – there is a clearly different size, either bigger or smaller when compared to the trees that were obviously planted; 3 – belongs to a species that does not appear in the list of species planted or seeded. Concurrently, stem girth values should be collected via measuring tape for any specimens with DBH $\geqslant$ 15 cm. For any specimens with a bifurcated stem below 1.3 m tall, DBH measurements should be taken from all branches above 1.3 m (provided that at least one of them has DBH $\geqslant$ 15 cm). Specimens which do not meet this criterion do not need to have their DBH measured.

3

The ecological dimension of forest restoration

All specimens recorded during the above process must be identified taxonomically or at least categorized into morphospecies. It is recommended that for each new sampled species, a botanical sample (branch up to 30 cm in length, if possible with flowers or fruits) is collected using pruning shears, and preserved by drying immediately after returning from the field, allowing for subsequent botanical identification. Specimens belonging to invasive species must be identified and accounted for in a similar manner to that described in Phase I.

If the restoration area does not show any improvement or if monitoring data reveal that forest cover is below or close to the minimum level established for Phase I (70%), it is recommended that forest cover and the other indicators described for Phase I be re-evaluated. This should be repeated in Phase II as well, in order to diagnose potential problems and identify corrective actions for the restoration project.

Data collected in the field should be recorded on prepared spreadsheets, following the worksheets proposed in Annexes 2 and 3. Worksheet 1 contains information on the predominant land use that surrounds the restoration site (e.g. grazing, agriculture or forestry plantation, crop type) and on the dominant vegetation in the surrounding area (forest, scrub, grasslands), plus its location in the landscape (hilltop, hillside or slope). Any positive changes in and around the area resulting from the restoration work should also be noted. For instance, any newly colonizing native non-tree species (epiphytes, lianas, shrubs, herbs etc.), any native trees in the reproductive stage, healthy plant growth, and any signs of native wildlife using the area (sightings, footprints, faeces).

In addition to the indicators presented in Worksheet 2, the estimated distance of the sampling plot to the nearest remaining forest fragment should be measured and also recorded in the worksheet. Such an estimate is calculated more precisely in the office, with the aid of GIS software and satellite imaging, and can be performed either before or after monitoring in the field.

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The ecological dimension of forest restoration

DATA ANALYSIS

Whilst analysing the data collected in Phase I and II, any collected unidentified species must be identified by consulting regional herbariums and/or by use of specialized publications. To facilitate identification, partnerships with regional Universities or Research Centres are highly encouraged. If possible, the reference material should be stored for comparison between specific monitoring stages, in order to maintain consistency in taxonomic identification and avoid the underestimation or overestimation of species richness.

In Phase I, the average forest cover in percentage (%) of each sample plot must be calculated. In Phase II, the DBH measure of each trunk must be converted to a cross-sectional area of the stem and, allowing the specimen basal area to be calculated. The following values are then to be counted and categorized for each monitoring plot:

(a) tree basal area; then summed to establish total basal area within the monitoring plot (m2 ha-1);
(b) total number of trees; then calculation of total density (ind ha-1)
(c) number of trees of (H) $\geqslant$ 0.5 m and DBH < 15 cm; then calculation of their density (ind ha-1)
(d) number of trees of (H) $\geqslant$ 0.5 m with DBH $\geqslant$ 15 cm; then calculation of density (ind ha-1)

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The ecological dimension of forest restoration

The above formulae should be then separated and analyzed for both (1) native and (2) exotic species. After collection of the data from the monitoring plots, the average values of quantitative parameters for each plot should then be combined to establish the averages for the entire ecological restoration project. For qualitative parameters, a brief description summarizing the results of the monitoring must be written for each project, with the aim of diagnosing any problems encountered and informing the definition of any corrective actions.

In order to determine the origin of a species (important for determining project species richness), one must observe the natural occurrence of these species in regional vegetation types. A suitable bibliography must be consulted, and properly quoted in the report, on the occurrence of the relevant plant species within the remnant vegetation of the region. Based on the list of species sampled in the plots, the project must also be evaluated for presence/absence of invasive planted or regenerating shrub and tree species (according to official lists of invasive).

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The socioeconomic dimension of forest restoration

Payment for environmental services, timber and non-timber forest products, favours both the success and the consolidation of ecological restoration initiatives, generating employment and revenue whilst also achieving competitive advantages in the marketplace related to environmental certification. Moreover, forest restoration activities typically maintain or enhance the socioeconomic well-being of other **stakeholders of the program**. Stakeholders in the program are defined here as all direct and indirect collaborators, and communities involved or interested in the program. The criteria, indicators and metrics of the Socioeconomic Dimension are presented as follows (table 3).

TABLE 3

Criteria (C, Dark Green), Indicators (I, Rose) and Metrics (M, Light Green) for monitoring the Socioeconomic Dimension of Forest Restoration.

Criteria
Indicators
Metrics

	ITEM	DESCRIPTION
C	1.Work and/or income from implementation/maintenance of areas under restoration process	Number of jobs and level of investment in the restoration program
I	1.1. Generation of jobs	Jobs directly generated by restoration activities
M	1.1.1. Number of jobs and type of labor (permanent or temporary/local or family)	Detailed list of all project workers (permanent or temporary/local or family).
I	1.2. Level of investment in the program	Total program funds directly invested into restoration activities (including program management).
M	1.2.1. Total program investment in restoration activities	Detailed record of entire program budget

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The socioeconomic dimension of forest restoration

TABLE 3 (CONTINUATION)

C riteria
I ndicators
M etrics

ITEM	DESCRIPTION
M 1.2.2. Investment in services by the program	Detailed budget and costs incurred by any legal entities or physical persons providing external services (including lease and/or loan of machines and outsourced labor)
M 1.2.3. Investment in supplies by the program	Detailed budget and expenses for material supplies (fertilizer, fuel, seedlings, posts, wire etc.)
M 1.2.4. Investment in labor by the program or project (via direct contract)	Detailed cost breakdown of labor in restoration activities
M 1.2.5. Acquisition by the program or project of tools, machinery and other physical implements	Detailed cost breakdown of depreciation, acquisition and maintenance of any machinery and accessories
M 1.2.6. Payment of taxes by the program	Detailed cost breakdown of taxes and fees
M 1.2.7. Program management expenses	Detailed cost breakdown for program management (office rent, water, electricity, telephone, coordination team etc.)
C 2. Revenues and financial incentives associated with restoration	Any income received during forest restoration activities for ecological goods and services of benefit to society
I 2.1. Payment of environmental services (PES) to the landowner	PES to the landowner related to water and/or biodiversity conservation, carbon sequestration, land use change, etc.
M 2.1.1. Detailed technical project aimed at the PES	Verification of the existence of such a technical project aimed at PES

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The socioeconomic dimension of forest restoration

TABLE 3 (CONTINUATION)

	ITEM	DESCRIPTION
M	2.1.2. Restoration program certified by independent entity	Verification of the existence of a certificate
M	2.1.3. Amount of resources received via PES	Detailed records of any income received through PES contracts
M	2.1.4. Payment source of PES	Detailed list of PES payers (government, private enterprise, market etc.).
M	2.1.5. Carbon credits generated (exclusive to carbon PES)	Detailed records of any carbon credits received
I	2.2. Tax incentives for the restoration program	Tax exemption or any other forms of tax incentives directly related to the restoration process
M	2.2.1. Tax incentives related to the area under ecological restoration	Detailed records of any tax exemptions applicable to the area under restoration.
I	2.3. Income associated with legal reserve compensation (according to mechanisms established by the Brazilian Forest Code)	The program or part of it will compensate the Legal Reserve (the amount of forest cover mandatory for each rural property according the Brazilian Forest Code) deficit on any third party land
M	2.3.1. Income earned via trading up restoration areas for Legal Reserve Compensation	Record of any income earned and proof of the existence of a Legal Reserve Compensation agreement.
I	2.4. Commercialization of timber forest products	Record of any income generated by the selling of timber.
M	2.4.1. Existence of a timber-producing forest project, plus approval by the relevant environmental entity	Verification of the existence of commercial project.
M	2.4.2. Income generated via commercialization of timber products	Breakdown of commercialized goods and any profits involved, plus records of the sales contracts.

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The socioeconomic dimension of forest restoration

TABLE 3 (CONTINUATION)

	ITEM	DESCRIPTION
I	2.5. Commercialization of agroforestry systems (AFS) and non-timber forest products	Income generated through the selling of non-timber forest products from areas under restoration.
M	2.5.1. Personal harvests of AFS and non-timber forest products in areas under restoration (for household consumption)	Overview of any activities involving the non-commercial exploitation of non-timber forest products (seeds, honey, extracts, leaves, fruits, etc.).
M	2.5.2. Commercial projects for the exploitation of AFS and non-timber forest products in the area under restoration process	Verification of a business plan for non-timber products.
M	2.5.3. Amount generated via commercialization of AFS and non-timber forest products	Accounting of any income generated through the selling of non-timber products.
C	3. Source of resources for restorationl	Financial donors/methods by which the implementation costs of restoration are being covered.
I	3.1. Origin of resources invested in the restoration project	Report concerning the financial resources that cover the implementation and maintenance costs of the restoration project.
M	3.1.1. Origin of resources invested	Report concerning the origin and amount of financial resources invested in the project.
C	4. Job opportunities, training and other services to local communities	Communities adjacent to the areas of forest restoration should be offered job opportunities, training and additional services
I	4.1. Hiring of labor	Criteria used for hiring labor

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The socioeconomic dimension of forest restoration

TABLE 3 (CONTINUATION)

	ITEM	DESCRIPTION
M	4.1.1. Percentage of local labor hired	Report on the source of local labor hired, with detailed lists and evaluation of workers
M	4.1.2. List of workers noting the age of trainees, including of their activities and school attendance	Detailed list of workers and their respective ages. Report on the presence of underage trainees, and if so, gather proof of school attendance
I	4.2. Income generation for local economy	Identification of any economic impact on the local economy
M	4.2.1. Percentage of total investment in the region where program is being implemented	Report which fraction of the total investment in the program (item 1.2.1) was spent in the region (municipality) where the project was implemented
C	5. Well-being of workers in forest restoration	Review of sanitary, environmental and working conditions that ensure the health and well-being of workers
I	5.1. Securing benefits to worker health	Compliance with existing legislative requirements ensuring that employees have access to healthcare
M	5.1.1. Existence of first aid equipment in the workplace	Verifying the presence and quality of up-to-date first aid equipment in the workplace
I	5.2. Responsibility for ensuring compliance with the appropriate sanitary and environmental conditions	Responsibility of the program manager to comply with the existing requirements in the current legislation, so that the employee is able to operate in appropriate sanitation and environmental conditions.
M	5.2.1. Quality and quantity of food and water for workers in the field being restored	Evaluation of the quality of food and water available to field workers.

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The socioeconomic dimension of forest restoration

TABLE 3 (CONTINUATION)

	ITEM	DESCRIPTION
C	6. Ensure appropriate work safety conditions	Any implementation of restoration activities should be designed as to not pose risks to the workers involved
I	6.1. Availability of personal protective equipment (PPE) for workers	Program management to comply with the existing requirements under the current legislation, making sure that the employees are able to operate in appropriate work safety conditions
M	6.1.1. PPE provided to employees free of charge when the activity so requires	Confirming the existence of appropriate PPE, assigned to employees at no charge
C	7. Relationship of the program with the surrounding community	Evaluation of positive and negative impacts of the restoration program on the surrounding community
I	7.1. Participation of communities and local stakeholders involved in program planning	Confirmation that communities and local stakeholders have a place where they can participate in program planning
M	7.1.1. Meetings with the local community and stakeholders	Verification and evaluation of meetings and meeting minutes
I	7.2. Environmental education actions	Actions aimed at raising awareness within local society about the benefits and importance of forest conservation
M	7.2.1. Implementation of environmental education actions	Evaluation of proposals for environmental education

A detailed version of the monitoring principles pertaining to the Socioeconomic Dimension is available (in Portuguese) on the website of the Atlantic Forest Restoration Pact.

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The socioeconomic dimension of forest restoration

4.1. METHOD FOR MONITORING THE SOCIOECONOMIC DIMENSION OF FOREST RESTORATION PROGRAMS

4.1.1. SAMPLING FRAME

The universe for the assessment of the Socioeconomic Dimension are “restoration programs” that are defined, for the purpose of this Protocol, as “a set of restoration projects with the same goal, proposed by an institution or a set of partner institutions in a particular region”. From this perspective, the survey of data should not limit itself to isolated occurrences unless, of course, they are highly relevant. The description of metrics therefore should not be limited to isolated occurrences in the restoration projects, and should consider all the occurrences in these projects, and in the program as a whole.

4.1.2. DATA COLLECTION

Methodological procedures for data collection of metrics of the Socioeconomic Dimension are: semi-structured interviews, participant observation and document analysis (Haguette, 2001). A semi-structured interview is a technical procedure that is developed from a basic script. Its striking feature is the great flexibility that conducting a conversation with the interviewee offers, avoiding the enforcement of a strict order in posing questions (Haguette, 2001). Though aiming to extract as much information as possible from the interviews, to ensure consistency the information gathered for measuring assessments should conform to the script presented in annexes 4-6, as this helps direct the conversation towards the topics

4

The socioeconomic dimension of forest restoration

Participant observation is a recognized process in which the observer participates in a social situation for research purposes, in order to both better interpret qualitative information and facilitate its evaluation. Participant observation is an important complement to interviews, since the technique incorporates attitude, behaviour and decision parameters, which allow for a much better understanding of the conversation and attitude.

Document analysis consists of gathering, analysing and extracting information from official documents such as contracts, letters, records and projects, reports, budgets and financial documents.

Data must be collected in relation to the metrics defined in the Socioeconomic Dimension tables **(Table 4)**. For each metric there is a corresponding text description that aims to clarify which data should be collected and how. Each text description proposes three different actions **a)** Verification; **b)** Survey and Record; **c)** Evaluation. The table below shows the relationship between these proposed actions and the recommended methodologies for their usage.

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The socioeconomic dimension of forest restoration

TABLE 4
Actions required, data type to be recorded, and method for data collecting for monitoring the Socioeconomic Dimension of restoration projects.

Action required	Type of data to be stored	Recommended methods for data collection
Verification	Yes or no	1. Semi-structured interview; 2. Document analysis; 3. Participant observation.
Survey and Record	Yes or no Quantitative: numerical data, values, lists and records	1. Document analysis; 2. Semi-structured interview.
Evaluation	Yes or no Qualitative: information, conclusions and observations	1. Participant observation; 2. Semi-structured interview; 3. Document analysis.

4.1.3. DATA ANALYSIS

Qualitative and quantitative methods do not exclude each other. Although differing in form and importance, these methods are complementary in the interpretation of data and in the composition of information. Qualitative methods contribute a variety of rational and intuitive procedures that can provide a better understanding of the phenomenon studied (Pope & Mays, 1995). Jick (1979) labelled this combination of quantitative and qualitative methods “triangulation”; a process which this protocol seeks to utilize in the evaluation of metrics.
Triangulation can establish links between findings obtained from different sources, illustrate these links clearly, and render them more comprehensible. Ideally, the analysis should be triangulated via different sources and survey methods. This form of analysis is possible only through a systematically unified undertaking of semi-structured interviews, participant observation and document analysis. The Socioeconomic Dimension needs to be periodically applied in forest restoration programs. The suggestion is to evaluate forest restoration programs each three years. However, this frequency is better defined by the program manager based on program resources and time availability as well as on the necessity of management information.

5

The management dimension of forest restoration programs

The goal of the Management Dimension in forest restoration programs are to ensure proper planning, evaluation, control and documentation, enabling proper implementation of each restoration project and preserving a collective memory of successes and difficulties. Included in this historical data must be information on historical land use within the restoration zone, the particular restoration methods applied, photographic records, spreadsheets of financial information and any other information that can assist in understanding possible causes of success or failure in restoration initiatives. Applying these principles to the Management Dimension is an important tool not only for aiding program management more generally, but also for the advancing technical knowledge on forest restoration in the Atlantic Forest. Via the survey of multiple program records, these principles allow for the replication of successful initiatives, whilst eliminating or revaluating practices that repeatedly generated unsatisfactory results. For managers, these principles can also help identify any implementation gaps in the various activities and stages that comprise a successful restoration program. The criteria, indicators and metrics of the Management Dimension are presented as follows (table 5).

TABLE 5

Criteria (C, Dark Green), Indicators (I, Rose) and Metrics (M, Light Green) for monitoring the Management Dimension of Fc rest Restoration.

Criteria
Indicators
Metrics

ITEM	DESCRIPTION
C 1. Planning and documenting program execution	Data must be collected during program implementation and the results obtained recorded
I 1.1. A restoration program with analyzed and planned activities	Program must hold information relevant to the planning and implementation of the various restoration stages
M 1.1.1. Socioenvironmental diagnosis of restoration areas	Confirmation that a diagnosis was made of the restoration areas which must at a minimum contain: socioeconomic survey, land use and land cover history, environmental characterization of the area

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The management dimension of forest restoration programs

TABLE 5 (CONTINUATION)

Criteria (C, Dark Green), Indicators (I, Rose) and Metrics (M, Light Green) for monitoring the Management Dimension of Forest Restoration.

Criteria
Indicators
Metrics

ITEM	DESCRIPTION
M 1.1.2. Mapping of areas undergoing restoration and their environmental characteristics	Confirmation that digital records exist with defined, georeferenced polygons of the restoration zones, also containing information about land use
M 1.1.3. List of native tree species recommended for the restoration program	Listing of the regional native tree species present within the reference ecosystem, compiled either by direct survey or via second party data on the regional vegetation
M 1.1.4. Methodological protocol informing the decision-making process regarding choice of the most appropriate restoration technique	Confirmation of the methodological protocol followed when choosing the restoration technique appropriate to the particular environmental situation.
M 1.1.5. Program budget	Compilation of a budget itemizing the different restoration program activities
M 1.1.6. Program implementation schedule	Confirmation of the existence of a program implementation schedule
M 1.1.7. Study concerning the economic viability of the program (applicable only in cases where there are expectations of any commercial activity generated through restoration practices)	Confirmation that such an analysis on th e economic feasibility of the program was undertaken
I 1.2. Records of the restoration program	Documentation of each and every step of the restoration activities Recording of the date when each intervention was performed (initial planting, invasive species control, application of fertilizer, monitoring etc.)
M 1.2.1. Record of program interventions	
M 1.2.2. List of plant species used	Listing of any plant species used in the restoration process (with number of seedlings/seeds per species and species richness)
M 1.2.3. Propagules source for restoration: natural regeneration, seedlings, seeds, topsoil, brushwood, etc.	Records of propagule origin in the restoration process

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The management dimension of forest restoration programs

TABLE 5 (CONTINUATION)

	ITEM	DESCRIPTION
M	1.2.4. Audiovisual records	Audiovisual records (photos and/or videos) of the restoration zone taken at different points in the restoration process
M	1.2.5. Accounting of costs	Records of the expenses incurred at each stage of the project, preferably within digital spreadsheets.
M	1.2.6. Productivity control	Records concerning the operational performance of the various activities undertaken throughout the restoration process
C	2. Formalized partnership with the rural property owner concerning the execution of forest restoration activities (only in cases where the owner is not directly responsible for program execution)	Documentation verifying the agreement by the rural property owner to participate in the restoration program
I	2.1. Partnership agreement with the property owner	Mutual understanding between the restoration delivery team (practitioners) and the rural property owner
M	2.1.1. Duration of the commitment to deliver the restoration project between the property owner and the program manager	Documentation verifying the time-span of the agreement with the landowner
M	2.1.2. Document confirming the ownership of the restoration zone by the owner mentioned in the above agreements	Confirmation of a valid document proving ownership of the restoration zone by the owner mentioned above
C	3. Technical ability of the restoration practitioners	Verification that practitioners with the technical ability to deliver the forest restoration project is in place
I	3.1. Qualified technical manager	Any relevant qualifications held by technical manager of the restoration project

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The management dimension of forest restoration programs

TABLE 5 (CONTINUATION)

	ITEM	DESCRIPTION
M	3.1.1. Professional qualification of the technician responsible for the program activities	Verification of any relevant professional qualifications held by the technician responsible for program execution
I	3.2. Qualified technical team	Technical team in place capable of delivering the planned activates
M	3.2.1. Professional experience of the restoration delivery team	Assessment of the professional experience and abilities of the restoration delivery team (previous work record and participation in training/courses) concerning the particular activities implemented or planned for the program
C	4. Existence of an adequate monitoring system	System in place to adequately monitor the actions and subsequent results of the restoration program
I	4.1. Existence of a monitoring follow-up protocol	Existence of a protocol to factor monitoring data into future management decisions
M	4.1.1. Existence of a protocol to act upon monitoring data	Existence of a protocol to act upon monitoring data arising from the restoration process
M	4.1.2. Application of the monitoring follow-up protocol	Verification that specific measures to implement the follow-up protocol took place within the areas under restoration
C	5. Clear and free communication among the actors involved in the program	Consistent, professional dialogue between the actors involved in delivering the forest restoration program
I	5.1. Clear flow of internal information between management and the practitioners	Consistent, professional communication between management and the practitioners
M	5.1.1. Clear communication of recommendations from management to practitioners	Records or accounts of the nature, quality and clarity of communication between management and practitioners

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The management dimension of forest restoration programs

TABLE 5 (CONTINUATION)

ITEM	DESCRIPTION
M 5.1.2. Clear communication between management and practitioners surrounding any difficulties encountered by the restoration program	Records or accounts of the nature, quality and clarity of communication between management and practitioners concerning difficulties faced by the program Clear, explanatory communication of program aims and progress with any other social actors interested
I 5.2. Flow of external information	
M 5.2.1. Communications with the surrounding community	Records of meetings, mobilization of local support/activities, or dissemination of program material amongst the surrounding community
M 5.2.2. Scientific communication	Records of any relevant publications in scientific journals, or use of the restoration program any wider scientific events Records of any promotion of the program via mass communication
M 5.2.3. Communication with the media	Records of any communication with Pact members or technical teams
M 5.2.4. Communication with the Pact	Records of any improvements upon existing forest restoration practices
C 6. Promotion of technological and methodological innovations in tropical forest restoration	Usage, discovery or establishment of any successful technological or methodological innovations not described within the theoretical framework of the Pact (PDF available at http://www.pactomataatlantica.org.br/pdf/referencial-teorico.pdf)
I 6.1. Technological or methodological innovation in restoration	
M 6.1.1. Existence of technological or methodological innovations	Records of any successful innovations and whether they have been communicated to the Pact in detail or described/disseminated though other means of communication

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The management dimension of forest restoration programs

5.1. METHOD FOR MONITORING THE MANAGEMENT DIMENSION OF FOREST RESTORATION PROGRAMS

The sample size for the assessment of the principles pertaining to the Management Dimension is the “restoration program”; defined for the purpose of this Monitoring Protocol as “a set of restoration projects that are designed to deliver a central objective, sought either by a single institution or by a set of partner institutions that operate within the same region”. The usage of monitoring metrics should therefore not be limited to the specific context of a restoration project, but instead consider the restoration program as a whole. From this perspective, data surveying should not encompass project outliers unless they happen to be highly relevant and expressive of particular phenomena. Outliers may also be incorporated if the purpose of monitoring is to verify precisely the specific conditions of certain restoration projects that make up a larger program.

Data should be collected through the metrics described in Table 5. For each verifier there is a text description that aims to clarify which data should be collected and how. The methodological procedures suggested for data collection in the Management Dimension are: semi-structured interviews, participant observation and document analysis (Haguette, 2001).

A semi-structured interview is a technical procedure developed from a basic script. Its most useful feature is the greater flexibility permitted when conducting conversations with interviewees, avoiding any enforcement of a strict question order (Haguette, 2001). Whilst still aiming to extract the maximum information available from interviews, in order to ensure coherence the information gathered when monitoring the Management Dimension of forest restoration should be tailored towards the spreadsheet available in Appendix 6.

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The management dimension of forest restoration programs

Participant observation is a process in which the observer enters into and participates in a social situation for research purposes. Participant observation typically allows for an improved interpretation of the qualitative information gained in surveys, via permitting a wider-ranging evaluation of the validity of that data. Participant observation is an important complement to standard interviewing, since it incorporates attitudinal, behavioral and decision-based parameters, allowing for a better understanding of the conversation.

Document analysis consists of gathering, analyzing and extracting information from official documents such as contracts, letters, program records, reports, budgets and financial documents. Most indicators pertaining to the monitoring of program management rely on verifiers that require the gathering and analysis of documents and records related to the program, since these would indicate whether or not the tools of project management had actually been applied.

Once the data have been collected with the aid of the worksheet in Annex 6, we suggest the creation of a brief report. This report should summarize the monitoring data regarding particular restoration program evaluated, and contain the most relevant positive and negative points regarding its management. The report should list all management steps that have not yet been performed or which were performed inadequately. Additional information should include any methods established in order to overcome failures or disputes within the current program that could prove applicable to future efforts. The Management Dimension needs to be periodically applied in forest restoration programs. The suggestion is to evaluate forest restoration programs each three years. However, this frequency is better defined by the program manager based on program resources and time availability as well as on the necessity of management information.

6

References

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annexes

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1

Glossary of the terms used in the Ecological Dimension

The following glossary defines certain terms employed in this Protocol, especially those employed within the Ecological Dimension, the definition of which is key when monitoring restored areas.

Adaptive management: any monitoring data obtained will serve to inform ongoing preventative and corrective actions taken at that same location. Adaptive management thus aims to stimulate, when necessary, periodic changes in management protocols and objectives. These would at times lead to active interventions in the ecosystem throughout the course of the restoration process, typically in order to overcome barriers or filters that hinder progress towards the desired goal (adapted from Aronson et al. 2011).

Basal area: the cross-sectional area of a tree at a given height from the ground, here standardized at 1.3 m (breast height). To estimate basal area, the circumference (C) of the stems are measured by a measuring tape, or the diameter (D) by using a caliper. The data are then converted to radius (r) and subsequently to the area (A) via the formulas

$$r=D/2; \qquad r=C/2\pi; \qquad A=\pi r^2$$

As a standardized procedure, only trees with minimal stem circumference $\geqslant$ 15 cm at breast height should be included in the dataset.

DBH: diameter of the stem (trunk) at breast height, standardized at 1.3 m.

Density: number of plants per unit area, expressed in plants per hectare.

Exotic species: species that do not occur naturally in the native vegetation of a specific region, introduced directly or indirectly by humans. Any species native to the Atlantic Forest area that do not occur in the particular native remnant vegetation under monitoring would be included in this category, as well as any non-invasive exotic species introduced from other countries or biomes.

Filling species: specific tree species selected for forest restoration that feature a wide canopy, good soil shading and rapid growth. These species are not equivalent to pioneer species that have rapid growth but do not always promote good soil shading in the short-term. Examples of inappropriate pioneers include embauba (***Cecropia*** spp.) and guapuruvu (***Schizolobium parahyba*** var. ***Parahyba***) that have a narrow and thin canopy.

Forest restoration: the ecological restoration of forest ecosystems.

Height (H): tree height, either measured or estimated. It is measured from ground level to the highest point of the canopy.

annexes

1

Glossary of the terms used in the Ecological Dimension

Invasive species: exotic species anthropogenically introduced into an ecosystem, that have high rates of growth, reproduction and spread (Silva-Mattos & Pivello, 2009). Typically, these non-native species colonize areas with great speed, and are thus difficult to control. They produce a great number of descendants that increase their population, and compete and harm native species (adapted from Aronson et al. 2011). In the case of invasive herbaceous species, major problems arise from the fern ***Pteridium*** spp., the para grass (***Urochloa*** spp.), the molasses grass (***Melinis minutiflora***), the "colonião" guinea grass (***Panicum maximum***), and other African forage grasses. To establish whether or not a species is invasive, official lists of invasive species from the State/region or from the nearest State/region must be consulted. A future project for the Pact is to prepare, with the help of specialists, a list of invasive plant species for each region of the Atlantic Forest.

Monitoring: the regular observation and recording of project or program activities, in order to verify whether the goals are being met within the expected deadlines. Ecological restoration also requires indicators that can verify whether objectives at each step of the restoration process are being met. Monitoring should emphasise the necessity of adaptive management.

Morphospecies: taxonomically unidentified species, differing from other unidentified species based on their morphology. In some situations, the difficulty of identifying some families (e.g. Myrtaceae, Lauraceae, etc.) during their juvenile phases should allow for native species to be identified as morphospecies instead a precise species categorization.

Natural regeneration: a set of processes by which plants colonize and establish themselves in the restoration zone without having been deliberately introduced by human action (adapted from Aronson et al 2011.).

Regional species: species that historically occur within the native vegetation of a specific region, without having been introduced by humans.

Restoration program: a set of restoration projects that are designed to deliver a central objective, sought either by a single institution or by a set of partner institutions that operate within the same region.

Restoration project: a restoration unit with homogeneous characteristics concerning the restoration method adopted, the year of implementation, the regional location and any other environmental characteristics to be defined by the evaluators such as soil type and vegetation characteristics.

Species richness: the amount of species present within a set of project samples. Unidentified specimens can eventually be grouped into morphospecies with similar characteristics.

Super dominant species: native species that behave as invasive due to an environmental imbalance (Silva-Pivello & Mattos, 2009) or abundant invasive species. In the case of dominant herbaceous species, the main examples in areas under restoration are the invasive para grass (***Urochloa*** spp.) and molasses grass (***Melinis minutifolia***), and the native bluestem grass (***Andropogon*** spp.) and satintail grass (***Imperata brasiliensis***). In the future, the Pact will prepare, with the help of specialists, a list of the dominant herbaceous species that can be problematic when restoring Atlantic Forest.

annexes

2

Worksheet template suggested for recording field data during Phase I monitoring of the Ecological Dimension of forest restoration projects.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

General Project Information – Worksheet 1

Region/ Municipality	Forest type	Project implementation data	Restoration technique	Area under restoration (ha)	Causes of degradation	Positive developments
Vale do Paraíba/ Guaratinguetá	Semideciduous Seasonal Forest	01/12/2006 (7 years)	Plantation throughout the entire restoration zone	20	Exotic species, leaf-cutting ants, exposed soil.	Plantation of well-developed seedlings and reproducing plants
Vale do Paraíba/ Guaratinguetá	Semideciduous Seasonal Forest	01/10/2012	Assisted natural regeneration	14	Erosion, fire in areas of the project.	Area containing diverse lifeforms and high levels of natural regeneration. Seeds dispersal into the area by avifauna.

annexes

2

Worksheet template suggested for recording field data during Phase I monitoring of the Ecological Dimension of forest restoration projects.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Plot data – Worksheet 2

Plot	Type	UTM Zone	Coordenates (UTM, SAD69)	Property[1]	Date	Cover of the tape by canopies (m)	Cover by super dominant herbaceous species (%)
1	permanent	23 K	417507 74599 49	Sítio do Pica-Pau	01/06/2013	5	high
2	permanent	23 K	417465 7459891	Sítio do Pica-Pau	01/06/2013	19	low
3	variable	23 K	417345 7459212	Sítio Recanto Feliz	02/06/2013	12	medium

Soil samples collected	Soil compaction (perometer resistance, Mpa)	Soil conservation	Causes of degradation	Other edaphic observation	Picture (nº)	Dominant vegetation and land use in the surrounding area	Distance to forest fragments[2]	Landscape location	Nature of restoration zone border
Yes	2.8	Evident sheet erosion, exposed soil.	Presence of cattle. Fires in part of the area.	-	48 - 49	100% sugar cane	50m	hilltop	Broken fence
No	-	-	-	-	50	Shrub vegetation	< 100m	hillside	Fenced
No	-	-	Severe damage by leaf-cutting ants.	Rock outcrop.	51	Sugar cane and slightly degraded forest fragment	> 100m	lowland	NA

annexes

2

Worksheet template suggested for recording field data during Phase I monitoring of the Ecological Dimension of forest restoration projects.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Survey of the invasive tree species within plots – Worksheet 3

Specimen	Planted (P) or Regenerating (R)	Family[1]	Species[1]	Species code	Picture (nº)	Observations
1	R	Moraceae	*Artocarpus heterophyllus*	101	55	Reproducing (with fruits)
2	P	Fabaceae	*Acacia mangium*	102	56	-
3	Unidentifiable	Fabaceae	*Leucaena leucocephala*	103	57	Reproducing (with flowers and fruits)

NA = Not applicable

[1] This information can be obtained after field data collection.

[2] This information can be obtained either before or after data collection in the field, ideally using GIS and/or satellite images.

annexes

3

Worksheet template suggested for recording field data during Phase II monitoring of the Ecological Dimension of forest restoration projects.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

General Project Information – Worksheet 1

Region/ Municipality	Forest type	Project implementation data	Restoration tecnique	Area under restoration (ha)	Causes of degradation	Positive developments
Vale do Paraíba/ Guaratinguetá	Semideciduous Seasonal Forest	01/12/2006 (7 years)	Plantation throughout the entire restoration zone	20	Exotic species, leaf-cutting ants, exposed soil.	Plantation of well-developed seedlings and reproducing plants
Vale do Paraíba/ Guaratinguetá	Semideciduous Seasonal Forest	01/10/2012	Assisted natural regeneration	14	Erosion, fire in areas of the project.	Area containing diverse lifeforms and high levels of natural regeneration. Seeds dispersal into the area by avifauna.

annexes

3

Worksheet template suggested for recording field data during Phase II monitoring of the Ecological Dimension of forest restoration projects.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Plot data – Worksheet 2

Plot	Type	UTM Zone	Coordenates (UTM, SAD69)	Property[1]	Date
1	permanent	23 K	417507 7459949	Sítio do Pica-Pau	01/06/2013
2	permanent	23 K	417465 7459891	Sítio do Pica-Pau	01/06/2013
3	variable	23 K	417345 7459212	Sítio Recanto Feliz	02/06/2013

Causes of degradation	Other edaphic observations	Picture (nº)	Dominant vegetation and land use in the surrounding area	Distance to forest fragments[2]	Landscape location	Nature of restoration zone border
Presence of cattle. Fires in part of the area.	-	48 - 49	100% sugar cane	50m	hilltop	Broken fence
-	-	50	Shrub vegetation	< 100m	hillside	Fenced
Severe damage by leaf-cutting ants.	Rock outcrop.	51	Sugar cane and slightly degraded forest fragment	> 100m	lowland	NA

annexes

3

Worksheet template suggested for recording field data during Phase II monitoring of the Ecological Dimension of forest restoration projects.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Survey of the invasive tree species within plots – Worksheet 3

Specimen	Planted (P) or Regenerating (R)	Family[1]	Species[1]	Species code	Native, exotic or invasive	Height classes[1]	DBH (cm)	Picture (nº)	Observation
1	P	Euphorbiaceae	*Croton floribundus*	88	native	2	20,5	-	-
2	P	Arecaceae	*Euterpe edulis*	47	native	1	-- (< 15)	52	Palm tree at risk of extinction
3	R	-	*Compund leaves*	100	Unidentifiable	1	-- (< 15)	53	Picture: aspect of the plant. Botanical collection = N.100
4	Unidentifiable	-	*Compund leaves*	100	Unidentifiable	1	16,3	-	-
5	Unidentifiable	Moraceae	*Artocarpus heterophyllus*	101	Invasive	2	22	55	Reproducing (with fruits)
6	P	Sapindaceae	*Koelreuteria paniculata*	102	Exotic	2	18	56	-

NA = Not applicable
[1] This information can be obtained after field data collection.
[2] This information can be obtained either before or after data collection in the field, ideally using GIS and/or satellite images.
[3] Height classes: 1: 0,5 ⩾ H < 1 m; 2: H ⩾ 1 m.

annexes

4

Worksheet template for recording field data during monitoring of the Socioeconomic Dimension.

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Economic indicators for the monitoring pertaining to the Socioeconomic Dimension of Forest Restoration – Field Worksheet

C riteria
I ndicators
M etrics

	ITEM	YES	NO	DON´T KNOW	NA	QTY (VALUES)
C	1.The program generates jobs and/or income through the implementation/maintenance of restoration practices in the area					
I	1.1. Direct generation of jobs by restoration activities.					
M	1.1.1. Number of jobs and type of labor (permanent / temporary / family)					
	a) Permanent and not family					
	b) Temporary and not family					
	c) Family					
	Description of any documents consulted					
I	1.2. Amount financially invested in the program					
M	1.2.1. Amount financially invested in program restoration activities					
M	1.2.2. Amount financially invested in program services					
	Description of any documents consulted					
M	1.2.3.Amount financially invested in project supplies					
	Description of any documents consulted					
M	1.2.4. Amount financially invested in program labor (direct contract)					
	Description of any documents consulted					
M	1.2.5. Amount financially invested in the acquisition of tools, machinery and other implements by the program.					
	Description of any documents consulted					
M	1.2.6. Amount paid out in taxes by the program.					
	Description of any documents consulted					

annexes

4

Worksheet template for recording field data during monitoring of the Socioeconomic Dimension.

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Economic indicators for the monitoring pertaining to the Socioeconomic Dimension of Forest Restoration – Field Worksheet

	ITEM	YES	NO	DON´T KNOW	NA	QTY (VALUES)
M	1.2.7. Amount financially invested in program management					
	Description of any documents consulted					
C	2. Revenue and incentives associated with forest restoration					
I	2.1. Payment for environmental services (PES) for the landowner					
M	2.1.1. Technical project defined with the aim of securing PES					
	Description of any documents consulted					
M	2.1.2 Restoration Program certified by an independent agency					
	Description of any documents consulted					
M	2.1.3. Amount of resources received via PES					
	Description of any documents consulted					
M	2.1.4. Financial source of the PES					
	Description of any documents consulted					
M	2.1.5. Carbon credits generated (only for PES carbon)					
	Description of any documents consulted					
I	2.2. Tax incentives for the restoration program					
M	2.2.1. Tax incentives for the area under ecological restoration					
	Description of any documents consulted					
I	2.3. Income associated with Legal Reserve compensation					
M	2.3.1. Income earned via negotiating restoration areas in exchange for Legal Reserve compensation					
	Description of any documents consulted					

annexes

4

Worksheet template for recording field data during monitoring of the Socioeconomic Dimension.

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Economic indicators for the monitoring pertaining to the Socioeconomic Dimension of Forest Restoration – Field Worksheet

ITEM	YES	NO	DON´T KNOW	NA	QTY (VALUES)
I 2.4. Commercialization of timber-based forest products					
M 2.4.1 Timber-producing forest project in operation, plus approval by the relevant environmental entity					
M 2.4.2. Amount generated through the selling of timber products					
Description of any documents consulted					
I 2.5. Commercialization of agroforestry (AFS) and non-timber forest products					
M 2.5.1. Personal harvests of AFS and non-timber forest products in areas under restoration (for household consumption)					
M 2.5.2. Project in operation for the commercialization of AFS and non-timber products from areas undergoing restoration					
M 2.5.3. Amount generated through the selling of AFS and non-timber products					
Description of any documents consulted					
C 3. Funding source for restoration works					
I 3.1 – Source of financial resources invested in the restoration project					
M 3.1.1. Source of any financial resources invested in restoration					
Description of any documents consulted					

annexes

5

Worksheet template for recording field data during monitoring of the Socioeconomic Dimension – social indicators (*).

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Social indicators for the monitoring the Socioeconomic Dimension of Forest Restoration – Field worksheet

C riteria
I ndicators
M etrics

ITEM	YES	NO	DON´T KNOW	NA	QTY (VALUES)
C 4. Job opportunities, training and other services for local communities					
I 4.1. Hiring of labor					
M 4.1.1. Percentage of hired labor from the local area					
M 4.1.2. List of workers at or under trainee age plus description of their activates and proof of school attendance					
Description of any documents consulted					
Evaluation					
M 4.2. Income generation for local economy					
4.2.1. Percentage of total program investment spent within the region (municipality) of the restoration zone					
Description of any documents consulted					
Evaluation					
C 5. Occupational health of forest restoration workers					
I 5.1. Ensuring worker access to healthcare. Compliance with existing legislative requirements regarding the provision of worker healthcare					
M 5.1.1. Adequate, up-to-date first aid equipment present in the workplace					
Evaluation					
I 5.2. Responsibilities met concerning legal requirements for appropriate worker sanitary and environmental conditions					
M 5.2.1. Quality and quantity of food and water present in the field for carrying out the restoration activities					
Evaluation					
C 6. Safe working conditions					
I 6.1. Secure, appropriate conditions for work safety					

(*) A more detailed version is available on the Atlantic Forest Restoration Pact website.

annexes

5

Worksheet template for recording field data during monitoring of the Socioeconomic Dimension – social indicators (*).

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Social indicators for the monitoring the Socioeconomic Dimension of Forest Restoration – Field worksheet

		YES	NO	DON´T KNOW	NA	QTY (VALUES)
M	6.1.1. Existence of Personal Protection Equipment (PPE) provided to employees free of charge, when the activity so requires					
	Description of any documents consulted					
	Evaluation					
C	47. Relationship of the program with the surrounding community					
I	7.1. Participation of community and other local stakeholders in program planning					
M	7.1.1. Meetings held with the community and other local stakeholders					
	Description of any documents consulted					
	Evaluation					
I	7.2. Environmental education program organized					
M	7.2.1. Environmental education delivered					
	Description of any documents consulted					
	Evaluation					

(*) A more detailed version is available on the Atlantic Forest Restoration Pact website.

annexes

6

Worksheet template for recording field data during monitoring of the Management Dimension.

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Monitoring of the Management Dimension of Forest Restoration – Field worksheet.

	ITEM	YES	NO	DON´T KNOW	NA	Obs. Description of any documents consulted for monitoring, critical analysis of the quality of the existing documents and records taken of any missing information sources
	Planning and documentation of the restoration process					
	Pre-implementation records (definition and planning) of the program					
M	1.1.1. Socioenvironmental diagnosis performed containing:					
	Socioenvironmental survey					
	Historic land use and occupation					
	Environmental characterization of the areas to be restored (soil type, climatic characterization, slope, aspect, landscape location, predominant vegetation type, etc.)					
	Others (specify)					
M	1.1.2. Polygons of the restoration zones mapped, environmentally categorized and available in a digital database					
M	1.1.3. List of native species to be included in the program					
M	1.1.4. Methodological protocol to define the appropriate restoration technique for the site-specific conditions encountered					
M	1.1.5. Budget prepared to finance the activities of the restoration program.					
M	1.1.6. Timetable prepared for program delivery					
M	1.1.7. Study performed analyzing the economic viability of the program (applicable only for programs with an expected economic return)					
	Pre-implementation records (definition and planning) of the program					
M	1.2.1. Data records kept of any program interventions					
M	1.2.2. List of species to be used in restoration					
	With the species used					
	With the amount of individuals per species					
M	1.2.3. Record of propagule origins (seeds, seedlings, topsoil etc.)					
M	1.2.4. Audiovisual record of the area undergoing restoration, showing different points throughout the restoration process.					
M	1.2.5. Documented record of the costs incurred at each stage of program execution					

annexes

6

Worksheet template for recording field data during monitoring of the Management Dimension.

Observation:
QTY = quantity.
NA = not applicable.

Monitoring protocol for ecological restoration projects affiliated to the Atlantic Forest Restoration Pact, 2013.

Monitoring of the Management Dimension of Forest Restoration – Field worksheet.

	ITEM	YES	NO	DON´T KNOW	NA	Obs. Description of any documents consulted for monitoring, critical analysis of the quality of the existing documents and records taken of any missing information sources
M	1.2.6. Documentation concerning operational performance of the various activities undertaken throughout the restoration process					
	Partnerships between the land owner and the program manager (only in cases where the land owner is not directly responsible for program/ project execution)					
M	2.1.1. Documented agreement exists between the program manager/coordinator and the owner of the rural property					
M	2.1.2. Documentation exists proving that the land is legally registered and held by the owner					
	3.1.1. A trained technical manager is responsible for the program					
M	3.2.1. The technical manager has relevant experience with all activities planned for the program					
	Monitoring system					
M	4.1.1. Specific monitoring plans exist for the areas under restoration					
M	4.1.2. Adaptive decision-making informed by the monitoring data will/has taken place					
	Internal and external communications					
M	5.1.1. Records exist of communications from management to practitioners					
M	5.1.2. Records exist of communications from practitioners to management					
M	5.2.1. Records exist of meetings, mobilization of local support/activities, or dissemination of program material, amongst the surrounding community					
M	5.2.2. Records of any relevant publications in scientific journals, or involvement of the restoration program with any wider scientific events					
M	5.2.3. Records of program promotion via mass media					
M	5.2.4. Records of communications between the program and the Pact					
	6.1.1. Methodological innovations in restoration					
	Any successful technological or methodological innovations established by the program (if so, specify in the observations section)					
	Report or description of successful innovations communicated to the Pact					
	Results achieved via the application of this innovation					

INICIATIVA

PACTO
PELA RESTAURAÇÃO DA MATA ATLÂNTICA

COOPERAÇÃO TÉCNICA E INSTITUCIONAL

VALE

Fibria

ALSTOM CORPORATE FOUNDATION
FOR THE ENVIRONMENT

PARCERIA

INSTITUTO AMIGOS DA RBMA

LERF
Laboratório de Ecologia e Restauração Florestal
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Proteger a natureza é preservar a vida.

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PROJETO PROTEÇÃO DA MATA ATL %NTICA II

Em nome do
Ministério Federal do Meio Ambiente, da Proteção da Natureza e da Segurança Nuclear
da República Federal da Alemanha

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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